

ROBIN ROTHENBERG

# Restoring Prana

A Therapeutic Guide to Pranayama and Healing Through the Breath  
for Yoga Therapists, Yoga Teachers and Healthcare Practitioners



# **RESTORING PRĀṆA**

A Therapeutic Guide to Prāṇāyāma and Healing  
Through the Breath for Yoga Therapists,  
Yoga Teachers, and Healthcare Practitioners

**ROBIN L. ROTHENBERG**

Foreword by Richard Miller

Illustrated by Kirsteen Wright



**SINGING DRAGON**  
LONDON AND PHILADELPHIA

# CONTENTS

*Foreword by Richard Miller*

Introduction: *Bhāvana* (Intention): Busting Myths

1. The Origins of Prāṇāyāma
2. Prāṇa, the Subtle Body, and the Energy Bank Account
3. The Biochemistry of Respiration
4. Hyperventilation: The Saṃskāra of Breathing Too Much
5. Biomechanical Considerations: Nose versus Mouth
6. Center Stage: The Diaphragm
7. The Core, the Bandhas, and the Breath
8. The Emotional Brain and the Breath
9. The Mind of the Subtle Body: Citta, Chakras, and the Breath
10. Prāṇāyāma as Kumbhāka
11. Therapeutic Applications: Healing Through the Breath

*Breathing Pattern Disorders Screening*

*In Conclusion*

*Appendix I: Āsana Practices to Restore Prāṇa*

*Appendix II: A Guide to Teaching Functional Breathing for Yoga Teachers, Yoga Therapists, and Healthcare Practitioners*

*Appendix III: Prāṇāyāma Curriculum for Program Directors: Key Concepts and Practices*

*Sanskrit Glossary*

*Physiology Glossary*

*Endnotes*

*Index*

*Acknowledgements*

## FOREWORD

On a cold and windy evening in 1981, I found myself standing next to a stately Tibetan lama during opening ceremonies for a national yoga conference. We were outside and he was dressed in a thin wrapping of light cloth. I was chilled to the bone, shivering, while bundled in a down jacket. Before heading inside to warm myself, I turned to greet the lama. He kindly enfolded my hands in his and I was immediately struck by how his hands were like fire while mine were ice. “Oh, you poor boy!”, he exclaimed. “Your hands are so cold.” In speaking with him, I came to understand that he had been able to keep himself toasty in this coldest of weather by using the powers of yogic breathing to regulate his body temperature. Such strategies have rendered yoga masters the capacity to cool themselves while surrounded by blazing fires in summer, and simultaneously retain their body heat while wrapped in frozen blankets in the dead of winter. Impressed with this living lama’s example, I vowed to pursue my practice of prāṇāyāma more diligently. That commitment has stood me in good stead ever since.

When I began learning the art of prāṇāyāma in the 1970s, I asked my teachers to explain the science behind this life-enhancing practice. Their answers left me wanting. They simply stated, “Trust me.” As a Westerner I’m willing to trust, but I also yearn to know the science that lies behind the practices in which I am engaged. Over the years, I’ve combed the research literature on respiration to understand more of the hows and whys that make prāṇāyāma so extraordinarily effective on the physical, psychological, and spiritual levels. So, it is was my great fortune to be asked to review and then write this foreword to Robin Rothenberg’s text, *Restoring Prāṇa*.

Robin emphasizes throughout this book that regular practice of prāṇāyāma is like putting money in the bank. She describes how the breath is a driving force behind every process throughout the body, including regulating our immune system. It is vital to maintaining our physical and psychological homeostasis and, as with my Tibetan Lama friend, has the power to keep us warm on a frigid night. We take over 24,000 breaths and exchange over 10,000 gallons of air in our lungs every day of our lives. During the past 71 years I have taken over 597,081,600 breaths, at least 38,340,000 of which have been during my practices of hatha, prāṇāyāma, and meditation. With these kinds of figures, it’s easy to see how breathing plays a significant role in our daily life and our practice of yoga.

Resonant with Robin’s description of personal transformation, I too have experienced the sustained impact of prāṇāyāma practice to enhance my reserves of health, energy, and vitality. In the early 1980s, I spent a minimum of an hour a day practicing prāṇāyāma. This afforded me a veritable fortune of prāṇa. I was able to draw upon this savings account while working on my doctoral dissertation. For those three years, even though my practice was less regular, I felt vibrantly alive and healthy, with an abundance of energy. However, during the



fourth year, I found myself becoming vulnerable again to colds and flu. With my prāṇa account depleted, I realized it was time to get back to my daily practice of prāṇāyāma.

In the Yoga Sūtra the sage Patañjali recommends the breath as a means for overcoming mental distractions that prevent us from understanding our Essential Nature. He understood that as breath slows and grows calm, so follows the thinking mind. This allows a doorway for meditation to open whereupon we have the ability to glimpse what lies beyond the dividing mind: our underlying Essential Nature of unbreakable peace and well-being. Patañjali specifically recommends exhalation and suspension after exhalation to balance and refine the flow of energy within ourselves, sharpen concentration, and hone our powers of observation. This helps us to discern how our actions, thoughts, and emotions color and distort our perception of reality. In this way, the breath sculpts away excess to reveal essence.

Contained within the etymology of the word prāṇāyāma are the secrets of this sophisticated science. The Sanskrit syllable “prā” implies spiritual energy that descends from above. “Na” represents the eternal divine vibration within us, which allows us to evolve spiritually. “Yā” implies the ability to harness, build upon, and put into action this spiritual force. And “ma” simultaneously represents the mother principle of the universe and our ability to modulate this energy through the breath. “Yāma” implies something that is “moving” and “ayāma” means extending, lengthening, and ascending. And Prāṇā with a large “P” represents the animating principles behind all of life, while prāṇa with a small “p” represents the life-force that infuses our body with life. Essentially, the word prāṇāyāma means, “To be living in, as, and nurtured by the life-force energy that has given rise to the entire universe.” Prāṇāyāma infuses our body and mind, with prāṇa which flows through us with each breath we take. Prāṇa represents the life-force that gives birth to and sustains life and ayāma is the way we learn how to experience and extend this energy within our body, throughout our daily life, by learning to work consciously with the breath.

Countless texts have been written through the centuries on prāṇāyāma in which step-by-step methodologies are offered as means for developing proper breathing habits. The ancients understood that breath is a vehicle for delivering and distributing live-giving essence (prāṇa) to every cell throughout our body. And while these texts explain in detail the techniques of prāṇāyāma, none have fully explained the hows and whys of the underlying mechanisms that make these techniques so effective.

Robin has done us a great service in compiling modern research, understandings of physiology, and practices that underlie the science of prāṇāyāma. Her writing draws upon years of experience as both a student-practitioner and teacher of prāṇāyāma. She writes with the passion of one who has wrestled deeply to understand this precious tradition from the inside out, and from the outside in, in order to help herself, those she serves, and now us as readers who are interested in plumbing the depths of this ancient practice. This is an important book that supports the evolution of prāṇāyāma into this modern era. This is a book to be read and reread, over and over again, as it contains priceless gems that can only be gleaned from our heartfelt commitment to thoroughly immerse ourselves in the wisdom contained in each chapter.

We can never know what an apple tastes like until we take a bite of an apple. We can never know the fruits that practicing prāṇāyāma can bring to our lives unless we dive into its practice. Like any form it requires patience, persistence, and perseverance. I hope you will, as Robin and I have, take to this precious practice. Each breath you take can be life-enhancing: a step in the direction of experiencing vibrant health, healing, wholeness, and well-being. Ultimately it holds the power to reveal the mystery of the Essential Nature that underlies and connects us all with the entire universe.

Could any practice be more timeless? Could any practice be more vital? Could any book be more needed? Dive into this delicious text that Robin offers. Study. Practice. Then pass on what you understand to those you meet. This is what Robin has done by revealing this book of secrets that are now open secrets to everyone who practices this ancient art that Robin has so beautifully placed in our hands.

*Richard Miller, PhD  
Founder and Developer of iRest Yoga Nidra Meditation  
San Rafael, August 2019*

# INTRODUCTION

## BHĀVANA (INTENTION): BUSTING MYTHS

***Vitarkabādḥane pratipakshabhavanam***

*When in doubt, one must look again from a different perspective.*

Patañjali's Yoga Sūtra 2:33

Within the first week of my budding romance with my soon-to-be husband, he told me the story of how his grandfather, Papa Louie, escaped from the pogroms of Russia. The story went like this: Papa Louie crossed over the mountains to safety hidden beneath the belly of a cow. Now granted, logic would call one to ask questions about the likelihood of this scenario, but I was in love and not yet aware of the vast imagination of my future spouse.

Twenty years later, our daughter Ryanne was assigned a school project which required her to share a family legend. I immediately thought of the story of Papa Louie's heroic escape, the legend that animated our household for decades. My husband was out of town. To fill in the details of the story, I suggested my daughter contact Auntie Selma, the grand matriarch of the family and Papa Louie's firstborn. When Ry explained the reason for her call, Selma's squawk could be heard through the phone to the far end of the house where I was making dinner. "He said WHAT?" she exclaimed, clearly put off by the notion of her father strapped to the udder of a bovine. "He came over in the belly of a cattle boat," she clarified, adding, "like all the other Jews who were emigrating from Eastern Europe at the time."

It's not hard to see how a young child hearing that story could merge the image of the cow belly with the belly of a cattle boat. Thus, a family myth was born and passed down for two generations. As clearly demonstrated in the game of telephone, the human mind often fabricates what it can't comprehend. We fill in the gaps. There was a time when most people believed the world was flat and it was considered heretical to suggest otherwise. Galileo has been falsely credited with being the messenger of the world's spherical shape (yet another myth!). It was actually Pythagoras from the 6th century BCE, who initiated the idea that the earth was round. Aristotle later confirmed this in 350 BCE. Myths build momentum, get distorted by the perspective and conviction of the narrator, and with that a form of reality is shaped which may or may not replicate the original "truth."

There are several myths that have arisen over time with regard to breathing which, like the cow-belly story, are derivatives of the truth. While commonly accepted as fact, they do not actually hold up when matched against respiratory physiology or the ancient yoga texts on *prāṇāyāma*. *Prāṇāyāma* (pronounced prawn-aw-yaw-mah) is the practice of breath control

and primarily breath retention as a means to regulate the flow of *prāṇa* (pronounced prawn-ah), which can be thought of as our energy or vitality.

Here are a few of the common “breath-myths” we’ll be deconstructing throughout this book:

- *Myth #1*: The more we breathe the healthier we are.
- *Myth #2*: Taking a bigger breath oxygenates us more.
- *Myth #3*: Taking a deep breath means taking a *big* breath.
- *Myth #4*: Our need for oxygen governs our respiratory rate.
- *Myth #5*: Carbon dioxide is toxic and a full exhale clears space in the lungs for oxygen.
- *Myth #6*: It is important to empty the lungs of air.

Take a moment to read through the list again and consider the felt sense of “truth” for you inherent in each of these statements. If our internal compass isn’t calibrated to true north, it can be difficult to shift this felt sense, even when confronted with new information. In my many conversations with people regarding the breath, I have found it to be one of those arenas in life where myths abound, and people have difficulty assimilating new ideas. Even the most conscientious of us can easily become swayed by misinformation. I know, because I spent 30 years believing the myths listed above, and had no idea how misguided my understanding was.

When I first began studying yoga, the breath seemed an afterthought to my instructors. They were hyper-focused on the alignment of my knees and elbows and how my pinky finger contacted the mat. Every once in a while, he or she would call out, “Don’t forget to BREATHE!” *Prāṇāyāma* was considered too advanced for new practitioners, and when I eventually did begin to study it, instructions pertained more to my posture than the breath itself.

Later, through a different lineage, I learned to orchestrate my *āsana* (pronounced aw-sah-nah) fluidly with the breath which felt much more natural, almost buoyant. I was taught that the breath was central to yoga, and that increasing my inhale and lengthening my exhale was a key determinant to health. As diametrically opposed as these two orientations were, I believed each of my teachers and dutifully practiced as instructed. It didn’t occur to me to question their authority. Only recently did I begin to examine the facts behind the curtain of mysticism that shrouds *prāṇāyāma*. In that process, I was shocked to find that much of what I had believed about the breath was in fact not true. To pique your curiosity, I offer to you these myth-busters in response to the six myths listed above. Each one will be explored in greater detail and validated through both the lens of Western and Vedic science in this text.

## **Myth #1: The More We Breathe the Healthier We Are**

### ***Myth-Buster #1: More Isn’t Better***

There is actually such a thing as the “right amount of breath.” Similar to our caloric intake for food, breathing more doesn’t necessarily make us healthier. In fact, it can add an additional burden for our system to process. At rest, a healthy person averages between 10 and 12 breaths and inhales approximately 4–6 liters of air per minute.<sup>1</sup> People who have cardiovascular disease, respiratory ailments, cancer, anxiety, or chronic inflammatory conditions regularly breathe at rates between 15 and 20 breaths, at a volume of 10–15 liters

per minute.<sup>2</sup> Contrast this with stories of yogis like Krishnamacharya or Swami Rama who could reduce their breathing to imperceptible levels. A recent study clocked a Japanese yogi breathing at a rate of one breath per minute for an hour!<sup>3</sup>

## **Myth #2: Taking a Bigger Breath Oxygenates Us More**

### *Myth-Buster #2: Bigger Breathing De-oxygenates Us*

Breathing is a complex process with three distinct components that will be thoroughly addressed in this book:

1. *Ventilation*: The act of breathing in and out.
2. *Perfusion*: The transmission of blood and lymph through the capillaries of the alveoli, where oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) are exchanged.
3. *Cellular Respiration*: The release of O<sub>2</sub> from the blood into the tissues (oxygenation) and the release of CO<sub>2</sub> from the tissues into the blood.

These three processes function interdependently and are critically interrelated. At the cellular level, the actual oxygenation process works optimally when our breath is gentle and appropriately regulated and matched to our body's metabolic need. If we breathe more than is necessary—e.g., big *ujjayi* (pronounced oo-jai-yee) breaths while holding a forward bend—we can actually *de*-oxygenate our body, by temporarily hyperventilating (breathing more than our metabolic needs). This concept, as with the others proposed here, will be explored extensively in later chapters.

## **Myth #3: Taking a Deep Breath Means Taking a Big Breath**

### *Myth-Buster #3: Deep Isn't the Same as Big*

When people say, “Take a deep breath,” most of the time this is interpreted as a large audible swallow of air followed by a noisy sigh of an exhale. However, if myth-busters 1 and 2 are true, then *bigger isn't better*. At the same time, most people, including me, would agree that shallow breathing isn't healthy. The term “shallow” is more indicative of *where* the breath is activated. “Shallow” most commonly refers to chest breathing and is correlated with a rapid rate (frequent number of breaths per minute). I prefer to think of “deep” as signifying low in the body—that is, efficient use of the diaphragm without excessive activation of the accessory muscles of the chest and neck—but not big in volume. Low and light is optimal for health.

## **Myth #4: Our Need for Oxygen Governs Our Respiratory Rate**

### *Myth-Buster #4: Carbon Dioxide Regulates Our Respiratory Rate*

Oxygen is necessary to sustain life. It is for this reason that our body has many systems in place to ensure our O<sub>2</sub> levels stay stable, even in crisis. It is actually fluctuations in our CO<sub>2</sub> levels that signal the brain to breathe more or less, according to need. This action is governed by the autonomic nervous system (ANS).

## **Myth #5: Carbon Dioxide Is Toxic and a Full Exhale Clears Space in the Lungs for Oxygen**

### *Myth-Buster #5: Carbon Dioxide Is Critical for Maintaining Homeostasis (Health)*

Your body makes CO<sub>2</sub> as a metabolic waste product in the form of gas, and while it can be toxic in high concentrations, the human body requires a balance of both CO<sub>2</sub> and O<sub>2</sub> to maintain a balance of acid and alkalinity that allows for homeostasis and health. Without sufficient CO<sub>2</sub>, we cannot optimally utilize the O<sub>2</sub>. These are not antagonists competing for space; both O<sub>2</sub> and CO<sub>2</sub> have specific and necessary functions in our body and they work synergistically together. Increasing our tolerance to CO<sub>2</sub> allows us to breathe less which has a profoundly pacifying effect on the nervous system and the mind. The ancient yogis increased their CO<sub>2</sub> tolerance via their prāṇāyāma practices, thus allowing them to maximize breath-holding time to reach altered states of consciousness known as samādhi (pronounced saw-mah-dee, a state of deep concentration).

### **Myth #6: It Is Important to Empty the Lungs of Air**

#### *Myth-Buster #6: The Lungs Always Maintain a Residual Volume of Air*

The perceived value of ridding the body of toxins (e.g., CO<sub>2</sub>) prompts an idea that the lungs need to be cleared of “bad” or “stale” air, and completely emptied. Yoga teachers may instruct their students to “inhale deeply, exhale completely,” but this is not possible because our lungs contain a reservoir of air, known as residual volume (RV). We were born with it and we die with it. RV ensures that the lungs do not collapse, and keeps them expanded between breaths. For healthy adults, RV ranges between 1.1 and 1.2 liters of air. Intentionally exhaling with force in a repetitive manner, as with *kapālabhāti* (pronounced kah-pall-ah-bah-tee) or Breath of Fire, puts us at risk of throwing our blood-gas ratio off-balance.

To summarize this myth-busting section:

- Breathing bigger isn’t better. Breathing low in the body and light is better than breathing in large volumes.
- Carbon dioxide isn’t the villain to O<sub>2</sub>’s superhero. Both are members of “Team Health.”
- The breath is complex and needs to be studied to be understood. Utilizing breathing techniques without fully understanding the impact on our chemistry puts ourselves and our students at risk.

There is more to the story of the breath than we learned when we went to yoga school. It is time for us as yoga teachers and therapists to reset our communal compass. We need to develop competence in our use of the breath, reflecting truth, and using it as a vital tool to propagate rather than deter health.

### **Prāṇāyāma and Health**

Throughout my 30-plus years of dedicated study and practice of yoga, prāṇāyāma has consistently been presented as both a panacea of mental and physiological well-being and an esoteric practice beyond the capacity of ordinary humans. Neither was ever fully explained. While my teachers gave explicit instructions around the use of particular breathing techniques to pacify or energize, the intricacies behind why these modalities work (when they work), and why they might not be effective or even beneficial for a particular individual, were not substantiated in any scientific way.

As a lay scientist with a curious, inquiring mind, I've consistently asked to understand the "why" behind what we are doing in yoga. I have a deep appreciation and respect for the philosophical tenets of yoga, and the versatility and application of the practices to address a wide range of health conditions that an individual may experience. Time and again, I've found that going outside the yoga world for a more complete explanation of the "why" has served me well. I have often received information and insight that I've been unable to muster within it. At times, I have found the lack of scientific grounding in the yoga community frustrating. I am a skeptic regarding teachings that are presented as if only a select, "enlightened" few can understand and utilize them, while other teachings are transmitted as "dogma" and tagged as the elixir of health for everyone. My teachers and personal experience have reinforced in me that what works very well for one person may not be at all useful for another. Considering the complexity of the human condition, it seems unrealistic to assign one āsana practice, one prāṇāyāma, or one meditation practice as optimal for everyone.

I fully appreciate loyalty to one's lineage and adherence to the teacher's counsel of "yoga in its original intent," especially when one is talking about the spiritual aspirations of the practitioner. However, when we begin to explore yoga as therapy, we need to become wiser than our own viewpoint and ask the question "What are the 'best practices' for this individual at this time in their life, given all the parameters?" Unless we are able to question the veracity of a particular concept or tool and find context for it, I'm afraid yoga therapy will never gain the credibility and viability as a healthcare modality that it deserves.

This leads me back to the reason behind the writing of this book. The intention here is not to offer a comprehensive treatise on prāṇāyāma as a means for attaining the state of *samādhi*, which can be thought of as a state of meditative absorption. There are rich texts written for this purpose, many of which I've utilized as resources for my own work. If that is your interest, I direct you to seek out the wisdom of these authors who are far more experienced than I am on that subject (see [Chapters 1 and 2](#), particularly the cited works by Swami Niranjanananda Saraswati, Swami Muktibodhananda, Dr. M.L. Gharote, and Swami Rama, to name a few). This book also is not specifically about the Buteyko Breathing Method. There are a plethora of wonderful books written by experts in Buteyko, such as Patrick McKeown, Jennifer Stark, Tess Graham, and Artour Rakhimov, some of whom I have the privilege of calling my teachers. They are also cited in [Chapters 1 and 2](#).

This book was written to establish a foundational understanding for contemporary yoga teachers, therapists, healthcare practitioners, and training program directors as to how dysfunctional breathing and breathing pattern disorders (BPD) impact our biochemistry, our biomechanics, and our psychosocial health. It is designed to offer accessible tools to cultivate awareness and developmentally broaden our collective knowledge of prāṇāyāma. Only then can we harness it as the transformative tool it was designed to be, minimizing many of the chronic maladies that afflict vast portions of the population. With this information, I believe we can utilize prāṇāyāma skillfully and with great benefit to our students and therapeutic clients.

## **A Call for Evolution**

Over the past two decades there has been a strong push within the āsana world to become more knowledgeable and informed about the anatomical structures of the body and functional movement in relation to yoga postures. Many yoga magazines and online courses are devoted to this topic. They often feature anatomy experts such as Ray Long, Tom Myers, and Julie Gudmestad. Some presenters reference other related techniques such as somatics, the



Feldenkrais Method, and Body-Mind Centering®. Not all of these folks are yoga teachers, and yet their work is of educational value for yogis.

Studying *Anatomy Trains* by Tom Myers,<sup>4</sup> and reading the work of Thomas Hanna has illuminated my understanding of the body and made me a better yoga teacher and therapist. Learning the difference between a dysfunctional sacroiliac joint and lumbar disc compression enables me to be more discerning in my approach to working with a student with lower back pain. As we become more astute in understanding functional versus dysfunctional movement through continuing education, we raise the bar for the whole community and are able to offer better options for the health and safety of our students.

Prāṇāyāma now warrants that same level of scrutiny, perhaps even more so than āsana. As practitioners of yoga, when we manipulate the spine in a back bend or a twist, we primarily affect the *annamaya* (pronounced ahn-nah-mai-yah, physical dimension), which if done improperly can result in *duḥkha* (pronounced dooh-khah, suffering) at the level of strains, sprains, or breaks. However, when we manipulate the breath, we are directly impacting our entire psychophysiology, which has far greater potential to stabilize or destabilize our health in profound ways. The yogis understood this, which is why the *prāṇamaya* (pronounced prawn-ah-mai-yah, the breath/energy dimension) is considered the center of physiological health in both yoga and Ayurveda (pronounced ai-yur-vay-dah), a system of medicine with historical roots in the Indian subcontinent, often referred to as the “sister science of yoga.” The masters knew that through the transformation of breath, state of mind and every vital physical function (and even longevity) could be impacted. The masters knew that through the transformation of breath, every vital function, state of mind, and even longevity could be impacted. As evidenced by the ancient Vedic texts and more contemporary treatises such as the Hatha Yoga Pradipika, the power of prāṇāyāma is made explicit: “By proper practice of prāṇāyāma, etc., all diseases are eradicated. Through improper practice all diseases can arise.”<sup>5</sup> Similarly, the Yoga Chudamanai Upanishad states that “Prāṇāyāma destroys all diseases, and diseases appear only in those who are not able to do it.”<sup>6</sup>

## Setting Our Compass

Fundamentally, breathing is a biochemical process. It is the primary chemical reaction that sustains us. Every other chemical reaction in the human body uses the alchemy of oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) as a barometer to gauge the correct level of response. Want balanced hormones and good digestion? Examine your breathing! This includes hormones and neurotransmitters. Our entire physiological system is founded on the balance of O<sub>2</sub> and CO<sub>2</sub> so if our respiratory chemistry is well balanced, it is much more likely that our cardiovascular, digestive, endocrine, immune, nervous, renal, muscular, skeletal and reproductive systems will function well.

Despite the explicitness of these truths, most of my yoga teacher and therapist trainings focused on the biomechanics of breathing rather than on the biochemical processes of respiration. Anatomically, the development of the accessory muscles of the thorax to increase chest expansion was given priority. (The relative usefulness of this methodology will be examined in [Chapter 6](#).) Diaphragmatic breathing was called out, but the biomechanics not fully explored with regard to proper synching of the abdominal muscles to form a stable core. Even less was said about the chemistry of the breath, other than that prāṇāyāma helps increase oxygenation. My teachers quoted the yoga texts with regard to prāṇāyāma’s

tremendous capacity to affect our health and mind. Potential dangers associated with improper techniques were underlined. However, the science of *how* the breath impacts the mind and the other systems was treated in a cursory manner.

The most detailed explanation I received in “yoga school” addressed the effect of inhalation and exhalation on the ANS. Likewise, when I have listened to my colleagues give seminars on the breath, common reference points are the ANS, fight or flight, the vagus nerve, and the use of exhalation to activate the relaxation response. This view offers an important, but only partial, summation of the impact of breathing on health. It belies the intricate world of the *prāṇamaya* (energy dimension) that synthesizes the oscillation of the breath and the flow of *prāṇa*. In reality, the breath cues each of the other systems to play in tune and in time. *Prāṇāyāma* can, in fact, provide a revelatory tool for self-efficacy capable of restoring health and protecting us from disease. The ancient yogis had intimate knowledge of this subtle world of the breath and manipulated it at will. Deconstructing the myths, and validating the practice scientifically, reveals this knowledge as accessible to all of us regular folk: modern-day yogis, teachers, students, and therapy clients alike.

## **Buteyko Breathing—A Door to “Why” Opens**

The Buteyko Breathing Method gave me the language and *pramāṇa* (pronounced prah-mawn-ah, direct experience) to understand this world of the subtle body. In the 1950s Dr. Konstantin Buteyko (pronounced Boo-tay-kow), a Russian physician, became curious about the breath while ministering to critically ill patients in the hospital where he was an attending. He noticed that the patients who breathed harder, faster, and more chaotically also fared worse and died sooner. He posed a very yogic question: “Is the disease driving the breath, or is the breath driving the disease?” Dr. Buteyko took it upon himself to explore the world of the breath through studying ancient traditions that centered on breathing, such as yoga and Asian martial arts. He experimented with the effect of breath retraining on himself, much like the ancient yogis did in their practices. Through the process, he discovered that he was able to manipulate and lower his high blood pressure consistently. The more he reduced his breathing, and the longer he was able to suspend his breath, the better health he experienced over all.

Dr. Buteyko then brought this information to his patient population. Initially, he focused on those with respiratory complaints such as asthma and chronic obstructive pulmonary disease (COPD). Over time, he recognized that reduced breathing could positively impact the cardiovascular, digestive, and immune systems as well. He posited a theory that over-breathing, or hyperventilation (excessive breathing), was the source of many of the common maladies that people in the modern world were experiencing.<sup>7</sup> Although his theory has been criticized by some in the mainstream medical world, there are many respiratory therapists, speech pathologists, myofunctional therapists, and orthodontists today who integrate his approach into their work. The Buteyko method or Buteyko Breathing Technique has been demonstrated to be particularly helpful for treating asthma, sleep disorders, cardiovascular disease and anxiety, and to increase athletic performance. There are approximately 1500 trained Buteyko Educators internationally, and interest in the method is growing.

I discovered Buteyko via a long-time yoga student, Pippa Kiraly. Pippa and I had worked together for over 20 years. When I met Pippa, she was in her mid-60s and had asthma so severe she kept her inhaler on her yoga mat during class. She was taking four asthma medications at the highest dose, and still frequently found herself in the ER suffering with life-threatening attacks.

Yoga provided Pippa with movement that unwound her extremely contracted muscles and a means to relax within her body. She added massage, acupuncture, and chiropractic to her health regime, and changed to an anti-inflammatory diet. All of this gave her some relief, but didn't change the severity of the attacks. At her doctor's suggestion, Pippa pursued a little-known breathing technique called the Buteyko Breathing Method. Almost immediately she experienced improvement. The eventual alleviation of symptoms freed her from the heavy use of medications and hospital visits. For her 70th birthday she celebrated her new-found health by going trekking in Nepal!

I watched Pippa's transformation with a great deal of admiration. All the teachers at my studio respected her clear boundary around the breath, i.e., she did her own thing and not what we were instructing. Intrigued by the theory behind her practice, I invited her to offer introductory seminars on the method, which I attended. I read the Buteyko primer by Jennifer Stark about hyperventilation, *The Carbon Dioxide Syndrome*.<sup>8</sup> I thought it made logical sense. At the same time, I admit to feeling resistant to the notion that the method itself would have anything better to offer me than the prāṇāyāma techniques I had learned from my teachers.

It wasn't until I had my own respiratory crisis and my naturopath diagnosed me as having asthma that I seriously considered trying the Buteyko method. I called Pippa, now a certified Buteyko Educator, and asked for her help. This ignited my world with a whole new understanding of the breath, calling into question decades of yoga prāṇāyāma training.

## **Avidya (Ignorance): The Greatest Seed of Suffering**

Prior to learning the Buteyko method, I had been able to calm myself with slow, deep exhalations (some of the time). I could utilize small holds or extended inhales to perk me up (some of the time). In my years as both a student and teacher-trainer, I ran many prāṇāyāma experiments with my trainees. Most had similar, short-term, discernible effects from their practice, either in the direction of calming/de-stressing or a bit of uplift, similar to sipping a cup of tea (some of the time). Several of us found that prāṇāyāma offered ongoing support as a tool for maintaining emotional equilibrium, to aid with getting to sleep, and to modulate life-tension (some of the time). Most of these benefits were related to slowing the breath, and in particular extending the exhale, which correlates with the parasympathetic or calming aspect of the ANS. While I accepted the ANS explanation, I also felt that there were critical holes in my understanding because the results were far from predictable or consistent.

There seemed to be so much more written about prāṇāyāma in the Yoga Sūtra (pronounced soo-trah) and Hatha Yoga Pradipika than what I was being taught. In my therapeutic yoga training, increasing exhalation and inhalation was emphasized as the first step towards health, especially for those with more fragile constitutions. This concept feeds directly into the myth that bigger is better, and likely has gone far to fertilize the big breathing practice observed in many of our contemporary yoga classes. *Kumbhākhas* (pronounced koom-baw-kahs, breath retention and suspension), which literally define prāṇāyāma practice in the ancient texts, were used sparingly and with great caution. Classic ratios like 8:32:16:4 were never explained, other than that they were "dangerous" because they pressurized the heart. I now understand that breath holding is progressively trainable and recognize the benefits of using it therapeutically, which is something that will be explored extensively in this book.

Encountering Buteyko at a time when I was experiencing an extreme health crisis humbled me. Even though I had been aware of the modality for years, I had rejected it as a

personal practice. In my arrogance, I was convinced that the yoga teachings on breath were superior to anything “Western.” Sickness dismantled my defenses, and suddenly I was open to learning anything that could help me regain my health. In the process of those first, initial days practicing Buteyko, I felt such dramatic and quantifiable changes that I knew I needed to learn more.

## **The Dawn of *Vidya* (Knowledge)**

My Dublin Buteyko Educator’s training with Patrick McKeown in 2016 captivated me. We spent the week immersed in the world of respiratory physiology, reading academic reviews of international research conducted on the breath and the resulting health implications. Most of these studies were based on clinical trials; only one referenced yoga specifically. I went home each night with books from Patrick’s library and continued to devour information and review the day’s discourse like a ravenous cub.

As I learned about the oxygen dissociation curve, the Bohr effect, how CO<sub>2</sub> dilates smooth muscle and balances pH, the relationship between the breath and the mitochondria, and the impact of mouth breathing on facial development in children, I kept asking myself, “Why was this never addressed in my yoga trainings? How has all this very important and relevant information seemingly been bypassed in the world of yoga? How can we/yogis tout ourselves as being experts on the breath without knowing these basics?”

I felt embarrassed and ashamed to think that I had boldly offered breath protocols for therapeutic clients based on what amounted to a fair amount of *avidya* (pronounced ah-vid-yah, ignorance). I was determined even then, when I barely could wrap my head (let alone my mouth) around the terminology, that once I had assimilated the information, I would share it. My intention was to share it with students, clients, and colleagues in the world of yoga, and the profession of yoga therapy.

The most reassuring part of this process is that ultimately it brought me back home, full circle, to the ancient texts such as the Yoga Sūtra, the Hatha Yoga Pradipika, the Yoga Yajnavalka and Yoga Rahasya. What I discovered, in my research, is that the yogis who wrote these texts had intimate understanding of the respiratory system. Their description and prescription of prāṇāyāma is congruent with Western physiology and the techniques I learned in Buteyko. The miss or myth lies in the way in which prāṇāyāma has been presented in modern times.

*The orientation towards teaching big breathing and expansive inhalation and exhalation is actually at odds with both respiratory health and the yoga texts on prāṇāyāma.* Challenging though it has been for me, my students, and colleagues to give up our addiction to big breathing, the shift towards health and greater sustained vitality and stability has been well worth it.

So, this is my *bhāvana* (pronounced baw-vah-nah, intention). It is my *dharma* (pronounced dahr-mah, purpose). I have no choice but to write this book. For those of you who find this information revelatory, counter-intuitive, or even shocking, I feel you! When I began this process, I had to clear my head of multiple cultural myths regarding the breath that now seem comparable to believing the world is flat. I encourage you, in the very fundamental meaning of the word, to move forward “with courage” or *from the heart*. Experience for yourself how breathing less, which is the essence of prāṇāyāma, can transform you.

## **Utilizing This Text**

This book is written in a *vinyasa krama* (pronounced vin-yah-sah krah-mah), a step-by-step progression. It is intended to act as a guide for those already familiar with the practice and teachings of yoga. However, for those who have little or no previous exposure to yoga philosophy, many of the basic precepts will be introduced in the first two chapters, and then referenced throughout the book. These ideas formulate a conceptual framework for the common yoga practices most people encounter in the West. The Sanskrit language was the language used by the authors of the original yoga texts, the Vedas. I utilize many Sanskrit words throughout this book. The first time a Sanskrit word appears it will be italicized and translated into English. At the end of the book you will find a Sanskrit glossary for reference, as well as a glossary for frequently used physiological terminology.

The chapters are organized to offer educational information in bite-size chunks. At the end of each chapter, you will have an opportunity to apply the theory directly through the **“Putting It into Practice”** sections, which will offer exercises for exploration. The chapters build conceptually, and each practice section draws from the preceding one. **Key Concepts** of each chapter are encapsulated, and then further elaborated upon in the **Chapter Summary**. I encourage you take your time digesting the material. Like the breath itself, this information is intended to be sipped, not gulped.

For those of you who love to dive into the deep end of the pool, there is an abundance of scientific and technical information and resources to keep you swimming for years to come. However, some of you might feel drawn more to the practical side. I encourage you to familiarize yourself with the Key Concepts and the ideas listed in the Chapter Summary, and then immerse yourself in the practices themselves. The physiology and Vedic science will be there for your reference, if, at a later date, you wish to explore a particular topic more fully.

**Chapters 1–10** lay out the foundational principles that support the six myth-busters listed at the beginning of this Introduction. **Chapter 11** offers examples of therapeutic application of this information, utilizing case studies of clients from my yoga therapy practice. I break down the science of mind, anatomy, and physiology from the previous chapters to support specific protocols used to address pathology. The **Appendixes (I–III)** offer āsana/prāṇāyāma practices for restoring *prāṇa*; a guide to teaching functional breathing for instructors and therapists; and an outlined prāṇāyāma curriculum for program directors. The latter collates the Key Concepts from each chapter, along with the chapter practices for application within a teaching context. It can be adapted according to the depth of your own curriculum. Of course, practitioners may also find this quick reference guide useful for their personal development.

I recommend you fully explore the concepts and practices from the first ten chapters before jumping into the sequenced practices and teaching applications. The amalgam of theory and practice up front is intended to lead you systematically and safely through an intelligently constructed approach to prāṇāyāma.

Within yoga, there are a multiplicity of lineages and approaches to practice. Even the names of āsanas or prāṇāyāmas might designate something very different depending on what tradition of yoga is being practiced. Having been certified in both Iyengar (until 1996) and Viniyoga, I honor each lineage’s uniqueness. I am not here to judge or assess a particular orientation to practice. Rather, the information offered in this book is fundamental to working knowledgeably in the field of yoga, much like knowing the location of the sciatic nerve. My role here is to be a messenger, a catalyst for connecting dots to increase understanding. I have been exposed to knowledge from outside of yoga that has enhanced my practice and deepened my appreciation of what yoga has to offer the world as a therapeutic tool. I wish to share that information in a format that will offer a solid foundation in respiratory science and the teaching of prāṇāyāma regardless of lineage. With greater knowledge and more accurate

understanding of anatomy, physiology, psychology, and the Vedic teachings, we can better serve our communities in health.

## Chapter 1

# THE ORIGINS OF PRĀṆĀYĀMA

*yoga citta vṛtti nirodhaḥ*

*The state of yoga reflects the cessation of movement within the mind.*

Patañjali's Yoga Sūtra 1:2

Throughout my yoga studies, I experienced flickers of results with prāṇāyāma practice, enough to recognize unrealized potential inherent in the manipulation of the breath. Curious, I exposed myself to teachers from a variety of traditions and quickly learned that even more so than with āsana, prāṇāyāma instruction is lineage specific. I encountered a splatter of mixed techniques, and conflictual explanations that were incongruent with one another, even among those with Ayurvedic and medical knowledge. One thing most all these modalities had in common was that they were dramatic, noisy, and required a great deal of muscular heaving. Though I found these practices intriguing and brought each home to my mat for further exploration, none transformed my mind or my prāṇamaya (energy dimension) in the way the texts spoke was possible. At the time, I assumed this was because I was spiritually unfit or emotionally unable to sustain practices that required that level of intensity.

The Buteyko method initiated my felt sense of the movement of prāṇa and the connection between breath, energy, and mind just as the yoga masters had alluded to. The difference in approach lay in the emphasis on quieting the breath, making it so light and thin that it became barely perceptible. It required pacification of the chest muscles, accompanied by progressively longer breath suspensions. At first, turning the volume down felt suffocating, oppressive. Then, over time, I was able to retain the breath comfortably and noticed less breathlessness throughout my day. Yet, the most profound internal shift was something I can only describe as an overall sense of satiation, a feeling of *sañtosa* (pronounced sahn-toe-shah) or contentment. It was as if by learning to need less breath, my entire system was feeling less need to need.

The omission of mental static in my head reminded me of how I felt swimming underwater when I was a young girl. I could hear the sounds of chaos above the surface, yet was safely cocooned from it all, submerged in a pocket of serenity, as if I had dived into a mental pool of calm. Buteyko gifted me with the experience of *nirodhaḥ* (pronounced ni-road-ah-hah)—the “still lake of the mind.” Swami Muktibodhananda, author of the Hatha Yoga Pradipika, described my experience beautifully:



When prāṇa moves, citta moves.  
When prāṇa is without movement citta is without movement.  
By this steadiness of prāṇa, the yogi attains steadiness  
and should thus restrain the vāyu (air).<sup>1</sup>

## The Origins of Yoga: Sāṃkhya Philosophy

Classical yoga explicitly states that the goal of practice is to still the mind's turbulence in order that one can experience the deeper soul-self within. As the mind becomes tranquil, like a placid lake, the teachings state that we come to recognize our divine essence. As we remember that this is also "us," we are drawn out of the state of perpetual frenzy in which we live—the mental chaos—driven largely by our desires and fears. This act of remembering, or rejoining, is the state of *yuj—yoga*—defined as union. It is the state of unified consciousness that we strive to achieve through practice. The teachings of yoga and Ayurveda are derived from *Sāṃkhya* (pronounced san-khi-ya), one of six classical Indian philosophies designed to explain the nature of reality. *Sāṃkhya* offers a distillation of the teachings from the Vedas, the original body of knowledge that emanated from the Indus Valley around 1500 BCE. The dualistic principle that underlies *Sāṃkhya* proposes that there are two aspects to the sentient world: *puruṣa* (pronounced pu-roo-sha) and *prakṛti* (pronounced prah-kri-tee).

*Prakṛti* is made up of all that is nameable, changeable, and finite. This includes even the unseen but felt experiences, such as thought and emotion. *Puruṣa* is that which is not *prakṛti*. Some understand this as God, others as Pure Consciousness, Cosmic Connectivity, or Pure Awareness. Each of us, then, is composed of both *puruṣa* and *prakṛti*. Together they create the manifest universe. The yoga teachings suggest that it is the forgetting of *puruṣa*, the divinity within us and around us, that causes much of our *duḥkha* (suffering). The intention of yoga is to heal that gap in our memory by providing us practices that return us to the state of wholeness.

All of *prakṛti* is infused with *prāṇa*. *Prāṇa* has been described in a variety of ways, most consistently as the subtle energy that animates us, akin to the Chinese medicine concept of *chi*. This *prāṇic* energy comprises three primordial qualities within nature known as the *guṇas* (pronounced goo-nahs). The *guṇas* are defined as: *rajas* (pronounced rah-jahs, movement), *tamas* (pronounced tah-mahs, inertia), and *sattva* (pronounced saht-vah, light/balance). According to *Sāṃkhya*, everything in the world of *prakṛti*, animate and inanimate, comprises all three *guṇas*. For instance, while a rock is primarily a tamasic object, it still houses a speck of *rajas* and *sattva*. On the other hand, a butterfly is a lithe entity of perpetual movement (*rajas*) which still contains a fractional amount of *tamas*. Sometimes, we humans are more "rock-ish"—heavy, rigid, and immobile—while at other times, we flit and flicker like a butterfly. Gauging our *guṇas* on a particular day or during a period of our life illuminates how our *prāṇa* is flowing. When we feel rested, healthy, clear-headed, and grounded, we are in a *sattvic* state.

*Prāṇa* (energy/breath) and *citta* (pronounced chit-ta, mind) are considered intimately linked, as implied by Muktabodhananda's quote at the beginning of this chapter. If *prāṇa* settles, the mind will follow and vice versa. As we practice yoga, we learn to quell both the lethargy of *tamas* and the agitation of *rajas* to cultivate *sattva*. *Prāṇāyāma* is one of the primary tools offered as a means to regulate our *prāṇa* and balance the *guṇas*.

The teachings of *Sāṃkhya* are encapsulated in Patañjali's (pronounced pah-tawn-jah-lees) *Yoga Sūtra*. This text, (of which there are numerous translations) offers a compelling commentary on the functioning of mind and the means to become more *sattvic*. In this

chapter, we will examine the relationship between the mind and prāṇāyāma, the fourth limb of asthanga yoga (pronounced ahsh-tahn-gah yo-ga, the eight-fold path of yoga), from the perspective of the Yoga Sūtra (see [Figure 1.1](#)).

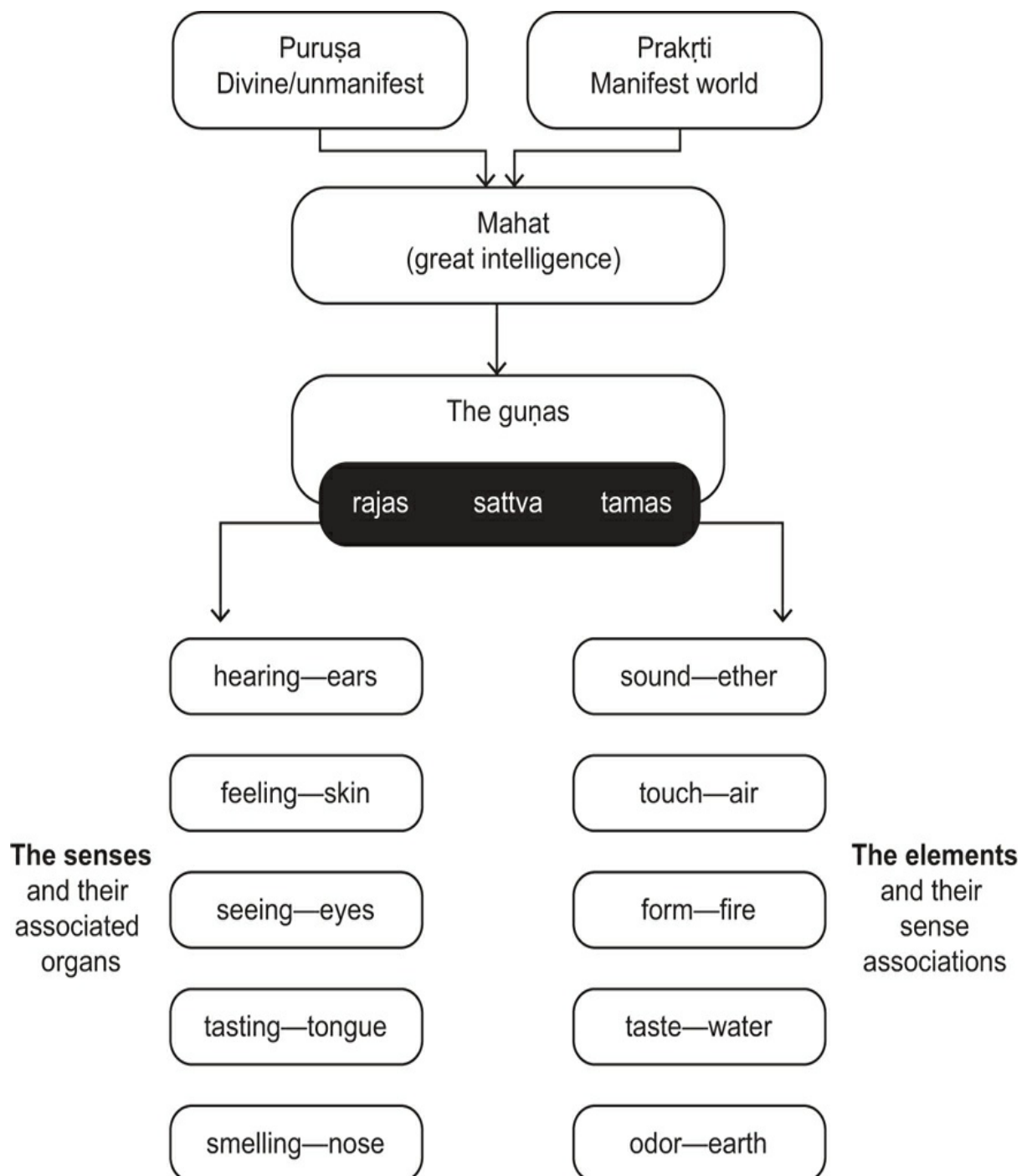


Figure 1.1 Sāṃkhya Evolution

## The Mind of the Yogi

Patañjali's Yoga Sūtra calls on us to become conscious of our habitual patterns and the residue they leave behind. Repetitive action leaves an imprint. These imprints are referred to as *saṃskāras* (pronounced sum-scar-ahs). It has been theorized that roughly 75–90 percent of our day is occupied by unconscious, repetitive thought and activity. Some of this is quite

useful. For instance, it would be a bummer to have to relearn how to brush our teeth or turn on the faucet each and every day! Other saṃskāras, such as shoveling potato chips unconsciously into our mouth while surfing the internet, are not so useful. As yoga practitioners, we learn to examine the effect of the saṃskāras which result from our daily actions. Through this process, we begin to discern whether an action serves the intention of becoming more sattvic (balanced) or keeps us swinging in the pendulum of rajas (agitation) and tamas (lethargy).

The intention of yoga practice is to reduce duḥkha. Duḥkha is most often translated as suffering. Every day, around the globe, people are suffering the horror of poverty, hunger, war, and abuse. In contrast, characterizing our daily frustrations and challenges as “suffering” can feel like an overstatement. For that reason, I prefer the interpretation of duḥkha as a sense of stuckness. When stuck, the mind is held hostage by a particular thought or pattern of thought, and is unable to see through to new possibilities. Everyone has experienced duḥkha at this level and can recognize the agony of being caught in the web of our own mind.

In order to unstick ourselves of duḥkha, we must become aware of all the ways in which the saṃskāras (imprints) from past actions are informing our choices in the moment, and then apply restraint. The vṛttis (pronounced v-rit-tees) are the habitual patterns that swirl through our mind, and take the shape of thought, feeling, image, and sensation. They are identified as a major source of duḥkha (suffering). This is why the practice of yoga emphasizes stilling the vṛttis.<sup>2</sup> While not all vṛttis create duḥkha, a majority of mental impulses are repetitive, and either rajasic or tamasic in nature. I often joke with students that we all suffer from a bad case of “vṛtt-itis” (made-up word), or inflammation of the vṛttis.

From the outset of the second chapter of the Yoga Sūtra, Patañjali offers the necessary ingredient list to successfully quiet the vṛttis and eradicate saṃskāras. This three-tiered approach is known as *kriya yoga* (pronounced kree-yah yo-ga), or the yoga of action:

### ***tapas-svādhyāya- īśvarapraṇidhāna-kriyayoga***

*The practice of yoga is comprised of these three: tapas, svādhyāya, īśvarapraṇidhāna.*

Patañjali's Yoga Sūtra 2:1

To break down this sūtra into its component parts:

**Tapas** (pronounced tah-pahs), from the Sanskrit root “*tap*” meaning to cook or heat, refers to the process of change. It takes great fortitude and discipline to actively pursue the transforming of habits that cause us to suffer. This is the essence of tapas. Change isn't easy. The more habituated we are to a particular construct of mind, or a postural or breathing pattern, the harder it is to shift it. The heat of tapas references the friction that arises from going against the grain of the familiar. Next to thinking, breathing constitutes our most consistently performed habitual pattern, unconsciously repeated *approximately 20,000 times a day*.

**Svādhyāya** (pronounced s-vah-dhee-yaw-yah), meaning self-reflection, is derived from the root words “*sva*” meaning self, and “*dhi*,” to reflect. In order to change our patterns, to free ourselves from the constraints of duḥkha, we first must recognize these patterns. *We cannot change what is unconscious*. Patañjali acknowledges that self-delusion is part of the human condition, and emphasizes the need for a teacher and wisdom teachings to guide us in this process of discernment. Other yoga texts, like the Hatha Yoga Pradipika, are emphatic about

the need for a teacher’s guidance when learning prāṇāyāma. This underlines the difficulty we encounter in identifying our own breath patterns, and the challenge we face in transforming something so chronically habituated, without the insight of an experienced teacher.

**Īśvarapraṇidhāna** (pronounced eesh-va-rah-pra-nee-dha-nah): The root, “*dha*,” meaning support, is understood to mean devotion to the Divine, or that which inherently supports us in a fundamental way. This can take the form of gratitude, compassion, acts of kindness, or in a more traditional way, prayer. Patañjali uses the term “*īśvara*” here to reference puruṣa (the Divine), clarifying that we have an innate need to connect to the spiritual dimension, and this must be actively nurtured. While not legislating how this must be done, or referencing specific deities, he indicates that in order for yoga to serve us, we must serve a greater good, beyond our own self-improvement regime.

For me, prāṇāyāma as a daily practice of *īśvara* establishes a prayerful ritual linking the breath to the cultivation of the quality of sattva. It is a way of taking ownership of the rajasic and tamasic energy I am both taking in and putting out in the world. Restraining the breath impulse reflects a capacity to restrain the mental impulses that activate anger, greed, and fear. With every breath I am reminded to treat my interactions with others with delicacy and awareness, and to curb the impulses that contribute to duḥkha.

Tapas, svādhyāya, and *īśvarapraṇidhāna* are the necessary companions on the yogi’s path, as they constitute a triumvirate in battling duḥkha. In many ways, tapas and svādhyāya can be considered an intelligently strategized process of detoxification from habits that no longer serve us. Through svādhyāya (self-awareness) we identify saṃskāras, patterns or behaviors that are linked to duḥkha (stuckness/suffering/pain). Through tapas, we ignite the fire of intention in a disciplined manner to ameliorate these tendencies. *Īśvarapraṇidhāna* protects us from the ego’s pull towards self-absorption and fosters an inner connection to puruṣa.

Yoga as a process of transforming saṃskāras includes all aspects of lifestyle: diet, exercise, work, sleep, relationships, emotional regulation, thought, and of course breathing. The science of prāṇāyāma is founded on the principles of kriya yoga. The incessant and mostly unconscious saṃskāra of breathing has tremendous impact on the vṛttis. This is why prāṇāyāma is considered to be the greatest tapas of all. It provides the means to achieve a clear, present, and sattvic mind, the mind of samādhi (wisdom—peace).

## ***Mind Loops, the Kleśas, and How We Become Free***

In the Yoga Sūtra, Patañjali articulates that the vṛttis (thoughts/feelings) that specifically lead to duḥkha emanate from the *kleśas* (pronounced klay-shahs), the five afflictions. The *kleśas* are the sticky goo that keep us stuck, mired in duḥkha. They are manifestations of our perceptions, beliefs, ideas, and opinions which gobble up our energy. Exploring our mind through the window of the *kleśas* can illuminate how we manage or mismanage our prāṇa.

This sūtra, which follows the kriya yoga sūtra, describes how kriya yoga attenuates duḥkha by thinning or weakening the binds of the five afflictions or *kleśas*:

***samādhi-bhāvanārthaḥ-kleśa-tanu-karanarthash-cha***

*Kriya yoga is practiced for attaining samādhi [meditative absorption] which comes from making thin the afflictions (kleśas) that cause suffering.*

The kleśas are defined as:

**Avidya** (pronounced ah-vid-yah): From the Sanskrit root “vid” meaning to know. Avidya literally means to not know. Avidya is more than simply not knowing facts; it’s inclusive of the many ways we misinterpret experience and foster ideas that are based on this misapprehension. From the banal (not knowing how to spell a word) to the spiritual (forgetting we are more than prakṛti), avidya forms the “soil” from which the other kleśas sprout.

**Asmitā** (pronounced ah-smee-taw): Each of the remaining kleśas can be understood as a facet of avidya. Asmitā refers to our sense of self, our “I-ness.” Many philosophers and authors have noted that “We see the world not as it is, but as we are.” This is the essence of the delusion of asmitā. It encompasses our tendency to prioritize and make special anything that we name as “I, Me, and Mine.” Whenever we think of ourselves as being better and more deserving than others, asmitā is the impetus for our perception. Patañjali notes that asmitā imbues a sense of separation and division, rather than inclusion.

**Raga** (pronounced ra-ga, hard “g”): The Sanskrit root of raga is “ranj,” which means to color. Interpreted in most texts as attachment, raga speaks to our tendency to become attached to the experiences that we “color” with the moniker of pleasure. Patañjali makes a clear distinction between the experience of pleasure and the attachment that leads to wanting more. Memory plays a role here—as does imagination—as we remember how good the first cookie tasted, and then reach for the whole box. It is the craving or grasping for more that constricts us, not the sense of delight that inspires the feeling. Raga inhibits our ability to choose freely and clouds our ability to disseminate value from transitory pleasure.

**Dveṣa** (pronounced di-vesh-ah): Aversion. Just as we want more of what we like, we also push back against that which we don’t want or believe will harm us. Patañjali is not insinuating we toss away basic intelligence and step into oncoming traffic. The imperative here is to question the many avenues of aversion, diversion, and denial we choose in life. The teaching of dveṣa requires us to assess what we may be avoiding that is actually a difficult, but perhaps necessary, component for our growth.

**Abhinevesha** (pronounced ah-bhee-na-vaysh-ah): The fear of death or survival instinct goes deep into our hard-wiring. Patañjali suggests that even the wise are at times deluded by this fear. Fear has many manifestations, from anxiety to phobic avoidance. It can cripple our ability to maximize our potential. It takes courage to move through self-limiting fears. I’ve heard Pema Chödrön, the well-known Buddhist nun, speak on this subject and offer this sage counsel: “The difference between the hero and coward isn’t the lack of fear, it is the willingness to take action anyway.”<sup>3</sup>

It is not hard to comprehend how our innate ignorance, sense of “I, Me, and Mine,” our attachments, aversions, and fear dominate the specter of the mind. In fact, it is difficult to fathom ourselves making choices that are not motivated by the kleśas (afflictions). Yet, that is in essence what Patañjali, and yoga, suggest we attempt to do. By emancipating ourselves from the claws of the kleśas, we become more able to wisely respond rather than react to the demands of the moment. As we deconstruct familial, cultural, and societal prejudices that restrict our perspective, we see a fuller picture, releasing myopic personal concerns. It’s a

way of de-dramatizing our lives, which is essential, in order to staunch the leaks in our prāṇic reservoir.

## **Asthanga Yoga—The Eight Limbs of Practice**

Patañjali lays out the eight-fold principles of practice in the second half of [Chapter 2](#) of the Yoga Sūtra. He lists prāṇāyāma as the fourth limb. To understand prāṇāyāma in its classical roots, we need to contextualize it with the other seven limbs. The eight limbs are a coherent guide-map for getting out of “duḥkhaville” (made-up word to describe being in the state of suffering) through the conscious application of kriya yoga. The presentation of the eight limbs, in the order they appear in the text, illuminates a preparatory process for the cultivation of “samādhi mind,” the sattvic mind of clarity and wisdom. Remember that in order to make the kleśas (afflictions) thin, we must engage in an ongoing process of reducing avidya (ignorance) so we can ultimately know our True Nature. This requires an ample dose of svādhyāya (self-awareness) and tapas (the will to change). The limbs are described below.

### ***Yama—The First Limb: Ethical Restraints in Relationship with Others***

The five yamas (pronounced yah-mahs) are:

- *ahimsā* (pronounced ah-him-sah): non-violence; cultivation of compassion and empathy for others
- *satya* (saht-yah): truthful communication, refraining from gossip, speaking with ahimsā
- *asteya* (ah-stay-ah): integrity in action; not taking what has not been offered to us
- *brahmacharya* (bra-mah-char-yah): conservation of energy; abstaining from actions that deplete us or infringe on others
- *aparigrahā* (ah-par-i-grah-haw): living simply with what we need rather than hoarding what we want.

*Yama* signifies restraint. The term acknowledges that in order for us to mature and evolve as humans we must control the impulses of the vṛttis (thought/feelings) that instigate aggressive and negative behaviors. Patañjali frames each of the yamas as a quality for us to cultivate and stabilize within us. The sūtras state that when one is stabilized in ahimsā (non-violence), the result is peace. When one is stabilized in satya (truth), what one says manifests, takes root. When one is stabilized in asteya (integrity), trust is fostered. When one is stabilized in brahmacharya (moderation), vitality thrives. When one is stabilized in aparigrahā (generosity), one comes to know oneself beyond the material world.

The yamas are considered the great vow that supersedes time, space, circumstance, or culture. Perfection in them is the driving force for the fastidious practitioner. However, they also provide important guideposts for those of us who are more moderate aspirants, living as householders. We elevate ourselves when we remember the yamas (the ethics), and we live our yoga off the mat, in our daily interactions with others.

## ***Niyama—The Second Limb: Personal Discipline to Ensure Integrity***

The five niyamas (pronounced ni-yah-mahs) are:

- *śauca* (pronounced shau-cha): purity, cleanliness of the body, mind, and heart
- *santosa* (sahn-toe-shah): contentment
- *tapas* (tah-pahs): cultivation of willpower over the pull of the senses through practice
- *svādhyāya* (s-vah-dee-yaw-yah): self-awareness and reflection that draw us closer to our Higher Self
- *īśvarapraṇidhāna* (eesh-var-ah-prawn-ee-dawn-ah): dedicating ourselves to that which connects us to Spirit/God.

The yamas and niyamas offer great insight into how we can manage our prāṇa. When we find ourselves out of alignment with these precepts, Patañjali suggests we change our perspective. This practice is known as *pratipakṣa bhāvana* (pronounced prah-tee-pahk-shah baw-vah-nah) or cultivating the opposite intention. In times of doubt or conflict we could consider getting counsel from a friend or advisor, going for a walk, standing differently, breathing differently, reading something uplifting, or anything else that gets our mind “unstuck” from its negative spin. Pratipakṣa bhāvana shakes us free of the kleśas (afflictions) and turns our mind back to yama and niyama (ethical restraints). The teachings caution that allowing ourselves to get mired in anger, greed, and delusion (the three poisonous leaks of prāṇa) will result in “unending duḥkha.”<sup>4</sup> From this perspective, all of the yamas and niyamas can be seen as a practice of brahmacharya, or the conservation of energy. They help us to regulate our prāṇa through the transformation of the vṛttis.

While āsana opens the door for many practitioners of yoga, as teachers we need to find ways to weave the teachings of yama and niyama into our classes. If we skillfully lay them out like breadcrumbs, our students will be able to use them to find their way home to heart and soul. This will add meaning to their practice and make it more personally satisfying. Prāṇāyāma, with its interiorization of focus, settles the mind, enabling us to reflect with more clarity on yama and niyama. This helps cultivate a more compassionate and sattvic (harmonious) perspective on life.

## ***Āsana—The Third Limb***

The Yoga Sūtra does not offer any instructions on Downward Dog, Triangle, or the other commonly recognized postures we consider fundamental to yoga practice today. As indicated earlier in this chapter, the sūtras primarily focused on transformation of the mind. To that end, they detail the experience of *saṃyama* (pronounced sum-yahm-ah), the amalgam of the last three limbs of the eight-limbed path: *dhāraṇā* (pronounced d-har-ahn-aw), *dhyāna* (pronounced d-hee-yawn-ah), and *samādhi*. The ultimate state of samādhi culminates in *mokṣa* (pronounced mo-k-sha), freedom from any felt sense of separation from puruṣa (our divine nature).

Āsana literally means “seat” in Sanskrit. It indicates the need for a comfortable and stable position in which to transact long sittings of prāṇāyāma and meditation. Active āsana was offered as preparation for the spine and hips in order to reduce the mental distraction emanating from the aches and pains that can accompany sitting for hours.



The sūtras were actually written hundreds of years before the emergence of *hatha* (pronounced hah-tah) yoga, where the science of āsana and prāṇāyāma blossomed with variety and nuance. Most of the schools of yoga today practice a form of hatha yoga and may not offer any connection to the teachings of Sāṃkhya or Patañjali. With the rise in popularity of yoga over the past 50 years, many classes are utilized more as an alternative to the typical gym workout and are void of any reference to prāṇāyāma or meditation.

That said, movement and breath are inseparable. Movement alters the rate and volume of the breath automatically and impacts the blood gases, producing more CO<sub>2</sub> through metabolism. Today, many people in the developed world spend their days sitting. The sparse moments of movement between cars, chairs, and bed probably total less than 1000 steps for many on a regular basis. This lack of movement is one of the greatest catastrophes of modern times and has a tremendous impact on the functionality of our breath, as well as our mental and physical health. We will explore this topic significantly in the upcoming chapters of this book.

Regardless of historical reference, Patañjali's placement of āsana before prāṇāyāma makes perfect sense from a physiological perspective. Daily exercise is a necessary part of prāṇāyāma practice, because it is through movement that CO<sub>2</sub> is produced. This in turn boosts oxygenation, increasing aerobic capacity, and mental acuity—by increased O<sub>2</sub> to the brain.<sup>5</sup> The key to maximizing the benefits of āsana is to maintain a sattvic (light) breath pattern throughout practice to avoid the tendency to make the breath excessively rajasic (overactive). If we are intentionally breathing harder (bigger) than our actual metabolic needs, it will tend to leach the body of CO<sub>2</sub>. Āsana practiced with a sattvic breath pattern facilitates the internalization of attention and mind–body connection. This supports the yogis' placement of āsana prior to prāṇāyāma with the intended goal of achieving samādhi.

My concept of āsana combines the understanding I've derived from the teachings of Patañjali, The Hatha Yoga Pradipika, and the physiological symbiosis between breath and movement. Here's my working definition of āsana for contemporary practitioners:

*āsana*: conscious movement practiced in synch with the breath; intended to transform structural saṃskāras, by stabilizing and mobilizing the body, and optimizing respiratory efficiency.

## **The Final Five Limbs**

The last five limbs are interwoven. The cultivation of prāṇāyāma is intrinsically linked to the settling of the mind, and the stillness exemplified by the state of samādhi (meditative absorption). Some commentators on the sūtras go so far as to say there can be no meditative state without mastery of the breath. Swami Saraswati (2010) captures the essence of this in the statement “Prāṇa is grosser than the mind and hence easier to control. Thus, when prāṇa is caught, the flighty mind is caught too.”<sup>6</sup>

The final five limbs are:

- *prāṇāyāma*: breathing practices that facilitate the retention of prāṇa through restraint of inspiration and expiration
- *pratyāhāra* (pronounced prah-tee-ah-har-ah): cultivating interoception through attending to the senses at a refined, subtle level
- *dhāraṇa*: cultivating the capacity for deep concentration and extended focus

- *dhyāna*: the state of meditation, whereby dhāraṇā is sustained effortlessly
- *samādhi*: the state of prāṇa vidya (pronounced vid-yah, knowledge), mastery of prāṇa; meditative absorption.

Below we will look at prāṇāyāma, the fourth limb, in greater detail.

## **Prāṇāyāma—The Fourth Limb**

Prāṇāyāma itself is a practice in restraint of prāṇa. Sandwiched between āsana and pratyāhāra (sense-withdrawal), prāṇāyāma initiates the inward journey into the subtle body. In Vyasa’s original commentary on the prāṇāyāma sūtras, he states, “Sipping the external air is in-breath. Expelling the visceral air is out-breath—braking their force and uncontrolled movement (gati), and [thereby] the absence of both is termed prāṇāyāma.”<sup>7</sup>

In other words, when we still the breath, the reserves of prāṇa are replenished. This helps to explain the seemingly opposing definitions which are commonly used for prāṇāyāma based on the Sanskrit etymology. The first, as indicated above, describes prāṇāyāma as the restraint (yama) of prāṇa. The second divides *prāṇ* (another derivation of prāṇa) and *ayama* (meaning to extend). Both are correct, as breath and prāṇa have a symbiotic relationship with one another. Vedic scholar and esteemed *acharya* (teacher) Swami Veda Bhāratī cautions that the movement of breath needs to be stopped (vi-ccheda) and calls us to refer back to an earlier sūtra (1:31) which links the uncontrolled breath with the disturbed mind. He states, “for this reason that which seems natural is to be eliminated.”<sup>8</sup> He describes prāṇāyāma as the practice of both contracting the breath to a “pinpoint” of concentration and “expanding the breath into subtlety.”<sup>9</sup>

The means to this process of refinement begins with the “sipping” of the inhale, which is known as *pūraka* (pronounced poo-rah-kah). Sipping signifies a very different action than gulping or gasping, as many of us tend to do unconsciously. All commentators agree that the in- and out-breath should be directed through the nose, unless using a specific technique such as *shītali* (pronounced shee-ta-lee), where the intake is through the mouth, funneled by the tongue, and highly controlled. Furthermore, Bhāratī clarifies that the term “visceral” in Vyasa’s commentary explicitly refers to abdominal-diaphragmatic breathing. He says it is to be applied “rhythmically and harmoniously.”<sup>10</sup> The benefits of abdominal-diaphragmatic breathing will be explored in great detail in [Chapter 6](#). Controlled exhalation with abdominal-diaphragmatic activation is known as *rechaka* (pronounced ray-cha-kah).

It is through the harmonizing and retention of breath that prāṇāyāma is mastered in a step-by-step process.<sup>11</sup> Inhale is described as the process of controlling the urge to exhale, and exhalation control over the urge to inhale. Kumbhāka, or total suspension of the breath, exhibits control over the urge to do either, and is the ultimate goal of prāṇāyāma. *Kumbhā* (pronounced koom-bah) means water jar. Water in a motionless jar remains still and contained. When we have stilled the breath so it too is motionless, then prāṇa is retained.<sup>12</sup>

Baba Hari Dass (1999), another contemporary scholar of the sūtras, describes prāṇāyāma as a sacred act of sacrifice, leading, in essence, to īśvarapraṇidhāna (connection to the Divine). “When the incoming breath is offered into the outgoing breath, the outgoing breath is offered into the incoming breath, or when both are offered into the retention, the mind is purified of self-interest.”<sup>13</sup> He reminds us that the breath is intimately linked to our attachment to life, each breath affirming our survival. This circles back to the kleśas (afflictions): our fears, aversions, desires, and ego. During our everyday life, the breath

seamlessly shifts according to our activities and emotions: accelerating when we're physically active, becoming rapid and shallow when anxious, slowing or even stopping at times of deep concentration. The breath, he surmises, is “the vehicle through which the five afflictions function.”<sup>14</sup> In order to make the kleśas “thin” we must refine and master the breath, so we release the mind from the grip of the vṛttis.

### ***Dīrgha and Sūkṣma—Long and Subtle Breath***

*Dīrgha* (pronounced deer-gah, long) and *sūkṣma* (pronounced sook-shmah, subtle) are the terms that specifically define prāṇāyāma in Sūtra 2:50.

#### **Dīrgha**

Perhaps the use of big breathing that we commonly experience in yoga classes these days has to do with confusion over the meaning of the term “dīrgha.” To clarify, Veda Bhāratī explains that through prāṇāyāma the breath becomes “like a compact ball of cotton being stretched and becoming longer.”<sup>15</sup> Length in this context relates to the uncoiling of the breath to produce a delicate thread that is then sustainable at a subtle level for longer periods of time, over days, weeks, and months. *Dīrgha does not refer to the length of a particular inhalation or exhalation, but rather to mastery of the impulse to breathe regardless of activity or fluctuations of mind.*

#### **Sūkṣma**

Consider the *external* and *internal* spaces of exhalation and inhalation. The *external* space of prāṇāyāma is measured by how far out from the body the exhalation breath can be felt. The more distant, the less the breath would be characterized as prāṇāyāma. In other words, as we exhale, we are being called to lighten the flow so that it's nearly imperceptible. It is said that the breath becomes appropriately subtle, sūkṣma, when it is so light that a piece of cotton doesn't move when placed at the opening of the nostrils.<sup>16</sup> This is a very close-in external space. The *internal* space of inhalation is observed by a pervasive sense of the touch of the breath expanding everywhere, feeding every cell and permeating the spaces in between. This happens when the inhale is gradual and freed from muscular effort which tends to localize sensation and encapsulate the experience in the thorax. Pūraka (sipping the inhalation) and rechaka (controlled exhalation) are then practices of pratyāhāra, requiring a fine attunement to the inner senses. Each necessitates dhāraṇā, focus or concentration. If the mind becomes distracted, the subtlety and rhythm will be lost. The external space will extend and the internal space will contract.

### ***Kevala Prāṇāyāma—Suspension without Effort***

According to Sūtra 2:51, as the breath becomes consistently subtle, eventually it stops on its own. This natural cessation of the breath is known as *kevala* (pronounced kay-vah-lah) prāṇāyāma. In the Yoga Sūtra, kevala is referred to as the fourth kind of prāṇāyāma, differentiating it from the controlled effort applied when restraining the inhale or exhale, or extending kumbhākas. Kevala can be explained through the recalibration of chemoreceptors within the brain and the diaphragm, which occurs when breath suspension is applied with discipline and awareness on a consistent basis. We will be exploring the mechanism for kevala in the respiratory physiology section of this book.

Kevala prāṇāyāma is considered the highest prāṇāyāma. It cannot be “practiced” in the sense that it emerges as the result of mastery of the other three. According to the texts, it happens naturally and corresponds to the state of samādhi (meditative absorption). With kevala, there is no awareness of the breath being stopped because the mind is completely “absorbed in the infinite, and no knowledge of the body is present in the mind.”<sup>17</sup> The usual agitation experienced with breath holding is completely absent as “prāṇa in the entire body is stabilized.”<sup>18</sup>

The effect of mastering the flow of prāṇa through prāṇāyāma practice is described in Sūtra 2:52. Here Patañjali credits it with removing the veil that covers the light of sattva (harmony). Saṃskāras (imprints of habit) of the practitioner are weakened as avidya (ignorance) lessens. Illuminative knowledge shines forth.<sup>19</sup> According to Veda Bhāratī, this view is substantiated by numerous Vedic texts:

As the dross of metals is burnt by being smelted,  
So the blemishes of living beings are burnt  
Through the control of prāṇa.<sup>20</sup>

Baba Hari Dass concurs, describing “the mind like a candle flame and the breath like the wind.”<sup>21</sup> He explains how regular practice of prāṇāyāma settles the restlessness of rajas guṇa (activity) and removes the dullness of tamas (inertia). This quiets the vṛttis (turnings of mind) that are driven by the kleśas (afflictions), fueled by the breath. Until prāṇa is contained by stilling the breath, he states, meditative concentration (dhāraṇā and dhyāna), as required to achieve the state of samādhi (meditative absorption), is not possible.<sup>22</sup>

Later texts like the Hatha Yoga Pradipika speak of the fruit of prāṇāyāma as the manifestation of vīrya (pronounced veer-yah, vitality). Vīrya implies a level of mental and physical vigor, stamina, and health. The yogis dedicated themselves to maximizing vīrya through their practices, specifically through the precise control of the breath. Mastery of prāṇa implies the capacity to retain vast amounts of vīrya and direct it at will. In the next few chapters we will explore the subtle body and respiratory physiology. This will shed light on how we can use prāṇāyāma as a pathway to stabilize the mind, increase vīrya, and restore prāṇa.

## KEY CONCEPTS

---

- Prāṇa (animating life-force), citta (mind), and breath are intimately linked.
- A primary intention of yoga practice is to create a sattvic (harmonious) flow in prāṇa through the breath, so that citta (mind) will become still.
- The teachings of yoga call on us to become aware of and transform the saṃskāras (imprints created by habitual patterning) that lead to duḥkha (stuckness/suffering).
- Breath and thought are the most habitual saṃskāras that we engage in every day.
- Prāṇāyāma is the practice of restraining the breath to restore prāṇa and create a more sattvic mind.

## — PUTTING IT INTO PRACTICE —

### Kriya Yoga Exploration

To transform a pattern, we must be able to identify it. The process of observation described below draws on the three aspects of kriya yoga to provide insight into your breath saṃskāras. This information will help you to synthesize and utilize the information in the upcoming chapters. It is a necessary component to knowing how to choose appropriate prāṇāyāma techniques in order to create practices that promote sattva.

To support you in this process, I encourage you to create a **Svādhyāya Breath Journal (SBJ)**, which serves as the companion workbook for this text. This workbook has built in spaces for you to write out reflections and to chart or graph your experience. You can also create your own SBJ. Either way, keep your journal with you as you commute to work or when you travel. The SBJ provides a tangible way for you to track your progress as you develop more understanding and mastery of the breath.

## SVĀDHYĀYA ON THE BREATH

---

- Begin to notice your regular breathing habit (saṃskāra) throughout the day.
- Observe when the breath is rajasic (rapid, erratic, heavy, loud); when it is tamasic (held, very slow, tight); when it is sattvic (smooth, silent, at rest, rhythmic/steady, easeful).
- Observe the predominant guṇa activating the mind at these times as well.
- What senses are stimulated during times of rajasic or tamasic breath patterns?
- What senses are stimulated during times of sattvic breathing?
- How do the senses impact the breath and mind?
- Can you identify which of the kleśas are fanned by the acceleration or arrhythmic quality of the breath (ignorance; ego; attachment; avoidance; fear)?
- How do you breathe when you practice āsana (rajasic, tamasic, or sattvic)?
- Can you practice in a way that is more sattvic? How does that feel different during and after practice? What do you notice?
- Can you apply this same awareness and strategy to exercise? What do you notice?

Take daily notes on this for a week or two, developing a *sat-saṃskāra* (*sat*, pronounced saht, means true or good, beneficial) of consistent observation of the breath and its impact on you.

## TAPAS WITH THE BREATH

---

After you take some time to observe the connections between your natural breath, your mind, and your activities, choose *one* arena to begin to gently initiate restraint. In other words, if you notice when you go for your morning walks that you huff and puff while going up the hill, try slowing down, closing your mouth, and maintaining a more sattvic quality to the breath (light, rhythmic, easeful). Perhaps you notice your breath getting agitated while driving. Develop a practice of breathing lightly while in the car and steadying the flow. Start with one area where you identify a consistent tendency for your breath to be arrhythmic, heavy, or chaotic. Practice transforming just that pattern before attempting to broaden your focus to other areas of your life.

Additionally, when you are practicing āsana and/or prāṇāyāma, breathe as the yogis suggest:

- Through the nose.
- Sattvic (light, easeful).
- Subtle.
- Abdominal-diaphragmatic, maintaining passivity in the muscles of the chest.
- Focus on the external space (reduce it—how close or far your breath reaches with your exhale); and the internal space (expand it); this is an energetic quality of internal spaciousness, as if the breath were permeating the cells of the body, infusing them with prāṇa.
- Begin to develop the pause after inhale/exhale, holding for 2, 4, 6, upward to 10 seconds—and notice your relative comfort level with each.

What do you notice about the ease or challenge of doing this? How does this practice challenge the breath saṃskāras (habitual patterns) you’ve developed through prior practice and study of yoga? What do you notice about your attachment—if any—to the concept of big breathing for health?

Return to your **Svādhyāya Breath Journal** and make notes about what you observed about how shifting the breath impacts the mind, the senses, the grip of the kleśas (afflictions), and your overall self-awareness.

## ĪŚVARAPRAṆIDHĀNA WITH THE BREATH

---

There are numerous ways to raise spiritual awareness. Linking connection to Īśvara with the constancy of the breath enables us to practice anywhere, any time. Mantra (pronounced mahn-trah) is a word or sound repeated to aid concentration in meditation. Here are just a few suggestions for the use of silent *mantra* to build your connection to puruṣa via the breath:

- Silently recite a word or prayer (a mantra) with each exhalation, e.g., Light, Love, Joy, or Peace.
- Use one of the yamas as a focus for the breath, reciting the word silently with the inhale or exhale or both.
- Use the word “sattva” as a reminder to keep the breath steady and calm, and also to remember the illuminative light within you.
- Combine your mantra practice with your tapas practice. An illustration of this based on the examples given above would be: Recite your mantra while walking or driving, in order to directly impact the quality and flow of the breath. How does reciting your mantra affect the experience you have of the breath and mind?

Mantra recitation can be nourished through daily prāṇāyāma (or āsana) practice. Then, the mantra can be brought forward, like a touchstone in times of stress, or when you recognize you are out of alignment with yama or niyama. In fact, this is the intention of mantra, to transcend the ordinary mind and transform the vṛttis.

Once again, return to your **Svādhyāya Breath Journal** and make notes about how the addition of *īśvarapraṇidhāna* has altered your experience.

## CHAPTER SUMMARY

---

- The teachings of yoga and Ayurveda are derived from Sāṃkhya philosophy.
- According to Sāṃkhya, *puruṣa* (the unmanifest) and *prakṛti* (the manifest) are inherent in everything.
- *Prakṛti* is infused with *prāṇa*.
- The three *guṇas*—*rajas* (activity), *tamas* (inertia), and *sattva* (light/harmony)—are constituent qualities of *prakṛti* and manifestations of *prāṇa*.
- Patañjali’s *Yoga Sūtra* encapsulate the teachings of Sāṃkhya.
- *Vṛttis*, the habitual patterns of mind, are viewed as a major source of *duḥkha* by Patañjali.
- The *kleśas* are the afflicted *vṛttis* that directly create *duḥkha*.
- The five *kleśas* are: *avidya* (ignorance), *āśmita* (ego), *raga* (attachment), *dveṣa* (aversion), *abhiniveśa* (fear).
- *Kriya yoga* (the yoga of action) is practiced with the intention to reduce the *kleśas*.
- *Kriya yoga* comprises *tapas* (disciplined effort to transform *saṃskāras*), *svādhyāya* (self-awareness), and *īśvarapraṇidhāna* (devotion, gratitude).
- *Yama* (ethical restraints) and *niyama* (self-discipline) support the restraint of the mind and counter the *kleśas*.
- According to the texts, ordinary breath patterns fuel the *kleśas*.
- *Āsana* can be utilized as a preparatory mechanism for *prāṇāyāma*, both to offer structural support and to provide biochemical balance.
- *Prāṇāyāma* is the fourth of the eight limbs of Patañjali’s *asthanga* (eight-limbed) yoga.
- *Prāṇāyāma* is inherently necessary to achieve a state of deep meditation.
- *Prāṇāyāma* supports knowledge and containment of *prāṇa*.
- *Vīrya*—vitality or health—is cultivated through the containment of *prāṇa*.



## Chapter 2

---

# PRĀṆA, THE SUBTLE BODY, AND THE ENERGY BANK ACCOUNT

*Prāṇa has many levels of meaning, from the physical breath to the energy of consciousness itself. Prāṇa is not only the basic life-force, it is the original creative power. It is the master form of all energy working at every level of our being. Indeed, the entire universe is a manifestation of prāṇa. Even kundalini shakti, the serpent power or inner energy which transforms our consciousness, develops from awakened prāṇa.*<sup>1</sup>

D. Frawley

Throughout my years of yoga study, prāṇa had eluded me. The concept of energy made sense, but the depth and subtlety conveyed in the Vedic teachings felt both more and less than the construct of “energy” as I used it in my everyday vernacular. As I began reducing my breath, making it less perceptible, I began to note the relationship between how I breathed and how I sensed the world around me. The teachings on prāṇa began to take shape inside of me. This shift moved from a mere conceptual understanding, to an inner knowing of connectivity. As my prāṇic rhythm quieted, I felt a more immediate awareness of the subtle flux of cause and effect in the natural world.

André van Lysebeth, in his book *Pranayama: The Energetics of Breath*, describes the permeating quality of prana in this way:

Prāṇa exists in our food, water, sunlight, but it is neither vitamin nor warmth nor ultraviolet rays. Air, water, food, sunlight: all convey the prāṇa on which all animal and vegetable life depends. Prāṇa penetrates the whole body, even where the air cannot be reached. Prāṇa is our true nourishment, for without prāṇa there can be no life.<sup>2</sup>

Over the winter of 2017–2018, I dove into writing this book while on retreat in Costa Rica. I found the natural environment enriched my prāṇa vidya—my blossoming knowledge of prāṇa. From the view of our temporary home, the sky opened into a great expanse across the ocean, inviting in spaciousness as a daily guest. Sometimes still and at other times chaotic, the wind reflected the dance of my breath/mind. Sun and moonlight clocked my circadian rhythms, constant reminders of the eternal, internal light of puruṣa.

We were marooned, two hours of potholes away from anything that could be considered a real town. This gave me pause before venturing out. I quickly realized I already had everything I needed: fresh fish, a cornucopia of tropical fruit and vegetables, miles of trails to walk, and quarries of silence, interrupted only by the howler monkeys' call. The simplicity of life in the jungle conjured a connection to our roots as human beings. There, they call it Pura Vida—Pure Living—a world that existed before “man-made” defined us.

Back in my “real” life, I’d be ricocheting between people to see and places to go, meeting each demand with a sense of urgency. Bundled up in layers, I’d ward off the elements rather than invite them in, as if the drizzling sky and cold-damp were enemies to fight against. The contrast between my life back home and Pura Vida illuminated the clutter and commotion of my everyday world back home. It fostered within me an appreciation for the untangled rawness of nature and the joy of fewer options.

## **Prāṇāyāma Then and Now**

I imagine the ancient yogis lived a simple life. The air they breathed, the water they drank, the soil from which they harvested their food—all were nutrient rich and unpolluted. They spent their days either physically active, securing necessities, or steeped in intensive practice. Social discourse, if any, was likely allocated only for the transmission of the teachings. The Vedas articulate a comprehensive knowledge of the cycles of nature and the spiritual domain, conveying that the authors had an intimate relationship with the world at large, seen and unseen. Thus, their starting place for the development of the practices of prāṇāyāma were based on their experience of living a prāṇa-rich life and building on that foundation.

We’re living in very different times on the prāṇic spectrum. The air, water, and soil are of questionable purity. Our food sources are weak in nutrients relative to times past. Today’s grocery stores offer processed foods full of chemicals that are actually toxic to our system. How much prāṇa is in a cupcake with a shelf life of 45 days?! Our options for consumption are now so vast yet, due to chemical-focused modern farming practices, basic nutrient profiles of common foods may be shifting to the point where some claim that poultry has gone from being a health food to a junk food. The more toxicity that exists in the body–mind, the less space for prāṇa to enter and circulate. The yogis claimed disease is caused by prāṇic leaks. The saying is that there is more prāṇa spilling out of our bodies than sustained inside.

Our cushy Western lifestyle further depletes our reserves. Too much of our time between waking and sleeping comprises sitting in an office or a car, or on a couch. We spend hours staring into screens, communicating with faceless souls whom we’ve never met. Back in the day—when our feet provided our transportation—we had to walk down the lane to chat with our neighbor, or venture to market to sell our wares and catch up on the latest news.

The low quality and over-quantity of what we consume, combined with our lack of physical activity, are sapping our vitality or vīrya, rendering us vulnerable to illness. As we discuss how to approach prāṇāyāma for the modern age, we need to maintain awareness of the context of our world today from the perspective of prāṇa. Attempting to carte blanche transfer the powerful tools of prāṇāyāma out of the balanced world of the ancient yogis, into our chaotic Western miasma, has led to misapprehension and potential health risks for practitioners.

Prāṇāyāma needs to be understood as the means to cultivate a healthy prāṇic reservoir for the vessel we call the body. Therefore, to restore our prāṇa, practice must be adapted or titrated appropriately, according to the practitioner’s starting point. This includes not just the individual’s current state of body, mind, and lifestyle choices, but also the culture and

environment in which that person is living—whether that is Beijing, the Andes mountains, or a farm in the Midwest USA.

*At the material level one also receives prāṇa from the environment, food, water, sun and air. All the elements are comprised of prāṇa. So, the quantum of prāṇa within each individual is influenced by the quality of the elements to which one is exposed and which one ingests in the course of everyday life.*<sup>3</sup>

## **Prāṇa and the Prāṇamaya Kosha**

When we talk about prāṇāyāma, we are speaking about much more than breathing. At its essence, the practice of prāṇāyāma sensitizes us, increasing our capacity to develop a tangible relationship with prāṇa. The practice of attuning our breath requires the attention of the mind, and attendance to the subtle movement of prāṇa within us, as well as all around us. The quality of prāṇa in the people we commune with evokes responses in us, leaves impressions, and shapes our inner motivations. Likewise, our unconscious and conscious thoughts, emotions, and actions move our prāṇa out into the world. This reciprocity is a constant, reflective of the intake and output of every breath.

The practice of prāṇāyāma elevates awareness of how we live in our subtle body. This specifically references the body associated with the internal systems which govern physiological functioning and the mind. In the Vedic teachings this is known as the prāṇamaya, the physiological or energy dimension. Through prāṇāyāma, we develop the capacity to alter the functioning of the prāṇamaya. We learn to control the subtle body and direct attention, mastering the alchemy of prāṇa from within.

## **Sāṃkhya and the Elements**

As we explore the world of prāṇa and prakṛti (the manifest world), Sāṃkhya philosophy provides further delineation from the gross level of the guṇas into the elements: earth, water, fire, air, and ether. Each of the elements embodies variant quantities of the guṇas: activity, inertia, and light. This elemental paradigm offers a more refined expression of prāṇa and gives us another way of connecting with the energies that flow through us and around us. Our common vernacular already ascribes elemental attributes to ourselves or others. One person may be portrayed as salt of the earth, another fiery in nature, and yet another may be known as a space cadet. [Figure 2.1](#) depicts the guṇas, the elements, and the doshas in relationship to one another.

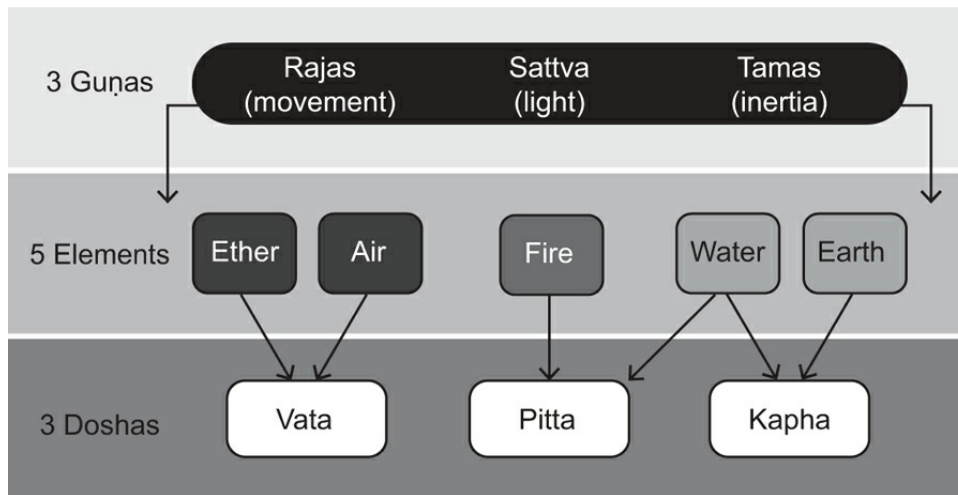


Figure 2.1 The Guṇas, the Elements, and the Doshas

Like yoga, Ayurveda is fundamentally based in the teachings of Sāṃkhya. From the five elements, three Ayurvedic *doshas* (pronounced doe-shahs) are formulated: *vata* (vah-tah), *pitta* (pit-tah), and *kapha* (kah-pha). An individual’s constitution or *prakṛti* (inherent nature) is determined from birth and made up of a balance of the elements ascribed to the three doshas. For someone whose *prakṛti* is *vata*, this would constitute a preponderance of ether and air. *Pitta* dosha is associated with fire and water. *Kapha* dosha relates to water and earth. We all have all five elements and thus each of the doshas is represented within us, to a greater or lesser degree. Our elemental or *prāṇic* uniqueness is reflected through the proportionate relationship of these elements with one another. While the doshas may be viewed as personality traits, these characteristics are more accurately understood to be the most prevalent way in which *prāṇa* manifests in a particular individual.

Our interactions with the world affect our *prāṇa*, and more often than not we find ourselves out of balance with our *prakṛti*. *Dosha* literally means fault or disease in Sanskrit. The term “*vikṛti*” (pronounced vik-ri-tee) is used to indicate the current status of our *prāṇa*, as it reflects our vulnerability to disease. For example, a person may constitutionally be a *vata-pitta*—someone who is active and peppy by nature. However, in the throes of a bad cold that overwhelms the body with damp and heavy mucus (an aspect of *kapha* dosha), she may feel lethargic and experience sluggish digestion with a foggy head. These are symptoms of a *kapha* imbalance. Her *prakṛti* will remain *vata-pitta*, but her *vikṛti* reflects the need for a *kapha*-reducing protocol in order to return her to health. While our *prakṛti* never changes, our *vikṛti* is in constant flux. The tools of yoga and Ayurveda are designed to stabilize us over time so we become less susceptible to shifts in our *vikṛti*.

Through the breath we have direct access to the *prāṇamaya* and can fine-tune the play of the elements by dialing up or down the volume of the wind that blows through us. The breath itself is inherently *rajasic* (active) in nature, an aspect of *vata* dosha (air + ether). The yogis considered *vata* the “king” of the doshas, a kind of “ringleader,” because its movement can push *pitta* (fire) and *kapha* (earth + water) out of balance.

Like a gentle breeze keeps the air around us fresh, we need a certain amount of flow or movement within us to ensure good circulation and avert stagnation in our system. However, too much wind creates agitation that can strip us of the very nutrients we need to thrive. Hurricanes and tornados are recognized as some of the most destructive forces in the world. *Prāṇāyāma*, because of its direct impact on our physiology through the control of *vata* dosha, is said to provide us with *ṛkshana* (pronounced rik-shaw-na), which means protection.

As we examine the world of *prāṇamaya* and its therapeutic applications, it is valuable to understand the concept of the doshas, and the elemental energies that drive imbalance from the Vedic perspective. We'll return to the discussion of the elements as we explore the *chakras* (pronounced chah-krahs, energy centers) and the specific *prāṇāyāma* techniques that correlate with them in [Chapter 9](#).

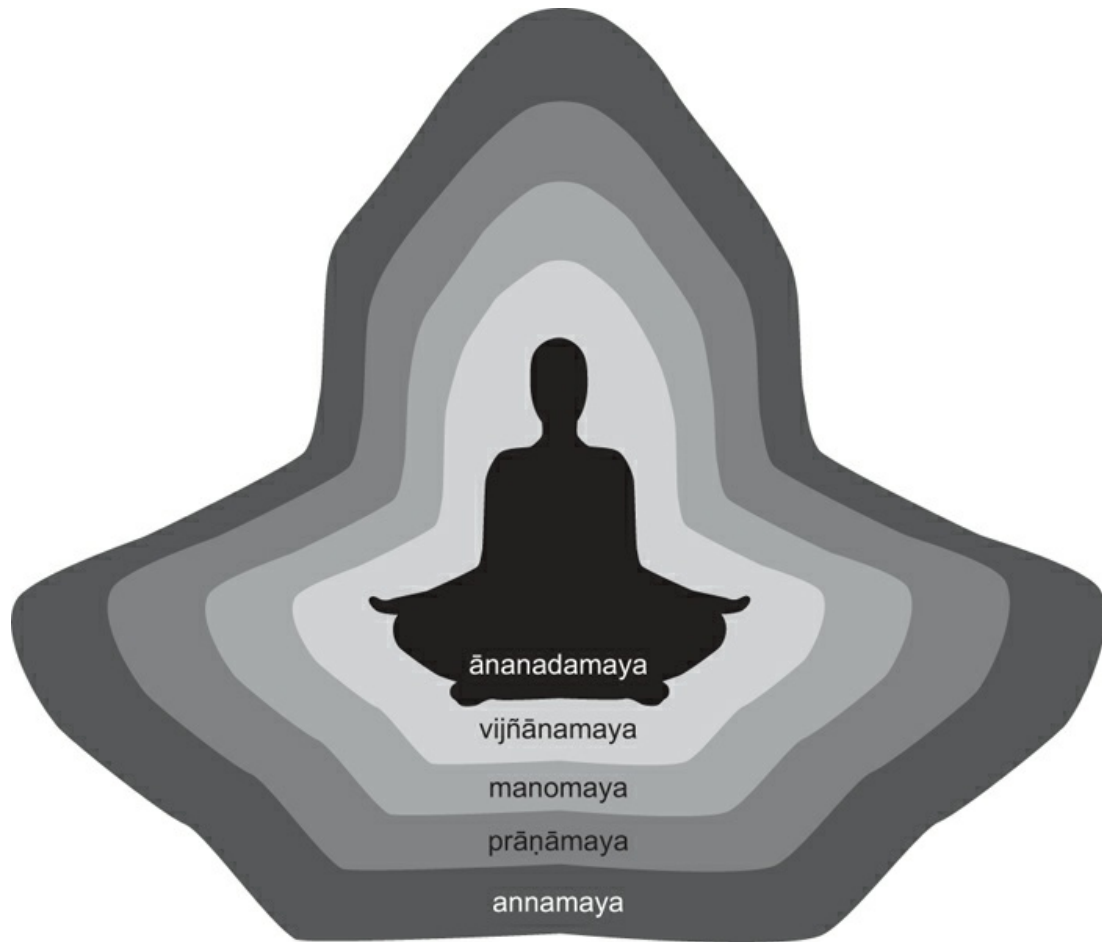
## The Panchamaya

To understand how *prāṇāyāma* works, we have to have some understanding of the *prāṇamaya*. The *prāṇamaya* is one of five *panchamaya* (also known as the *koshas* in some lineages), or dimensions of *prakṛti*. The teaching of the *panchamaya* (pronounced pawn-chamai-yah) comes directly from the Vedas and Upanishads. *Pancha* means five. *Maya*, depending on the teacher or the text, has been translated as illusory or pervasive dimension. It has been described as that which divides what is indivisible or measures what is immeasurable. “Illusory” refers to the impermanent, changeable nature of *prakṛti*. The *mayas* are interpenetrating, constantly informing the narrative of who we claim ourselves to be. Each dimension of the *panchamaya* is then considered an individual facet, and collectively they reflect the gem of our humanity. The five *panchamaya* are:

- *Annamaya* (pronounced ahn-nah-mai-yah): The food or physical dimension; considered the musculoskeletal dimension, it is composed of the five elements: earth, water, air, fire, ether.
- *Prāṇamaya* (pronounced prawn-ah-mai-yah): The *prāṇic* or vital dimension that houses the subtle body. The *prāṇamaya* is intimately related to the breath, physiological function, and health. It is made up of the five winds or *vāyus* (pronounced vai-yoos), which will be discussed in detail later in this chapter.
- *Manomaya* (pronounced mah-no-mai-yah): The dimension of the mind and the senses. The *manomaya* knows the world through comparison and relativity; one thing is bigger, hotter, better than another. The five senses and the mind together provide internal and external information that impact our perception of the world and sustain us in dualistic thinking.
- *Vijñānamaya* (pronounced vig-nah-na-mai-yah): The dimension of wisdom; the root “*jñā*” refers to inner knowledge. *Vijñānamaya* is a deeper level of mind than *manomaya*. It is linked to our subconscious beliefs, cultural attitudes, and patterns which have been transmitted generationally. *Vijñānamaya* also provides the seat of creativity, original thought, and the wisdom of discernment.
- *Ānandamaya* (pronounced aw-nahn-dah-mai-yah): The spiritual heart of our being. The word “*ānanda*” refers to the inherent quality of expansiveness within us. This is the joy of connection, of belonging, of devotion and open-hearted love. At the level of *ānandamaya*, the mind is able to move beyond duality and rejoin, relink with *puruṣa*, the Divine.

Often the *panchamaya* are represented as layered circles, stacked inside one another like nesting dolls, from the *annamaya* on the outside to the *ānandamaya* in the center (see [Figure 2.2](#)). This image creates an optical illusion in that it implies a separation between these dimensions, as if the body, breath, mind, heart, and spirit weren't interconnected. I prefer to superimpose them upon one another as a composite of overlapping, translucent circles, much

like a Venn diagram (see [Figure 2.3](#)). Since the prāṇamaya is the primary focus of this book, I've placed it in the center, so you can get a visual sense of how it pervades all the other dimensions.



*Figure 2.2 The Panchamaya*

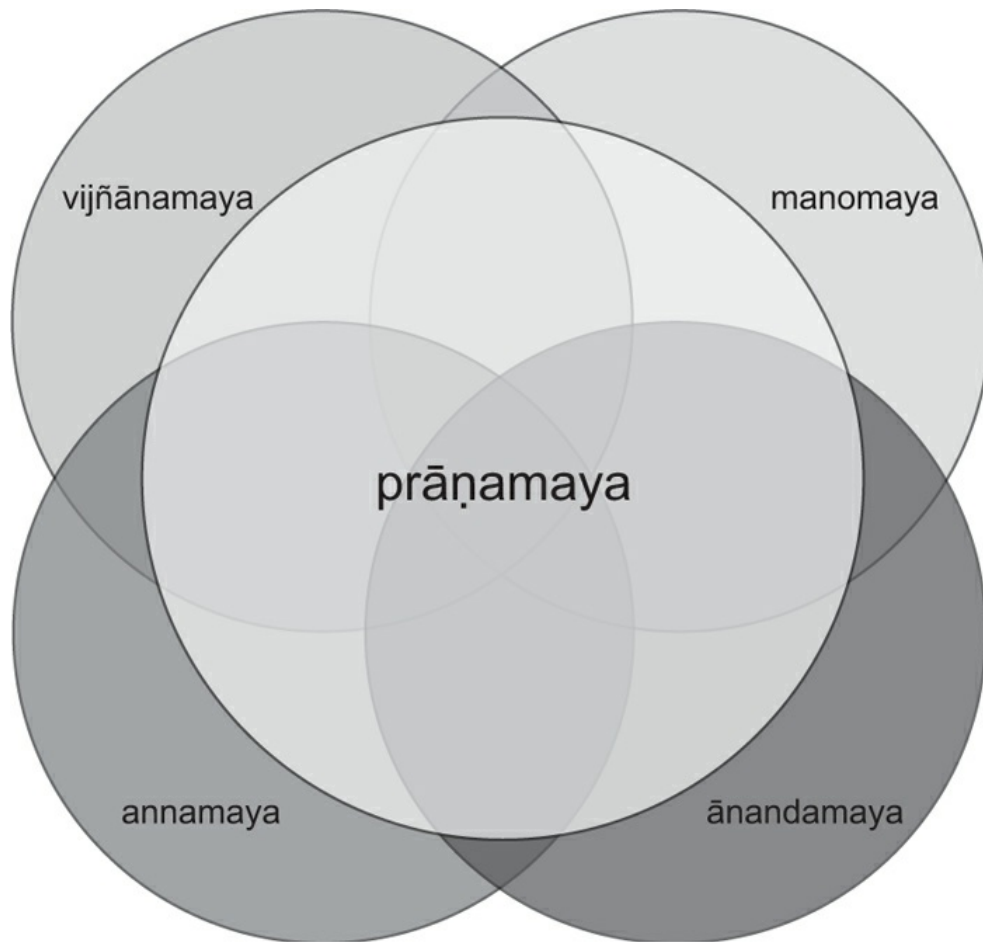


Figure 2.3 The Panchamayas through Prāṇamaya

## Prāṇamaya—The Five Prāṇas or Pancha Vāyus

To delve more deeply into the prāṇamaya and prāṇāyāma, we need to explore the five individual prāṇas within this domain. They are most commonly referenced as the *pancha vāyus* (pronounced pawn-cha vai-yoos, five winds) that move energy through us. According to Ayurveda, the improper function of the vāyus is the generative source of most imbalances and disease processes. Even when symptoms seem to arise from the other koshas, stabilization in the vāyus is a critical part of the treatment protocol. For instance, in the case of anxiety or depression, which could be viewed as a condition of manomaya (mental dimension), prāṇāyāma would be used as a primary tool to balance the mind.

*When all the prāṇas are balanced, the body and mind are in a state of optimized harmony. However, this is not usually the case. Due to overuse and misuse, the prāṇa of most people are in a state of imbalance... This in turn causes fatigue, depression, inefficient digestion and circulation. As this vicious cycle continues, the body does not have the strength to walk, work or think and the smallest disturbance causes nervousness and anxiety... The first objective of prāṇāyāma, is to charge and replenish the prāṇas through practice.*<sup>4</sup>

While there are many esoteric teachings and texts on the pancha vāyus, the orientation offered here is based on the teachings from the Krishnamacharya lineage, and heavily influenced by David Frawley’s powerful article, “The secrets of prana.”<sup>5</sup>

The pancha vāyus are: *prāṇavāyu*, *apānavāyu*, *samānavāyu*, *vyānavāyu*, and *udānavāyu* (Figure 2.4 illustrates the pancha vāyus and their directional flow of movement). Thinking of them as winds helps to correlate them with the breath, with the elements of air and space, and the Ayurvedic dosha of vata. Like the wind, they are rajasic (active) and subtle, and they are pervasive, like space. They move us and move through us in unseen yet palpable ways. Each vāyu governs a particular aspect of what we might think of as our physiology and awareness.

*Relative to our physical existence, prāṇa or vital energy is a modification of the air element, deriving primarily from the oxygen we breathe. On a subtle level, the air element corresponds to the sense of touch; through touch we feel alive and are able to transmit our life-force to others.*<sup>6</sup>

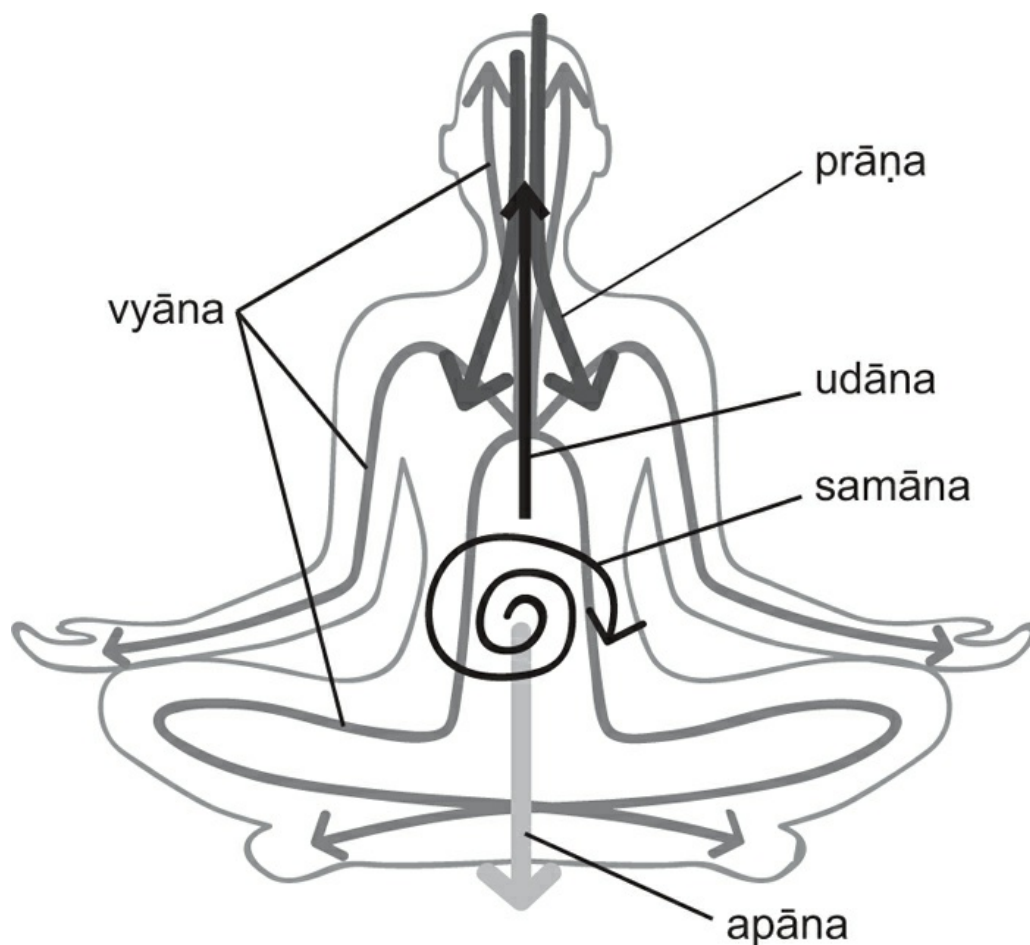


Figure 2.4 The Pancha Vāyus

The five Pancha Vāyus are:

- *Prāṇa* (pronounced prawn-ah): Incoming energy via the senses; movement is down and in. Governs everything we take in, including air, water, food, sights, sounds, taste, smells, touch, information, ideas, and experiences. Breath: Directs inhalation, the taking in of oxygen.
- *Apāna* (ah-pawn-ah): Outgoing energy in the way of waste, negativity; movement is down and out. Governs defecation, urination, perspiration, menstruation, ejaculation, and even the process of birth. It also governs the release of negative emotions, sensory



experiences, and thoughts. Breath: Directs exhalation in terms of the release of excess CO<sub>2</sub>.

- *Samāna* (sah-maw-nah): Energy of digestion; centered in belly, the seat of *agni* (pronounced ahg-nee, digestive fire). Governs digestion of nutrients, thoughts, emotions, ideas, spiritual experience. Breath: Supports perfusion in the lungs, greater absorption of O<sub>2</sub> into the bloodstream. Correlates with retention of breath after inhale (*antar kumbhāka*—pronounced ahn-tar koom-bah-kah).
- *Vyāna* (vee-yawn-ah): Energy of assimilation/absorption; movement is outward from *samānavayu* into the body. Governs circulation via the blood and plasma, neurotransmission; endocrine secretions. Breath: Supports cellular respiration via the dispersion of O<sub>2</sub> through the bloodstream into the tissues; metabolism; and production of CO<sub>2</sub>. Correlates with suspension of breath after exhale (*bāhya kumbhāka*—pronounced buy-yah koom-bah-kah).
- *Udāna* (oo-dawn-ah): Energy of upliftment, transformation, and growth, physical as well as spiritual. Upward and forward-moving wind. Governs growth, the ability to stand, speak, step forward, the expression of enthusiasm, positivity, singing, laughter, vomiting, belching, coughing. Breath: Directs the movement of exhalation.

We can easily illustrate the current of the *vāyus* (winds) through the *prāṇamaya* (energy dimension) using two very different types of dining experiences: a traditional Thanksgiving meal complete with three slices of pie or, in contrast, a kale salad garnished with tempeh or grilled salmon with a piece of fruit for dessert.

The choice of consumption itself is considered part of *prāṇavayu* or the process of ingestion. Conscious or unconscious, everything we take in and how we take it in is governed by *prāṇavayu*. To break down the nutrients and waste for each of these menu choices taxes discrete levels of digestive energy—*samānavayu*. *Samāna* affects the rate and movement through the digestive tract. Absorption and circulation of the nutrients by our tissues is governed by *vyānavayu*. Clearly, the quality of what we take in and how well the food is digested will affect the nourishment of our cells. Even the quality and quantity of our waste elimination, the sovereignty of *apānavayu*, will be a distinct reflection of the intake and digestive processes. *Udānavayu* will be apparent through the level of vibrancy or lethargy we experience post-digestively.

Most of us can relate to the aftermath of having over-consumed, as with the Thanksgiving meal: the tryptophan-trance of over-indulgence, the digestive irregularities that often follow. In the same way, a more health-conscious, well-apportioned meal (like the kale salad with salmon) engenders a feeling of satiation without bloat. It tends to leave us feeling energized and the digestive channels flow with ease. Food, however, is just one of many types of *prāṇa* that we ingest. The *vāyus* are calibrating *all* that we take in, digest, assimilate, and eliminate. Frawley emphasizes that the key to health is to “keep our *prāṇas* working in harmony.”<sup>7</sup> The consequence of imbalance in one *vāyu* will be apparent in all the others, as they are necessarily interdependent. Lysbeth differentiates between health and disease with this bold contrast: “The healthy body can be compared to a mountain lake continuously fed with fresh water which runs out at the same rate through a stream, whereas a sickly body is like a bog where the water stagnates and becomes foul.”<sup>8</sup>

## The Pancha Vāyus and the Breath

Just as with the earth's atmosphere, fluctuations in oxygen and carbon dioxide levels in our bodies can have devastating consequences. In our body, the proper balance between these two formative gases must also be maintained at appropriate levels to sustain our health. The breath is the primary driver of the chemical reactions that maintain the vāyus (winds) in homeostasis, or balance. The quality, quantity, and rate that we breathe in and out have a significant impact on how we ultimately feel. Respiration actively regulates our ability to digest, assimilate, and eliminate. It is a critical part of udāna, and what comes up and out of us.

Inherent in the teachings of prāṇāyāma is the recognition that there is actually such a thing as too much breath. Just as there can be too much food or too much of anything else, too much breath can be burdensome for our system. If we gulp air in with big gasps, it's as if every day is a Thanksgiving feast. We're, in essence, consuming 5000 calories of air when 2000 is sufficient. Likewise, if we are constantly talking, sighing, yawning, coughing, and snoring, it's as if we had a case of the "runs," depleting our reserves of carbon dioxide. Remember, we need the appropriate balance of O<sub>2</sub> and CO<sub>2</sub> in order to maintain homeostasis. Breathing lightly in and out nourishes us without taxing our system, and maintains our gas equilibrium in healthy parameters. (These ideas will be detailed in [Chapters 3 and 4](#).) The practice of prāṇāyāma evolved out of this keen recognition, which is why the yogis cautioned us to retain prāṇa and emphasized kumbhākas (breath retention and suspension), which provide periods of rest and recalibration between breaths.

In the truest sense, prāṇāyāma is akin to going on an "air diet." This is what is required for many of us to get our prāṇamaya (energy dimension) back to homeostasis. The functioning of the pancha vāyus (the five winds) depends on good oxygenation of the tissues. As we explore the effect of over-breathing, in the upcoming chapters on physiology, we'll see that proper oxygenation does not come from front-loading the system with an onslaught of air. The secret of vīrya (vitality) lies in our capacity to utilize oxygen to the max—and that requires balance throughout the prāṇamaya.

***brahmacharya-pratiṣṭhāyām vīryalābhaḥ***

*When one is firmly established in conservation of energy/prāṇa, vitality is obtained.*

Patañjali's Yoga Sūtra 2:38

## Energy versus Prāṇa

One of the difficulties I've encountered in discussing the pancha vāyus (five winds) among students and clients has to do with the interpretation of the word "energy" itself. In English, the word "energy" is used to correlate with the feeling of being tired or wired; grumpy or happy; full of good or bad vibes. It can also be used euphemistically when we actually don't really know how to define a particular sensation or experience. This makes translating prāṇa as "energy" problematic. "Energy" lacks both the subtlety and clarity that is signified by the term "prāṇa" in the yoga texts.

The yogis were actually quite precise in their language regarding the flow of prāṇa through the pancha vāyus. I find this model informative and more useful in understanding imbalances. It gives me a more explicit means to hone therapeutic protocols, rather than considering "energy" in a nondescript manner that leaves room for misinterpretation. That

said, “energy” is the closest English word we have to indicate the movement of prāṇa. I therefore use the word “energy” with a reverent nod to the vāyus (winds of prāṇa).

## **Prāṇic Accounting: Assessing Your Energy Bank Account**

When I teach students about the prāṇamaya and the vāyus, I often speak in terms of balancing an Energy Bank Account (EBA). To assess the health of your EBA, begin by creating a metaphorical (or actual!) spreadsheet and do some prāṇic accounting. Through this process, the source of particular reoccurring symptoms may become acutely apparent.

### ***Prāṇavayu in Your Life***

The first consideration is prāṇavayu. What do you “take in” during the course of a day, a week, a month, a year? This includes movies, the multitude of events, classes, discussions with friends, arguments with family, music, traffic, smells, physical embrace, exercise, and the news-feed... Of course, what you eat and drink is a major consideration as well. How much, how often, and what quality is the sum total of your prāṇavayu?

Sometimes the issue with intake isn’t so much the lack of quality; it’s the sheer quantity, the drive for more. Consider how many stacks of partially read books sit on your night-stand right now, just waiting for you to have either the time or the energy to open them. Consider how often you’ve heard an inspiring podcast or attended an awesome workshop and found yourself downloading the next one, before you’ve even distilled the first. Even on the level of “spiritual consumption,” a sense of insufficiency can drive us to constantly look outside ourselves and perpetuate the imbalance and depletion of our prāṇa.

### ***Samānavayu in Your Life***

The word “agni” (digestive fire) shares its roots with the word “ignite.” Samānavayu is the seat of the flame that ignites our ability to digest not just food, but all that we take in. It discerns between what is nourishing and what is waste to be disposed of through apānavayu. A primary source of health challenges (demonstrated by the number of advertisements for digestive support), samānavāyu is often ignored until we’re suffering. We are a “reflux culture,” shoveling one thing in after another, giving very little time to actually chew, swallow, and digest.

This goes beyond fast-food mania. It is evident in how we schedule our time, rushing to teach the next yoga class on the other side of town while choking down our green smoothie en route. The classic teaching from Ayurveda states that our health depends on the agni burning just right. As with any steady flame, the requisite balance between fuel, oxygen, and space determines whether the coals stay ignited and burn sustainably. This central concept is applicable to our discussion of the impact of breathing on our physiological (and mental) digestive health.

### ***Apānavayu in Your Life***

As we turn to apānavayu, the energy of elimination, we need to consider how frequently, completely and easily we eliminate waste. In Ayurveda, issues of constipation, diarrhea, menstrual difficulties, and erectile dysfunction are considered to be conditions of excess or depletion related to apānavayu. However, apāna is not exclusive to the movement of physical

waste. There are also stores of negative emotions and thoughts (vṛttis perpetuated by the kleśas [afflictions]) that need to be processed, along with the narratives that drive them. How many more times will we ruminate about the college professor that didn't give us the A on the test, and feel a resurgence of righteous anger?

The baggage of the past comes with us, unless we have the inner resources to know how to off-load it. The yogis believed this *ama* (pronounced ah-ma, waste) was toxic to our system, whether it took the form of undigested food particles or undigested experience. Like our garbage cans at the end of the week, by the time we reach our middle years, we may be overflowing with ama. If we don't find the means to purify ourselves of it, our system gets fundamentally clogged and we end up recycling ama throughout the prāṇamaya via vyānavayu.

### ***Vyānavayu in Your Life***

Vyānavayu governs the internal transport processes. This refers to anything that moves through our system via blood, lymph, or plasma. Vyānavayu is the medium, the wind that carries nutrients to the tissues and back out again. Health conditions of the circulatory system, the nervous system, immune and endocrine systems reflect imbalance on the level of vyānavayu.

In the Vedic lore, what we circulate through our mind as well as our body becomes part of our cellular structure. Allowing space to rest, before gobbling in the next experience or breath, supports the functioning of vyānavayu. Like the pulse of the heart that beats and then rests rhythmically, we need to insert resting pauses in our life. This is critical in order to fully utilize what we've taken in—not just between bites, but after the meal. Rushing forward to the next event, job, or relationship can put us into a kind of emotional atrial fibrillation, as if caught up in a chaotic rhythm that overrides our natural flow. The yogis' use of kumbhāka (suspension and retention of breath) provides the body and mind with a period of rest before the next incoming breath. That sanctuary of stillness allows the prāṇic system to reset, refuel, and restore.

### ***Udānavayu in Your Life***

In Frawley's article, he speaks of udāna vāyu, the forward and upward-moving energy, almost as a reflection of healthy function of the other vāyus.<sup>9</sup> Udāna governs speech, growth, motivation, spiritual seeking, and positive thinking. It also governs vomiting. Whatever comes up and out of us in the way we express ourselves and our ability to move forward (or not) in our life says much about the state of our udāna.

In a big-picture way, you can assess the relative health and balance of your prāṇamaya via your udāna. A well-functioning prāṇamaya is reflective of the ability to digest well, sleep well and wake up each day rested and content with sustainable vitality and a clear mind. If this is the case, you're in good shape. However, if you're consistently dragging yourself to the coffee shop for a venti to prevent falling asleep over afternoon reports while sucking on antacids to debloat and then knocking back a few glasses of wine in order to sleep...all the while grumbling about the stress of life...it may be time to do some serious prāṇic accounting.

## **The Antarāyāh—The Obstacles Along the Way**

The yoga masters recognized our vast capacity for self-delusion, and so they offered us multiple lenses through which we can observe our mind and our life habits, to become more self-aware. The antarāyāh (pronounced ahn-tar-ai-yah) offer another way to consider the level of function of our prāṇamaya. Known as the obstacles to practice, they exemplify the day-to-day manifestations of the kleśas (afflictions). If we pay attention, they can reveal when we are stuck in “duḥkhaville” (state of suffering). The antarāyāh impede our capacity to attain the calm, present state of yoga. They depict common ways we habitually leak or clog our prāṇic vessel, thereby creating toxicity and malaise. The antarāyāh are listed in Patañjali’s Yoga Sūtra, and the signs of the antarāyāh are expressly named as an agitated mind and agitated breath.

***vyādhi-styāna-saṁśaya-pramāda-ālasya-avirati-bhrāntidarśana-  
alabdhabhūmikatva-anavasthitatvāni-cittavikṣepāḥ-te-antarāyāḥ***

Patañjali’s Yoga Sūtra 1:30

The nine obstacles according to Patañjali’s Yoga Sūtra 1:30 are:

- *vyādhi* (pronounced vi-yah-dee): disease, illness, sickness
- *styāna* (stee-yawn-ah): inefficiency, mental dullness
- *saṁśāya* (sum-shy-ah): indecision, doubt, skepticism
- *pramāda* (prah-maw-da): carelessness, negligence, lack of interest
- *ālasaya* (aw-lahs-yah): sloth, laziness
- *avirati* (ah-vir-ah-tee): sensuality, craving
- *bhrānti darśana* (brawn-tee dar-sha-nah): false or distorted perception
- *alabdhabhūmikatva* (ah-lob-da-boom-ee-cot-vah): failing to meet the goals of practice
- *anavasthitatvāni* (ah-nah-vahs-teet-aht-vawn-ee): inability to maintain inner stability once attained.

Overlaying the obstacles on the five vāyus (winds) one can make direct lines of connection between imbalance on the level of the prāṇamaya (energy dimension) and the resulting antarāyāh (obstacles). For instance, drinking pitchers of margaritas will likely lead to a feeling of ālasya (pronounced aw-lahs-yah, sloth) the next day. We needn’t look further than current events to recognize how distorted self-perceptions are fed by the friends we keep, the news we tune into, the social media posts we read. The symbiotic relationship between prāṇa (vitality) and citta (mind) is a consistent theme in all of the Vedic teachings. In fact, Sūtra 1:31 specifically states that pain, depression, nervousness, and hard breathing are the symptoms of the antarāyāh (obstacles). Baba Hari Dass describes hard breathing as “Irregular and spasmodic; gasping, sighing, and long inhale or exhale.”<sup>10</sup>

The yogis utilized the quality of the breath to “diagnose” the state of health in the body and the mind, interweaving the panchamaya (the five dimensions) naturally. In our medical world of specialization, many people suffering from “prāṇic imbalances” may be sent to three or four specialists, each of whom examine them from their insulated perspective. The cardiologist may address heart palpitations, the gastro-intestinal doc may put them through a barium swallow, while the psychiatrist discusses medications for treating depression resulting from a recent divorce. This is not to say that Western medicine doesn’t offer beneficial tools

to address disease. However, the derivation of the word “health” is the same as “whole” and “holy.” The yogis’ teaching of the panchamaya as one interconnected system provides a refreshing paradigm. Health from this perspective is considered in terms of what makes us whole, including the merging of our humanity with our divinity.

So much about an individual’s state of health can be gleaned by how they breathe. With regard to my personal health history, I chased down answers from a variety of practitioners for years, attempting to address the reoccurrence of vyādhi (sickness) in my life, without resolution. Each one provided remedies, which addressed the symptoms, however all of us were ignorant of the underlying cause. It is clear to me now that a life-long pattern of over-breathing was driving my illness. The rajasic (agitated) quality of the breath itself zapped me of prāṇa, creating a major imbalance in my vāyus (winds). This produced the myriad of symptoms that I experienced. It wasn’t until I gained more vidya (knowledge) of the breath that I could see how consistent “hard breathing” contributed to, and was symbolic of my illness.

The gravity of this reveals why the yoga texts emphasize prāṇāyāma and breath as the gateway to both health and the state of samādhi (meditative absorption). If we hold this as a truth, then prāṇāyāma becomes not just a means to calm us down for the moment, but also a critical tool to transform our psychophysiology, and bring us back into prāṇic balance. In the next two chapters, we’ll explore respiratory physiology and breathing pattern disorders to understand the mechanisms that drive this process from a Western scientific perspective.

## KEY CONCEPTS

---

- Prāṇāyāma (breath restraint/control) is the primary tool from yoga given to balance our prāṇa.
- Prāṇāyāma practices need to be adapted and titrated appropriately according to environmental, cultural, and individual circumstance.
- Breath was used as a diagnostic tool by the yogis, as improper breathing was commensurate with health concerns and mental instability.
- Before embarking on a prāṇāyāma practice, it is helpful to assess your EBA and to monitor it over time.

## — PUTTING IT INTO PRACTICE —

### **Monitoring Your Energy Bank Account**

Becoming aware of your prāṇamaya (energy dimension) and the various aspects of the pancha vāyus (five winds) is a critical piece of prāṇāyāma practice. It is worthwhile to take an inventory of how your lifestyle choices impact your prāṇa before manipulating the breath in any significant way.

I suggest you systematically go through the following questions and add your reflections to your **Svādhyāya Breath Journal**. As you more formally begin to work with prāṇāyāma, you may find it useful to revisit these questions, as a means of gauging how your breath practice is supporting you in health. I require all of my yoga therapy trainees to go through this process, as well as many of my therapeutic clients, particularly those with auto-immune conditions. All have found it to be revelatory.

For instance, through contemplation of their EBA, many of my chronic fatigue clients have come to recognize that they don't allow themselves time for digestion and assimilation, time to pause to refuel. They begin to connect the dots of cause and effect between a life-long habit (saṃskāra) of driving themselves to do (rajas), and ending up in bed, exhausted (tamas). Their healing accelerates as they learn to pace each day, and live more sattvically—in balance/harmony. This means allowing time to rest, digest, and recover before the next errand or social event. It may also require saying “No,” to simplify their life, in order to shift their health in a positive direction.

Consider the reflective questions below in measurements of a typical day, week, or month. It may even be useful to break this down into smaller increments, like in the course of a morning or an hour.

- What do you take in? (Consider all the senses and the mind.)
- How much do you take in?
- What is the quality of what you take in?
- At what pace do you schedule your life?
- Do you leave time for quiet and stillness between experiences in order to digest fully, or do you race forward to fill your time with something new?
- How much of what you take in do you really assimilate and make your own?
- Do you tend to regurgitate others' experiences before knowing it directly as a personal truth?
- What are you able to let go of, and what do you cling to? (Think in terms of ideas, beliefs, relationships, even spiritual aspirations.)
- How do your beliefs limit you or propel you towards growth?
- How much time do you spend nurturing your sense of joy, spirit, soul?
- When you speak, what do you choose to talk about? Do your words elevate the conversation, criticize, or simply take up space?
- What's the nature of your vṛttis, as you examine the inner dialogue you keep with yourself? Do the vṛttis accumulate around a particular set of topics? Are they rajasic, tamasic, or sattvic in nature?

Once you've gone through these prāṇamaya questions, go back through the kriya yoga (yoga of action) entries in your **Svādhyāya Breath Journal**. What can you observe about the interweave of your breath, your mind, the vāyus (winds), and your lifestyle choices?

## CHAPTER SUMMARY

---

- Prāṇāyāma is a means to elevate awareness and direct attention, in order to master the flow of prāṇa.
- The ancient yogis lived in a prāṇically rich and prāṇically balanced environment, relative to how we live today.
- The guṇas form the elements: earth, water, fire, air, and space.
- The elements combine to form the Ayurvedic doshas: vata, pitta, kapha.

- Elemental or doshic balance designates health, both within us and on a more global, planetary level.
- Imbalance in the doshas indicates a sign of prāṇic imbalance or instability.
- The panchamaya are the five dimensions of prakṛti: annamaya (physical), prāṇāyāma (the subtle or vital), manomaya (the sensory mind), vijñānamaya (the seat of inner knowledge), ānandamaya (the expansive mind, beyond duality). They are interpenetrating, meaning they inform one another.
- The prāṇamaya is made of the pancha vāyus or five winds: prāṇavayu, apānavayu, samānavayu, vyānavayu, udānavayu. Each vāyu (wind) correlates to a specific aspect of physiology and mental construct.
- The pancha vāyus (five winds) are impacted by environmental factors, lifestyle choices, and proper breathing.
- The Energy Bank Account provides a way of mapping our own personal prāṇavayu health status.
- The nine antarāyāh (obstacles) reflect common ways in which prāṇavayu imbalance may be displayed.
- Chaotic or “hard breathing” is symptomatic of the antarāyāh.



## Chapter 3

---

# THE BIOCHEMISTRY OF RESPIRATION

In my own case, it was definitely a prāṇic crisis that sent me down the rabbit hole of breath retraining, and the deep exploration of prāṇāyāma. The immediate impetus was the “flu from hell” that I couldn’t seem to shake. Truth be told, I had been prāṇically deficient all of my life.

My memories from childhood center around illness. At age four, I had adenoid surgery, followed by double pneumonia. I slept with a humidifier nightly to ward off the chronic ear and throat infections that disrupted my sleep. I was so frequently dosed with antibiotics that to this day, I can distinctly recall the flavors of cherry tetracycline and the horrid orange penicillin that were regularly spooned down my throat. My morning ritual began with my father, an oral pathologist, checking my throat glands to determine whether I was well enough to brave school or if it would be yet another sick day spent at home in bed.

In my early 20s, I was diagnosed with chronic bronchitis, chronic fatigue, and fibromyalgia. Pregnancies with both my daughters were fraught with premature labor due to a hyper-active uterus that kept me on full bed-rest for months. My family and I just assumed I was fragile and would always be limited by my lack of health.

Then, at 26—I found yoga. Weekly yoga classes gave me the first glimpse of what healthy might feel like. I began to get stronger and need fewer naps. I could think clearly more days than not. I began to crave anything that added to this new experience of vitality, and was repelled by anything that dropped me back into the abyss of exhaustion. I changed my diet, my entire lifestyle. Daily choices were weighed against whether they would take me towards health or away from it. For the first time, my Energy Bank Account was in the black.

Like so many others, my self-healing journey inspired me to want to help others discover health through the fantastic tools that yoga offers. Fast-forward 30 years and I achieved that dream. However, even with the many ways in which I had strived to get my prāṇic house in order, I continued to feel an underlying fragility. If I stayed out too late or ate less conservatively, I could easily tip over into feeling low energy with the all familiar tell of swollen glands. As my training programs accelerated and I began lecturing for 5–10 days straight, I found myself once again battling a chronic cough, fighting exhaustion, and chasing supplements. Acupuncture and dietary restrictions once again moved to the forefront of my life, in an attempt to get my system back into balance.

In the fall of 2015, I hit rock bottom. I contracted the annual crud that was going around and I couldn’t shake it. I was up hacking all night. I rotated between various breathing practices, in an attempt to subdue the tickle so I could rest. My ribs hurt. My head hurt. I was

wiped out. Terror set in when I could feel my throat closing off as I was finally drifting off to sleep: obstructive sleep apnea (OSA). This was particularly shocking, as I did not fit the typical image for OSA, in that I was not overweight.

I knew then that there was something deeply amiss. Until I explored the breath in depth and became aware of my own *saṃskāra* of over-breathing, I didn't fully understand how pervasive the imbalance in my system truly was. Not one of the doctors, alternative healers, or senior yoga teachers that I worked with over the course of my life had ever suggested that the root of my chronic health issues lay in my habitual pattern of breathing too much. American physiologist A.C. Guyton, author of the *Textbook of Medical Physiology*, infers in his work that all chronic pain, suffering, and diseases are caused from a lack of oxygen at the cellular level.<sup>1</sup>

I share my story as a way of conveying that breathing pattern disorders (BPDs) are commonly missed or misunderstood. As a result, many people like me chase answers linked to the symptoms of the problem, rather than treating the actual cause. According to several experts in the field of respiratory health, BPDs, including hyperventilation, are extremely prevalent in society today. BPDs affect nearly 10 percent of the population.<sup>2</sup> While these disorders are beginning to be recognized as a major cause of ill-health, they still remain widely undiagnosed and under-treated.<sup>3</sup>

Breathing is a complex business. There are multiple mediating factors that affect the quality of our breath: biochemical, biomechanical, and psychosocial. The biomechanical, that is postural and muscular components, are often touched on in yoga and other movement classes. These often address diaphragmatic breathing and posture. The relationship between emotions and breath has been well substantiated, with the recognition that strong feelings like grief, anger, and anxiety instantly make our breath swell or become chaotic and shallow. Less understood in the layperson's world is the chemistry of breathing. Oxygen is a gas. Carbon dioxide is a gas. Most people know in a superficial way that we breathe in O<sub>2</sub> and breathe out CO<sub>2</sub>. But what does that really mean?

Leon Chaitow, respected author of *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, stated it succinctly. He said, "Respiration is ultimately a chemical matter."<sup>4</sup> In other words, breathing is fundamentally about moving O<sub>2</sub> and CO<sub>2</sub> through our body in proper proportion. It is this action that maintains our chemical balance and ensures every cell is well oxygenated and able to generate energy. When our respiratory gases are in balance, homeostasis of the other chemical reactions in the body (which can include both neurotransmitters and hormones) is more easily maintained. When the breath chemistry goes awry, the chain reaction sets us up to have less vitality, to be more emotionally and physiologically fragile, and cognitively dull.

Once this cycle of cause and effect gets set into place, it can be sustained by improper biomechanics and psycho-emotional upheaval. If the underlying chemical imbalance is not addressed, any attempt to change the breathing pattern—as in a once-a-day typical *prāṇāyāma* practice—will result in intermittent but not long-lasting change. The biochemical, biomechanical, and psychosocial aspects of breathing are constantly on alert for potential signs of threat to the system and cueing one another to respond.

From the perspective of the *panchamaya* (five dimensions), it is as if the first three—*anna*, *prāṇa*, and *manomaya* (body, breath and mind)—were a set of triplets playing copy-cat with one another. After a while it becomes impossible to differentiate between them, or to even know who started the game. *Vijñānamaya* fuels the confusion with its added layer of

beliefs and cultural bias that motivate lifestyle choices. For this reason, prāṇāyāma or any other type of breath retraining needs to address all four dimensions in a consistent manner.

In this chapter, basic respiratory physiology will be explained. This will set the stage for the next chapter, which will provide a more nuanced understanding of what happens when the chemistry goes awry as it did with me, in the case of hyperventilation.

## **Respiratory Physiology 101: The Way We Breathe**

Breathing in and out may appear to be a simple mechanical reflex; however, respiration and respiratory health are considerably more complex. Here is a road map through the basics of respiration in a normal functional breather. Then, a closer look at the role of carbon dioxide and the autonomic nervous system (ANS).

### ***The First Tier: Breathing, aka Ventilation/Perfusion***

Breathing goes by many names! Breathing is the mechanical process of taking in and expelling air from the lungs; but once air is in the lungs, respiration refers to the involuntary chemical process of gas exchange in the tissues. The technical term for breathing is ventilation, which refers to the volume of air moving into the lungs during inspiration (inhalation) and out of the lungs during expiration (exhalation). Pulmonary ventilation is due to pressure differences between the atmosphere and the gases inside the lungs. As will be explored throughout this text, nose breathing is far healthier than mouth breathing and the ideal means to ventilate the lungs. Measuring ventilation by volume over time allows us to make determinations about a person's respiratory health status.

Tidal volume (TV) is the measure of how much air is moved in and out of the lungs during a single normal breath. The respiratory rate (RR) is a measurement of how many breaths are taken per minute at rest. For the average healthy adult, the RR averages between 10 and 15 breaths per minute. Respiratory minute volume (MV) is the total *volume* of air entering and exiting the lungs per minute. The average MV ranges between four and six liters for healthy adults depending on the age, weight, sex, and height of the person. Minute volume is calculated by multiplying TV and RR, and provides the basis for the rest of the respiratory process.

$$MV = TV \times RR$$

For example:

$$5 \text{ liters (minute volume)} = 500 \text{ milliliters (volume)} \times 10 \text{ breaths per minute}$$

A reserve amount of air always remains in the lungs, even after maximal exhalation, and this is known as the residual volume (RV). Tidal volume and respiratory rate are the only aspects of respiration that we can shift at will (see [Figure 3.1](#)).

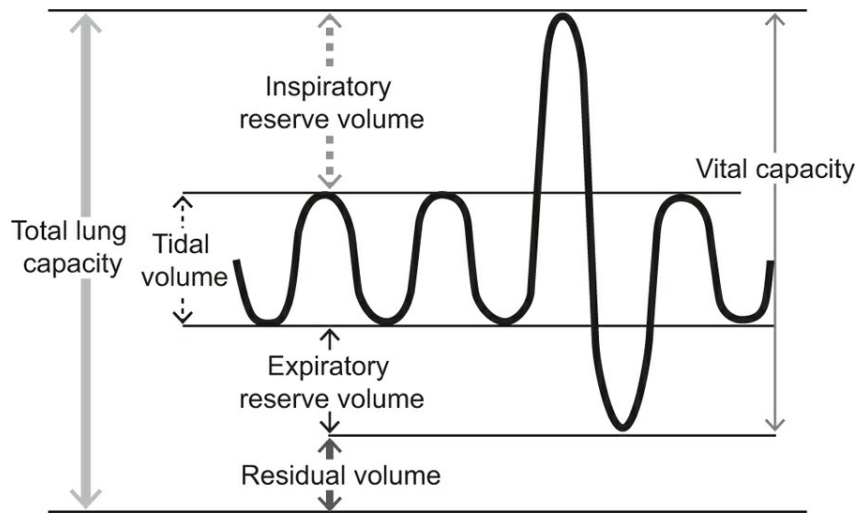


Figure 3.1 Breathing Volume and Rate Comparison Chart

All breath retraining processes, including *prāṇāyāma*, manipulate minute volume by altering rate, quantity, or both.

#### PATAÑJALI'S YOGA SŪTRA 2:50

**bāhayābhyantara-stambha-vṛttir-deśa-kāla-samkhyābhiḥ-paridṛṣṭo dīrgha-sūkṣmaḥ**

Prāṇāyāma is the regulation of inhalation, exhalation, and suspension by space, time, and number. This makes the breath prolonged and subtle.

When we breathe in, air passes through dead space which extends from the nasal passageway down the throat and through the trachea (windpipe) into the bronchi of the lungs. This zone encompasses the anatomical structures collectively known as the upper respiratory tract—nasal cavity, pharynx, and larynx—and also extends into the bronchioles to form a continuous passageway for air to move in and out of the lungs. The lower respiratory tract is comprised of the trachea below the vocal cords, the bronchi and the lungs, and it is deep within the lungs where gas exchange takes place at the ends of the bronchioles, in the alveoli. Within these thin-walled structures of the lower respiratory tract, inhaled oxygen is diffused into lung capillaries in exchange for carbon dioxide. When we breathe out, excess carbon dioxide flows from the lungs back out through the dead space, and is exhaled (see [Figure 3.2](#)).

Not all inhaled air is actually involved in respiration (gas exchange). A portion of ventilated air known as dead space air is so called because it stays in the upper airways and does not participate in gas exchange. Dead space air generally amounts to 150ml or approximately a third of resting TV, i.e. a third of each breath.

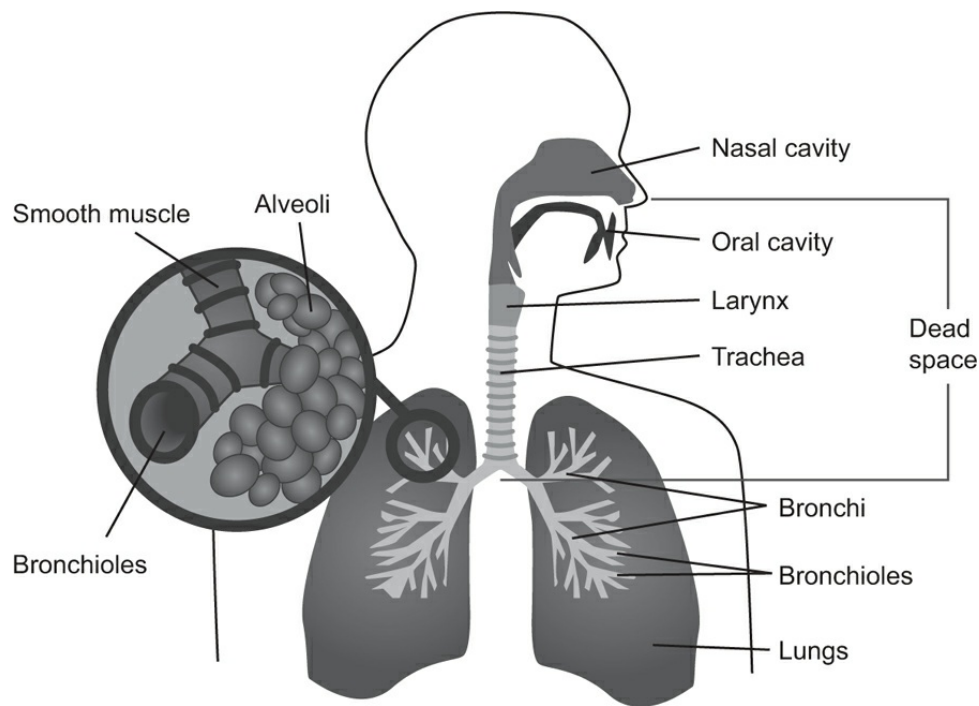


Figure 3.2 The Respiratory Tract

### PARTIAL PRESSURE EXPLAINED

Atmospheric pressure is the sum of all gas tensions in the air. At sea level, it is calculated at 760 mmHg, which is read as millimeters of mercury pressure. The term “partial pressure” indicates the percentage of one component of a mixture of gases to the total pressure of the atmosphere. The partial pressure of gases within our body is calculated accordingly, and signified by a “P” before the gas, such as:  $PO_2$ , meaning partial pressure of oxygen in the lungs, or  $PaO_2$ , which means partial pressure of oxygen in the arterial system, or bloodstream.

Gas pressures always move from high pressure to low pressure.

In the atmosphere, the partial pressure of oxygen is much greater than the partial pressure of carbon dioxide. The partial pressure of oxygen in the atmosphere is much greater in comparison to the lungs, creating a pressure gradient. This allows oxygen to flow from the atmosphere into the lungs during inhalation. Since gravity pulls gas molecules towards earth’s center, atmospheric pressure decreases with height above sea level making the air less dense. This affects the amount of pressure forcing air into the lungs during inhalation.

At sea level, the air we breathe comprises a percentage of atmospheric pressure:  $O_2$ : 21% mmHg;  $CO_2$ : 0.04% mmHg; the majority of what we breathe in is nitrogen: 78% mmHg. Argon, other gases, and water vapor make up the remainder.

**Perfusion**, or the exchange of gases in the lungs, takes place in the alveoli, which are microscopic grape-like clusters at the end of the bronchiole. These highly elastic air sacs are wrapped in a mesh of very thin blood vessels called capillaries. As we breathe in and out, the alveoli expand to take in  $O_2$  and conduct it through the capillaries into the bloodstream; then the alveoli contract to expel  $CO_2$  out of the circulatory system into the lungs. Approximately two-thirds of newly inhaled air reaches the alveoli, while the rest remains dead space air (see [Figure 3.3](#)). Airway disease such as bronchitis, emphysema, and asthma can damage the alveoli, which decreases the amount of gas exchange that can take place and diminishes lung function.

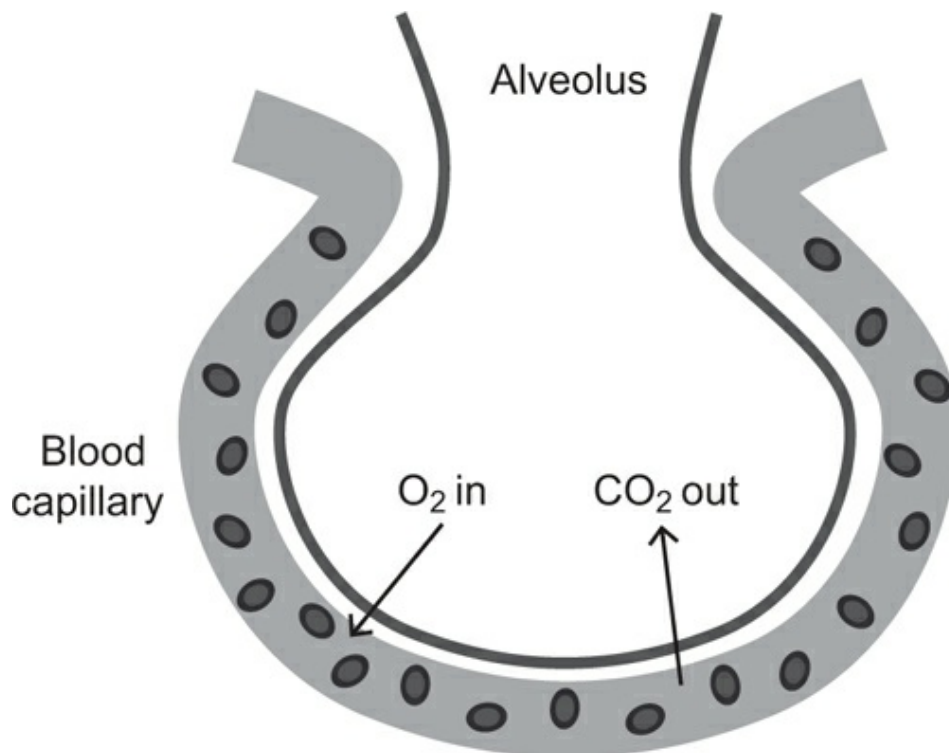


Figure 3.3 Gas Exchange through the Alveolus

Alveoli are distributed throughout the lungs, but due to gravity and our human tendency to spend more time in an upright posture, more blood pools in the lower lobes of the lungs.<sup>5</sup> Therefore, perfusion is greater in the lower lungs where the exchange between blood flow and gas exchange is highest. Nose breathing has been shown to take the air deeper into the lungs than mouth breathing. In part, this is due to nitric oxide (not to be confused with nitrous oxide), a gas that is generated from inside the nasal cavity. Nitric oxide redistributes blood from the lower regions of the lungs to the upper regions, thus allowing a better gas exchange to take place there as well.<sup>6</sup> Nitric oxide (NO) also acts as a vasodilator in that it opens blood vessels in the walls of smooth muscles, preventing constriction. It is a key ingredient in Viagra and other medications used to treat erectile dysfunction.

For efficient gas exchange to take place, all that is required is a gentle pumping action of the diaphragm, without recruitment from the accessory muscles of the chest. Oxygen from the lungs moves into the arterial system where it is transported to the tissues. As a by-product of metabolism (see “The Third Tier: Cellular Respiration,” below), CO<sub>2</sub> moves from the tissues into the venous system where it is delivered to the lungs to be expired out through the nose with the exhalation breath.

The **ventilation/perfusion ratio** can therefore be defined as the ratio of the amount of air reaching the alveoli to the amount of blood reaching the alveoli. These two variables constitute the main determinants of blood gas concentration levels. The abbreviations PaO<sub>2</sub> and PaCO<sub>2</sub> represent partial pressure of O<sub>2</sub> and CO<sub>2</sub> in the arteries. In a healthy individual, the partial pressure of oxygen (PaO<sub>2</sub>) is 100 mmHg, and the partial pressure of carbon dioxide (PaCO<sub>2</sub>) is 40 mmHg in both the alveoli and arterial blood.

## ***The Second Tier: Transport of Blood Gases***

Next, the freshly oxygenated blood has to move from the lungs into the rest of the body. In order for our heart, liver, brain, and the rest of the body to actually become oxygenated,  $O_2$  has to be delivered to the tissue. Think of the arterial system as a super highway, and hemoglobin (red blood cells which carry oxygen) as commuter buses. Imagine then that each hemoglobin molecule picks up four oxygen molecules as passengers. As the hemoglobin “buses” move through the body, their job is to deposit oxygen to the tissues. However—and this is important to understanding why the way we breathe matters—the ability of the cells to receive  $O_2$  is dependent upon the presence of sufficient levels of  $PaCO_2$ . In other words,  $CO_2$  holds the key to opening the door to the hemoglobin bus and the delivery of oxygen to the tissue (see [Figure 3.4](#)).

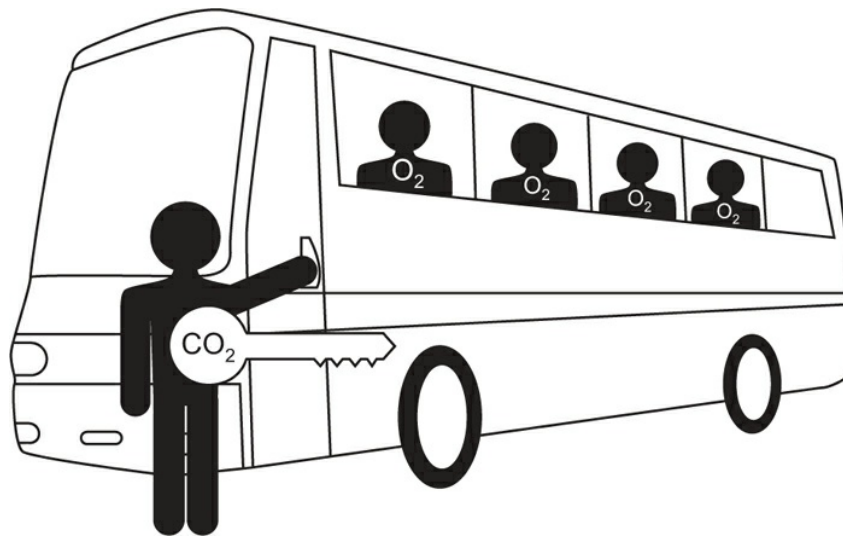


Figure 3.4 The Hemoglobin Bus

If  $CO_2$  levels in the arterial blood are below 40 mmHg (which is caused by breathing too much, i.e., fast and in large volume), blood pH increases. This will result in tightening the bond between  $O_2$  molecules and the hemoglobin such that the hemoglobin will not release the  $O_2$  molecules into the body’s tissues to meet the body’s demands. Known as the Bohr effect, this was identified by a physiologist named Christian Bohr in 1904 (see [Figure 3.5](#)). The Bohr effect ensures that  $O_2$  within the bloodstream stays saturated at approximately 98 percent. During normal healthy breathing, the blood is almost fully saturated with oxygen. Having lots of oxygen in the blood is one thing, but the real question is whether the oxygen in the blood is getting where we need it—into the cells. For this transfer to take place, there must be a requisite amount of carbon dioxide in the blood. Low levels of  $CO_2$  in the bloodstream will result in the rest of the body (including the brain) actually being oxygen deprived!



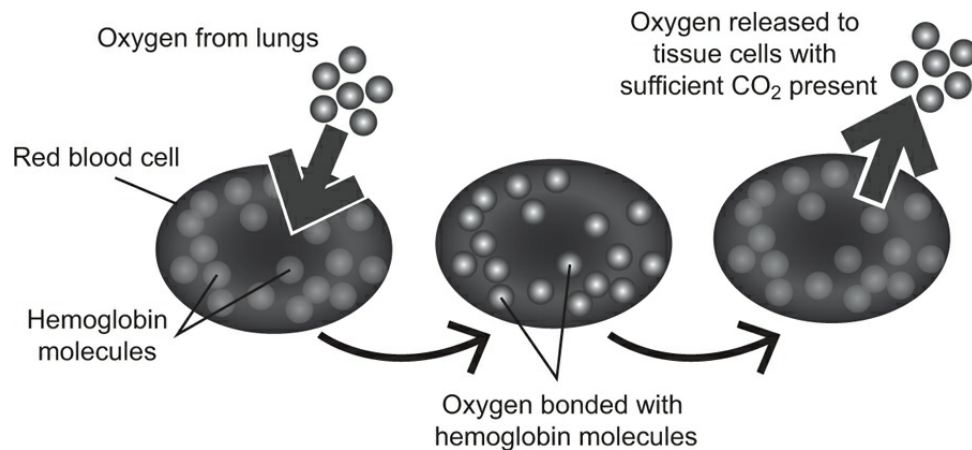


Figure 3.5 The Bohr Effect

There is such a reserve of  $O_2$  in the human body that a third of the oxygen we inhale is exhaled again without being absorbed into the bloodstream.<sup>7</sup> Even when the level of oxygen in our lungs drops, as when we dive into a pool or hold our breath for short periods of time, the blood oxygen saturation rate stays constant. Arterial levels of oxygen ( $PaO_2$ ) have to drop nearly 50 percent before the brain's hypoxia (low oxygen) detectors are moved to increase the respiratory rate in response.<sup>8</sup> This significant oxygen reserve within the lungs acts as a self-protective mechanism to ensure there is always enough oxygen on board to sustain life.<sup>9</sup>

### ***The Third Tier: Cellular Respiration***

We need oxygen in order to produce ATP (adenosine triphosphate), which is the form of energy used in all cells in our body. It is produced in the mitochondria, which are energy “factories” within each cell. ATP is created via the complex process of metabolism in which glucose or other sugars, proteins, and fats are broken down and then combine with oxygen to fuel our system.  $CO_2$  is a by-product of this metabolic process known as cellular respiration.  $CO_2$  is picked up by the venous system and returned to the capillaries in the lungs and exhaled out through the nose.

### **Movement and Respiration**

$CO_2$  is produced primarily through metabolism, which increases with exercise or physical movement. When we move very little and breathe heavily (as is the case for many people in our society), we produce less  $CO_2$ . Rapid or big, breathing can deplete our  $CO_2$  stores and result in hypocapnia and bronchoconstriction, leading to our body being less oxygenated. Poorly oxygenated muscles feel fatigued and tense, making exercise less appealing. In addition, a feeling of breathlessness often accompanies this depletion in  $CO_2$  and can put people off physical exercise. In fact, the very people who need to partake in physical exercise are often the ones less likely to do so.

People with chronic pain and illness move far less than healthy individuals. They experience higher degrees of muscle soreness post-exercise due to higher levels of lactic acid. Lactic acid levels are tied to low  $CO_2$  and poor oxygenation. In addition, low  $CO_2$  in the blood (hypocapnia) reduces  $O_2$  flow to the brain: for every 1 mmHg reduction in  $PaCO_2$ , 2



percent less oxygen is diffused into the brain. This can lead to anxiety, brain fog, lack of concentration, and memory problems.<sup>10</sup>

The most effective way to increase the amount of oxygen delivered from the blood into the tissues is to *breathe less and move more*. This will improve oxygen delivery throughout the body. However, increasing exercise alone won't alter this pattern. Poor breathing patterns during rest will persist during physical exercise. If someone over-breathes at rest (with audible sighs or rapid, heavy breaths) she will likely over-breathe during activity. To get the most from physical exercise and change our breathing patterns during rest, it is important to sustain the breath at a steady level during exercise. Unless the activity is extremely strenuous, a steady breath can be maintained through nose breathing alone, and one should avoid the huffing and puffing range. This will help retain the higher amounts of carbon dioxide that are produced with movement.<sup>11</sup> This is a useful way to build our CO<sub>2</sub> reserves to eventually sustain a steady nose-breathing pattern during exercise.

Aerobic exercise is recognized as a good way to oxygenate the body. The definition of aerobic exercise was coined by Kenneth H. Cooper, an American physician widely known as the “father of aerobics.” Dr. Cooper described it as activities which require a “modest oxygen intake and thus can be maintained for extended periods of time.”<sup>12</sup> To me, this sounds like light breathing and not panting. However, in my experience, people equate huffing and puffing with getting a better workout. Yet, if we were to compare a sedentary person to an elite athlete walking up a hill, who would we expect to have a quieter and more modest breath? My guess is the elite athlete. Who would we deem more aerobically fit? Again, my guess is the elite athlete. This example highlights the cultural confusion between heavy breathing and aerobic conditioning.

Breathing in bigger volumes or at a faster rate does not increase oxygenation. In fact, due to the Bohr effect, breathing hard decreases oxygenation as it expels more CO<sub>2</sub>, thus signaling hemoglobin to bind tightly to O<sub>2</sub> in the bloodstream. In other words, the volume of air that you breathe determines the partial pressure of CO<sub>2</sub> in the blood, and this influences the amount of oxygen delivered to the cells. The key to optimal oxygenation is to keep the breath slow and the volume low. If you find yourself breathing hard, it's an indication that that your CO<sub>2</sub> reserves are too low to meet the metabolic demand. Cognitive dissonance often arises with this, as the felt sense of someone who huffs and puffs up a hill is that they are not getting enough air in. Their automatic response to this sensation will be to breathe even harder, thus perpetuating the pattern.<sup>13</sup> This concept will be more fully explored in later chapters as we address physical fitness and āsana practice as preparation for prāṇāyāma.

## The Power of CO<sub>2</sub>

Carbon dioxide is most commonly referred to as a waste gas. While that is true in part, it is far from the whole story. Here is a list of a few of the primary vital mechanisms in our body that are dependent on PaCO<sub>2</sub> being maintained at its proper level of 40 mmHg:

- CO<sub>2</sub> regulates pH in the body.
- CO<sub>2</sub> dilates smooth muscle.
- CO<sub>2</sub> reduces oxidative stress, thus decreasing inflammation.

Before we directly address how CO<sub>2</sub> affects each of these aspects of our physiology, we must

start with how CO<sub>2</sub> levels are monitored in the brain and the relationship between CO<sub>2</sub> and the autonomic nervous system (ANS).

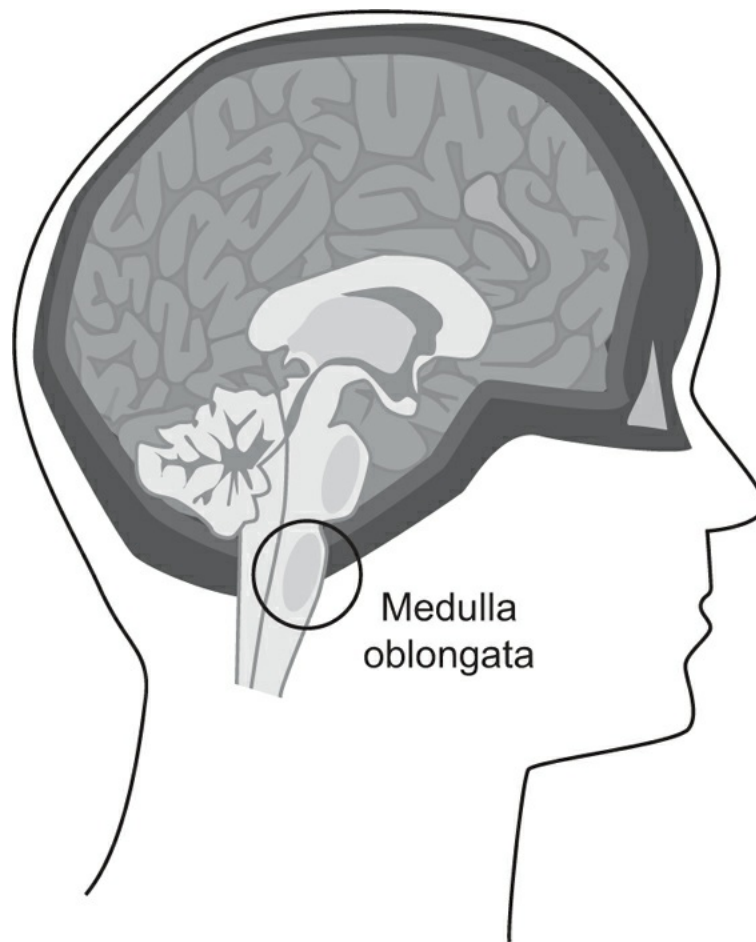
## The Mighty Medulla and the Autonomic Nervous System

The medulla oblongata was long thought to just be an extension of the spinal cord up into the brain (see [Figure 3.6](#)). This remnant of the older reptilian brain is now recognized as crucial for controlling our cardiovascular, respiratory, and other reflexive functions. The medulla connects the higher levels of the brain to the rest of the central nervous system. It is responsible for several functions of the autonomic nervous system (ANS), which has two branches: the sympathetic nervous system (SNS), which activates the fight/flight/freeze response, and the parasympathetic nervous system (PNS), which prompts the relaxation, rest, and digest response. The medulla monitors:

- *The control of ventilation:* Respiration is regulated by groups of chemoreceptors in blood vessels, which are highly sensitive to changes in the pH of the blood. If CO<sub>2</sub> levels increase, as during exercise, the blood becomes more acidic. To counter this, the medulla oblongata sends electrical signals to increase respiration rate in order to meet the additional demands of the body to maintain blood oxygenation and pH homeostasis.
- *Regulation of blood pressure:* Stretch receptors called baroreceptors can detect when the walls of blood vessels expand and contract, thus monitoring changes in blood pressure. The baroreceptors send information to the medulla so it can ensure that an adequate supply of blood circulates through the body at all times.
- *Control of reflex centers:* vomiting, coughing, sneezing, and swallowing.

These autonomic functions are in intimate relationship with one another and are intended to maintain a state of homeostasis (healthy balance). One example of the ANS's sympathetic activation might be a case of nervous jitters before a public speaking engagement. Your heart may pound, your breath quicken, and you may even feel like throwing up. In the post-presentation let-down, our breath slows, our heart rate stabilizes and our tummy settles enough to go out for a victory meal to celebrate. These are signs of parasympathetic activation.<sup>14</sup>

The medulla oblongata acts as the respiratory thermostat in our brain. Its chemoreceptors are set to read CO<sub>2</sub> levels in our blood and relay signals to the rest of the ANS based on that information. It adjusts moment by moment based on activity levels, altitude changes, and emotions. Overall, the medulla establishes its set point by our most predominant pattern of breathing. Remember how those saṃskāras are formed? Through repetition!



*Figure 3.6 The Medulla Oblongata*

Breathing regularly in a way that maintains CO<sub>2</sub> at its healthy 40 mmHg provides our ANS with a resilient buffer. However, if we develop a consistent pattern of over-breathing or hyperventilating, the medulla will reset and over time this new pattern will become the norm. In other words, our brain “gets used to” too much volume/rate and too little CO<sub>2</sub>.<sup>15</sup> This will affect our ability to negotiate stressors through our ANS, our pH levels, and the other physiological processes that are impacted by breathing.

## **A Deeper Look at the Autonomic Nervous System**

The two aspects of the ANS—sympathetic and parasympathetic—vacillate with the breath. With every inhalation, the heart rate goes up slightly and with every exhalation the heart rate drops. This dance is constant throughout our day. It is called heart rate variability (HRV) and has been shown to be a strong predictor of stress resilience. HRV measures the fluctuation between the number of heartbeats during inhalation relative to exhalation. The greater the variability between the two, the more robust and flexible the system. People with anxiety, depression, post-traumatic stress disorder (PTSD), attention deficit hyperactivity disorder (ADHD), cardiovascular disease, and irritable bowel syndrome (IBS) have been shown to have reduced HRV.<sup>16</sup>

Slowing the breath or extending the exhalation, as we often practice in yoga, can positively impact HRV by supporting parasympathetic modulation. Italian cardiologist Luciano Bernardi has extensively studied “slow breathing,” which he defines as a rate of six

breaths per minute. His research has shown that slowing the breath has significantly positive effects on lowering blood sugar levels in diabetics,<sup>17</sup> supporting cardiovascular health, and in facilitating climbers at Everest in summiting without the need for oxygen.<sup>18</sup>

While slowing respiratory rate has proven to be a valuable tool in modulating the ANS, volume also needs to be considered when addressing respiratory chemistry. Remember: Total amount of air that is ventilated (MV) equals RR multiplied by TV. Rate and volume ebb and flow in response to one another. If rate slows down, volume will increase to sustain minute volume at a constant. If volume lowers, rate will increase proportionately. This is a key consideration in our prāṇāyāma practices because if we aren't conscientious as we slow the rate, volume will tend to increase. Prāṇāyāma practice—with its intention to restrict vāyu and contain prāṇa—requires that we **slow the rate and lower the volume** of the breath in order to consistently change the amount of air being ventilated.

## pH (Partial Pressure of Hydrogen): The Ultimate Regulator

Hydrogen is actually the key ingredient of our chemical soup. Water is composed of one hydrogen and two oxygen molecules. Our body is approximately 60 percent water. Hydrogen maintains hydration of the cells, helps eliminate toxins and waste, and ensures that nutrients are able to be transported to the cells. Hydrogen keeps joints lubricated and the immune system able to defend itself and fight infection.

On the spectrum from acid (0) to alkaline (14), pH or partial pressure of hydrogen in the blood is in its happy place hovering around the 7.4 mark, which is slightly alkaline. If pH veers too far to the right (8) or left (6), death is certain. Even slight increases or dips in acidity or alkalinity make our system vulnerable to disease (see [Figure 3.7](#)).

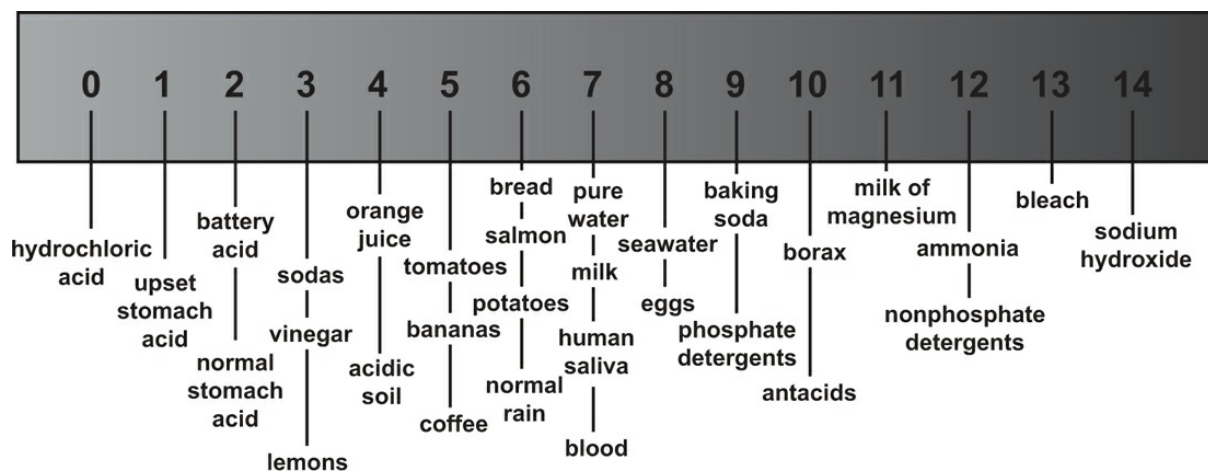


Figure 3.7 The pH Scale (Approximate Figures)

The level of pH influences every organ of the body and its proper balance is imperative to life. It helps to regulate enzymatic action, endocrine secretion, integrity of protein molecules, and cellular metabolism, as discussed above. For this reason, the body's survival system is willing to compensate via other biochemical processes in order to maintain pH at its appropriate level.

A momentary activation of the SNS, as when a car swerves into your lane in a near miss on the highway, could double your breathing volume, which significantly lowers CO<sub>2</sub> levels and will subsequently increase pH, moving it from 7.4 to perhaps 7.5. Our body is vetted to be resilient to these kinds of quick jolts in the SNS. However, a steady pH of 7.5, as happens

when people endure long-term stress, creates a pattern of over-breathing and could seriously compromise physiological health.<sup>19</sup>

CO<sub>2</sub> is the most important determinant in maintaining blood pH because shifts in minute volume provide the quickest way for the body to right itself. The kidneys offer a back-up system, but it takes hours rather than seconds to off-load excess bicarbonate through the urine to regulate pH. By taking one big breath or holding the breath for a matter of seconds, CO<sub>2</sub> levels can be altered instantly, maintaining homeostasis. This is happening all day—every day—without our awareness.<sup>20</sup>

As mentioned in [Chapter 1](#), CO<sub>2</sub> in its raw form is quite toxic. However, in our body it switches its chemical make-up rapidly to create acid and alkaline buffers that balance pH and maintain it within its healthy, but narrow range of 7.35–7.45. The equation below demonstrates the various ways CO<sub>2</sub> breaks down or dissociates from weak acid to stronger buffers to sustain proper pH.



Weak acid → carbonic acid → bicarbonate ion<sup>21</sup>

There is a constant interplay between minute volume, the amount of CO<sub>2</sub> produced, the partial pressure of CO<sub>2</sub> in the arterial blood, and the blood pH. *Note that the concentration of CO<sub>2</sub> in the blood, not the amount of oxygen, is the major regulator of breathing drive.* Maintaining pH levels is the autonomic nervous system's first concern and the ANS will sacrifice normal CO<sub>2</sub> levels in order to sustain pH. As we move into the topic of chronic hyperventilation in [Chapter 4](#), the relationship between pH and consistent over-breathing will be explored in depth.

## Smooth Muscle and CO<sub>2</sub>

There are over a hundred thousand miles of smooth muscle within our body.<sup>22</sup> Smooth muscle is a non-striated muscle that wraps around and is enmeshed within tissues, blood vessels, the airways, and most of the major organs of the body. These muscles are involuntary, meaning we do not have direct control over their recruitment as we do over our biceps or hamstrings. They are regulated by our ANS, and their impact on our organ function is significant. The level of dilation or contraction in the smooth muscle will determine the ease or difficulty we experience with basic physiological processes like breathing and peristalsis (the movement of digestion through the intestines). Smooth muscles play a role in blood pressure levels and are entwined around the bladder, uterus, and other reproductive organs, affecting their function as well.

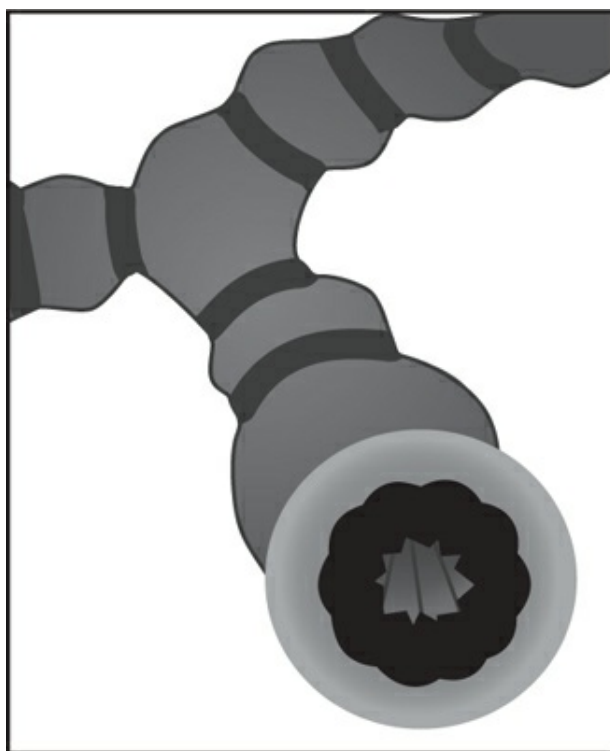
These muscles are highly responsive to CO<sub>2</sub>, which acts as a vasodilator, meaning it dilates or expands blood vessels within them. (You might recall that NO, another respiratory gas, also acts as a vasodilator.) The symptoms we commonly feel during sympathetic arousal are largely the result of contractions of the smooth muscle that occur with fluctuations of CO<sub>2</sub> levels when breath rate changes. For instance, when the fight or flight response is triggered, breath rate increases. One might feel like the lungs are in a vise and that the heart is pounding out of the chest. The tummy tightens as the digestive system proceeds to shut down in preparation for attack. When people have chronically low levels of PaCO<sub>2</sub>, as happens with

hyperventilation, the smooth muscle is consistently wound tight, making it far easier for the slightest trigger to tip them into a SNS response. This could manifest as anxiety, gut-tension, or a variety of other common symptoms, depending on the vulnerability of the individual.

Not surprisingly, the vasodilation effect of CO<sub>2</sub> on smooth muscle is believed to have a direct impact on asthma and hypertension, as well as digestive disorders. It indirectly affects erectile dysfunction (no vasodilation, no fun!). Several of my clients have expressed relief from life-long issues such as mildly elevated blood pressure, breathlessness, constipation, and gastroesophageal reflux disease (GERD), which resolved once they changed their breath pattern to bring up their CO<sub>2</sub> levels. It is not just a matter of relaxation in the moment—it is the normalization of CO<sub>2</sub> prompting dilation of the smooth muscle that brings lasting relief (see [Figures 3.8](#) and [3.9](#)).



*Figure 3.8 Normal Bronchiole Wrapped in Smooth Muscle*



*Figure 3.9 Asthmatic Bronchiole with Smooth Muscle Constricted Due to Low CO<sub>2</sub>*

## **Oxidative Stress, CO<sub>2</sub>, and the Inflammatory Process**

CO<sub>2</sub> also acts as a natural antioxidant to reduce oxidative stress on our system.<sup>23</sup> The body produces free radicals during normal metabolic processes and luckily our cells also produce antioxidants that can neutralize these free radicals. The key is balance. Oxidative stress can result from an imbalance of free radicals and antioxidants in the body, which can lead to cell and tissue damage. It is commonly understood to contribute to inflammation, which can make the body vulnerable to disease. Free radicals are formed by an oxygen molecule with an unpaired electron that attacks healthy cells in search of an electron to stabilize. Free radicals particularly target the mitochondria where ATP—the energy currency of our cells—is manufactured.

A number of factors, such as diet and environmental pollution, can contribute to free radical production, and if the body cannot keep up with the pace of oxidative stress, breakdowns can occur. Remember, the word “oxidation” is synonymous with rust. Free radicals break down or “rust” our bodies in a variety of ways that hasten us towards ill health and even death. Oxidative stress has been implicated in a number of diseases, including cardiovascular disease, Alzheimer’s, neuro-degenerative disorders such as Parkinson’s, lung disease, diabetes, and fibromyalgia to name a few.<sup>24</sup>

Antioxidants are substances that inhibit oxidation. They diffuse the destructive potential of free radicals by bonding with them and acting as protectors of our cells. While the supplement market is laden with antioxidants that one can purchase and consume, it may be that through proper breathing we can boost our body’s best antioxidant—CO<sub>2</sub>! This will help protect our mitochondria by maintaining proper cellular respiration and pH. It also appears that reduction of CO<sub>2</sub> increases lactic acid, which promotes inflammation and fibrosis.<sup>25</sup> Carbon dioxide has antioxidant effects, and many other stabilizing actions, including



protection against hypoxia (lower than normal levels of oxygen), calming of the central nervous system, and a reduction in inflammation.<sup>26</sup>

To summarize, maintaining PaCO<sub>2</sub> at its normal level of 40 mmHg is imperative for our health. It stabilizes pH; therefore it keeps the smooth muscle dilated, facilitating good circulation and organ function. CO<sub>2</sub> provides protection for our body from the damaging impact of free radicals and high levels of lactic acid. One could say that CO<sub>2</sub> is powerful medicine. The miraculous thing about it is that we produce it—it is free for the making! By learning to breathe properly we can contain it, thereby increasing our health and fortifying our vīrya!

## The Yogis and the Breath

It is hard to say exactly how much of the chemistry of respiration the yogis understood on an academic level, as has been discussed here. What is apparent from their descriptions of prāṇāyāma and their emphasis on breath retention is that they were intentionally manipulating gas levels in their practice. They induced these chemical changes to impact their physiology and mental acuity. Furthermore, they seemed to recognize that transformation was not a once-a-day proposition. Practice was prescribed multiple times throughout the day, unlike the once-a-day approach taken by most modern yogis. “Prāṇāyāma should be practiced perfectly four times a day: early morning, midday, evening and midnight, so that retention is gradually held up to eighty [counts in one sitting].”<sup>27</sup>

Reinforcing breath retention throughout the day is the most effective way of changing respiratory chemistry and reducing a strong ventilatory response (urge to breathe). This is because the medulla responds to function, i.e. how you breathe most of the time. A 30-minute prāṇāyāma practice will produce low dividends if during the rest of the 23.5 hours you are breathing large and fast, including snoring during sleep. You may experience a short-term sense of relaxation or calm mind, but once you are up from the cushion and resuming your daily routine, the pre-set breath rate and volume will take over. Consistent practice of low-level breathing and breath retention is the only way to effect long-term metabolic change. Each of the chapters of this book offers a variety of means to employ a transformative prāṇāyāma practice in your daily life to make a true shift in your medulla’s set point.

“When prāṇāyāma is done correctly, it is like sowing potential seeds in fertile soil. When practiced incorrectly, it is like planting small stones in the soil, believing them to be seeds and expecting plants to grow.”<sup>28</sup> Practicing prāṇāyāma multiple times during the day in 10–15-minute sessions, while maintaining a light, subtle volume, will alter your autonomic nervous system and your blood chemistry. This is what is suggested by both the ancient yogis and Dr. Buteyko. Perhaps even more importantly, this way of practicing maintains a level of svādhyāya, self-awareness, effectively reinforcing the intention to keep the breath slow and low, and illuminating how you breathe throughout the day. More than anything, this has the potential to help you recognize the habituation or saṃskāra of over-breathing and its impact on your body and mind.

Consistent day-long practice also helps with the management of your Energy Bank Account, as focus on the breath synchs your mind with all of your physiological functions. Dietary, speech, exercise, and sleep habits are no longer viewed as separate events, but rather as part of the larger prāṇavayu picture. Framed by the monitoring of the breath, the prāṇamaya leaps to the forefront of the mind and every choice becomes a choice either to



move towards homeostasis or stay stuck in the rut of duḥkha. To restrain or retrain the breath requires nothing short of constant vigilance.

## KEY CONCEPTS

---

- The primary function of breathing is to oxygenate the cells of the body.
- Proper oxygenation depends on the balance between O<sub>2</sub> and CO<sub>2</sub>.
- Healthful breathing is primarily about efficient exchange of gases in the lungs and in the tissues to produce energy and maintain pH.
- Low levels of CO<sub>2</sub> in the blood compromise our health and make us vulnerable to disease.

## — PUTTING IT INTO PRACTICE —

---

### Measuring our CO<sub>2</sub>

For a layperson it is not possible to scientifically measure CO<sub>2</sub> levels without the aid of a fairly expensive device called a capnometer. These are used primarily by respiratory therapists or experts in the field of respiratory rehab and pulmonology. However, there is a simple test that has been shown to be relatively accurate and is believed to be an indirect measurement of PaCO<sub>2</sub>. This is known as the Comfortable Pause, or Control Pause, abbreviated as CP.<sup>29</sup> This is a simple test that approximates one's comfort level with breath suspension *after the exhale*. A higher CP would be indicative of one's ability to tolerate higher levels of CO<sub>2</sub>. The inability to comfortably hold the breath after exhale may be indicative of low CO<sub>2</sub>, marked by a constant call from the body to breathe more. This is one of the hallmarks of chronic hyperventilation—or an instilled pattern of breathing too much.

To take your **Comfortable Pause (CP)**, all that is necessary is a stopwatch or a means to track seconds:

- Take a gentle inhale in through the nose.
- Exhale lightly out through the nose.
- Pinch your nose shut and start the stopwatch.
- Hold after exhale until you feel the *first* desire to breathe.
- Release and look at the time. The number of seconds you held after exhale represents your CP.

The quintessential component for taking an accurate CP reading is reflected by the term “*comfort*.” The challenge arises with the ego's attempt to want to push beyond the comfortable range to achieve a higher number. If you tend to strive for perfection, the practice itself will be a useful svādhyāya mirror. High achievers need to bring a sense of humor to this practice, to balance out their ambitious nature, otherwise they'll find themselves frustrated. Pushing the breath will cause the CP to drop. When the pause is truly *comfortable*, the breath immediately following the pause will be calm and relaxed, as if there had been no breath suspension at all. If the breaths that follow the taking of the

CP are at all labored, louder or larger than the breaths before, then that is an indication that the hold was pushed. I usually suggest shaving off a second or two in these cases, to stay honest with yourself. After all, the intention of taking your CP is to give you an accurate assessment of your breathing samskāra CO<sub>2</sub> levels.

## ***Understanding your CP***

- A CP below 12 is an indication of very low CO<sub>2</sub> levels and will likely correlate with a person being highly symptomatic.
- A CP between 12 and 20 indicates low CO<sub>2</sub> with a vulnerable system easily triggered into reactivity.
- A CP consistently ranging between 20 and 25 indicates a more stable and resilient system.
- A CP between 30 and 40 correlates well to a full tank of CO<sub>2</sub>, and will likely match someone with consistent vīrya (vitality) and good health.

For all those who are in the below 20–25 range, training yourself and students you are working with to become 24/7 functional breathers is a great place to start. This includes three key components: nose breathing day and night; breathing efficiently with the diaphragm; making the breath light, silent, and slow.

If you are a yoga teacher, it is also important to become conscious of is how you are cueing for the breath in your classes. Even if your own CP is well within the healthy range, consider how many of your students may be low-level hyperventilators. If you’ve been teaching big, audible ujjayi breathing, I’d suggest you shift to functional breathing as your baseline. This is the safer way to go with breath practices in a group context moving in the direction of “low and slow,” i.e., low volume, low in the body (abdominal-diaphragmatic), and slow. See the instructions for Subtle Breathing at the end of [Chapter 4](#).

Monitor your CP throughout your day. Incorporate your findings into your **Svādhyāya Breath Journal** and track how it changes—from morning to night, at times of stress, and at times of ease. Begin to take your CP prior to your prāṇāyāma practices and then again at the end and notice if there is any change. Observe and witness, conjuring equanimity and curiosity, rather than ambition to change.

## **CHAPTER SUMMARY**

---

- Breathing harder does not increase oxygenation (in fact it does the opposite!).
- Minute volume is calculated by multiplying tidal volume and respiratory rate.
- All breath retraining processes, including prāṇāyāma, manipulate minute volume by altering rate, quantity, or both.
- The lower lobes of the lungs have more blood flow, therefore efficient breathing is diaphragmatically (not chest) driven to increase ventilation and perfusion.

- Due to the Bohr effect, when CO<sub>2</sub> levels are below 40 mmHg, the bond between hemoglobin and O<sub>2</sub> tightens, decreasing oxygen delivery to the tissues.
- Oxygen levels have to drop below 50 percent before the brain's hypoxia detectors increase respiratory rate in response.
- The respiratory center in the brain (the medulla oblongata) signals how much and how often we breathe. The medulla signals in response to CO<sub>2</sub> levels rather than O<sub>2</sub> levels. CO<sub>2</sub> levels set our minute volume!
- Slowing the rate of breath without lowering the volume will not necessarily change the set point in the medulla.
- Low CO<sub>2</sub> means less oxygen to the brain and can lead to anxiety, brain fog, lack of concentration, and memory problems.
- The most effective way to increase the amount of oxygen delivered from the blood into the tissues is to *breathe less and move more*.
- Breathing heavily during exercise depletes CO<sub>2</sub> and decreases oxygenation.
- CO<sub>2</sub> regulates pH in the body.
- CO<sub>2</sub> dilates smooth muscle.
- CO<sub>2</sub> acts as an antioxidant thereby reducing oxidative stress, which can be a factor in chronic inflammation.
- The yogis prescribed breathing less and emphasized breath retention.
- Prāṇāyāma was intended to be practiced multiple times a day.
- The ability to suspend the breath comfortably for 40 seconds correlates with health-promoting levels of CO<sub>2</sub>.
- Yoga teachers and yoga therapists, especially in group classes, need to learn how to cue for functional breathing: through the nose, diaphragmatic, low, slow, and silent.
- Changing our breath habit requires a consistent retraining program enacted throughout the 24-hour daily cycle and lots of svādhyāya (self-awareness).

## Chapter 4

# HYPERVENTILATION

## THE SAṂSKĀRA OF BREATHING TOO MUCH

*Lightness of the body, brilliance [on the face], increase of the digestive fire, and slimness of the body—these occur definitely.*<sup>1</sup>

Tantric commentary on PYS 2:51,  
from Swami Veda Bharti's Yoga Sūtra of Patanjali

Because I spent decades experiencing the effects of over-breathing (clinically known as “chronic hyperventilation”), I had to train myself to breath less as a regular practice. Breathing less was not easy or comfortable, especially in the initial phase. I was coached by Pippa Kiraly to devote myself three or four times a day to a 15–20-minute reduced breathing session, totaling a full hour of practice; this process was combined with breath holds of various lengths. Some days the practice greeted me with an immediate sense of suffocation; other days I felt as if a secret chamber in my lungs had opened and I could bask in stillness without any sense of panic or urge to breathe more. The higher my **Comfortable Pause (CP)** rose through practice, the lighter the feeling in my chest and the more easily I breathed throughout the day.

I found I had to work with my mind as much as my breath and was grateful for the chanting practices I had learned in yoga that could coach me through the challenging moments of doubt. I reassured myself with a silent mantra of “This is enough. There is enough air for now.” This affirmed the fact that I was still alive, cognizant of all these new and testy sensations. It allowed me to differentiate between the feelings that sparked fear and the truth of the moment. My beliefs about how much breath is “enough” were constantly being defied. Ultimately, I came to realize they were founded in an experience of constant excess. It was as if I’d been consuming the equivalent of 5000 calories a day and was trying to wean myself back to 2000. It wasn’t that I was actually starving, but that I had become acclimated to so much more that culling back to the baseline felt onerous.

While systematically attending to my inner vṛttis, the benefits of this lesser breath were immediately apparent. Within three weeks, my chronic cough reduced by 70 percent. My energy throughout the day stabilized to the extent that I found I needed 1–2 hours less sleep per night and woke up peppy and bright. Aerobic exercise workouts were less taxing; I was able to increase both the incline and resistance on the elliptical machine without feeling breathless. Without intentional dieting, I began peeling off the extra 15 pounds I had gained over the previous two years. The chronic yawning and sighing were gone. Apnea gone. My

beloved husband commented that he found my silence at night a bit jarring after nearly 40 years of being lulled to sleep by the drone of my snoring.

Fascinated by these changes, I had to understand how it was possible that changing my breath could have such far-reaching effects on every other system in my body. The study of physiology and the chemical imbalance created by hyperventilation instructed me in the potency of the breath, revealing its capacity to either spawn disease or nurture health.

## Chronic Hyperventilation and Breathing Pattern Disorders

Many of us have an image of hyperventilation as depicted in the movies by someone in the throes of a full-blown panic attack, frantically breathing into a paper bag. However, one needn't be at the point of panic in order to be suffering from low-level hyperventilation. Remember Baba Hari Dass' description of hard breathing: "Irregular and spasmodic; gasping, sighing, and long inhale or exhale."<sup>2</sup> This is the manner in which many people unknowingly breathe all day, every day, unknowingly. I've had countless students claim that they do not over-breathe while gasping through every sentence. The actual definition of the syndrome is as follows:

Hyperventilation has a strict physiological meaning of breathing in excess of metabolic requirements. This means that ventilation is too high in relation to the rate of CO<sub>2</sub> production, thus leading to a fall in PCO<sub>2</sub> [pulmonary CO<sub>2</sub>] below the normal range, and therefore arterial hypocapnia [meaning PaCO<sub>2</sub>, below normal CO<sub>2</sub> in the blood].<sup>3</sup>

In other words, hyperventilation is an expression of low levels of CO<sub>2</sub> resulting directly from breathing too much. While utilized only in the extreme circumstance, the paper bag technique effectively allows the person to re-breathe the CO<sub>2</sub> trapped in the bag. This replenishes and brings blood gases back into temporary balance.

Hyperventilation syndrome (HVS) is just one of several types of breathing pattern disorders (BPD), but it is one of the most commonly occurring and most commonly missed.<sup>4</sup> Chest breathing, mouth breathing, paradoxical breathing, and hyperinflation are also types of BPD and will be explored more thoroughly later in this book. Not surprisingly, these biomechanical breathing disorders often accompany hyperventilation. To note, people can over-breathe intermittently, so while their carbon dioxide levels are not consistently below normal, they are on the borderline and may still be symptomatic. They too will be aided by bringing their respiratory rate and tidal volume down to functional levels through practices like the orientation to *prāṇāyāma* recommended here.

The pattern of *hypo*ventilation (under-breathing) is not a disorder that most yoga teachers will encounter in their classes. It is most evident in people who are severely ill and under a doctor's care. Often these people have advanced stages of COPD, heart disease, or diabetes, and/or are morbidly obese. People with this condition need attention from a trained respiratory therapist, and for the most part, are beyond the scope of our work as yoga teachers and yoga therapists.

The *saṃskāra* (habitual pattern) of unconscious breath holding (also known as daytime apnea) during periods of stress is not the same as hypoventilation. Often people think they "under-breathe" because they are aware of frequent periods of breath holding—especially when their body signals for them to sigh or gasp deeply in response. What they may be less aware of is the rapid or chaotic breathing pattern which precipitated that unconscious breath-holding event. In other words, much as with night-time apnea (discussed more fully later in

this chapter), the breath holding is in response to over-breathing, not a symptom of under-breathing overall.

The classification of hyperventilation and its complex symptom picture isn't new on the scene, even in Western medicine. In 1871, DaCosta syndrome, also known as “soldier's heart” and “effort syndrome,” was identified in soldiers returning from the war. These veterans exhibited symptoms mimicking heart disease although the heart itself seemed to be functioning just fine.<sup>5</sup> In 1938, Soley and Shock linked soldier's heart and effort syndrome to hyperventilation.<sup>6</sup> We now think of this as part of the complex symptom picture of post-traumatic stress disorder, which includes disordered breathing, panic attacks, anxiety, and sleep issues.

Recent studies have found hyperventilation syndrome present in approximately 9.5 percent of the adult population.<sup>7</sup> Children diagnosed with asthma, sleep disturbance, and chronic rhinitis may suffer from HVS as well.<sup>8</sup> In spite of this, the mainstream medical world has been reluctant to acknowledge the devastating consequences of maladaptive breathing patterns on health.<sup>9</sup>

## **Chronic Hyperventilation among Yoga Practitioners**

According to Yoga Health Foundation, the top three reasons people attend yoga classes are stress relief, pain relief, and better breathing.<sup>10</sup> Unlike fitness buffs who hang out at gyms or running tracks, however, people drawn to yoga may also have low exercise tolerance and be unable to comfortably participate in regular aerobic-type exercise regimes. Stress and pain both increase respiratory rate, and new yoga students often complain of anxiety, back pain, fatigue, and inflammatory conditions like migraine headaches or irritable bowel syndrome. All of these, including low exercise tolerance, can be symptomatic of chronic hyperventilation. As discussed in [Chapter 3](#), biochemical changes that result from hyperventilation profoundly influence circulation, digestive function, musculoskeletal structures, and emotional regulation.<sup>11</sup> Therefore one can surmise that a high percentage of people seeking yoga and yoga therapy may suffer from disordered or dysfunctional breathing patterns, perhaps more so than within the general population.

As yoga teachers and therapists, we need to recognize how hyperventilation relates to a variety of conditions that our students and clients are experiencing. The more we understand how to assess breath patterns and develop practices that will restore respiratory balance, the more effective our yoga practices will be in truly promoting health.

## **The Pervasiveness of the Breathing Saṃskāra**

To fully understand why breathing is such a central fixation with regard to health, we have to consider the frequency with which we breathe. The average healthy individual breathes *15,000–20,000 times a day, based on approximately 10–12 breaths per minute*. As addressed in [Chapters 1 and 2](#), habituation and the impact of saṃskāras is a major topic in the original yoga teachings. It is now getting the recognition it deserves in the modern field of neuroplasticity.

Dr. Claude Lum, a respiratory physician who specialized in research on hyperventilation syndrome, described how habit perpetuates the condition:

It has always seemed to me that hyperventilation is essentially a bad habit; a habit of breathing in such a way that the day to day level of CO<sub>2</sub> is relatively low. Given this

basic bad habit, any physical or emotional disturbance may trigger off a chain reaction of increased ventilation, rapidly producing hypocapnic [low CO<sub>2</sub> levels] symptoms, alarm engendered by the symptoms, consequent sympathetic arousal resulting in increased ventilation and increased symptoms.<sup>12</sup>

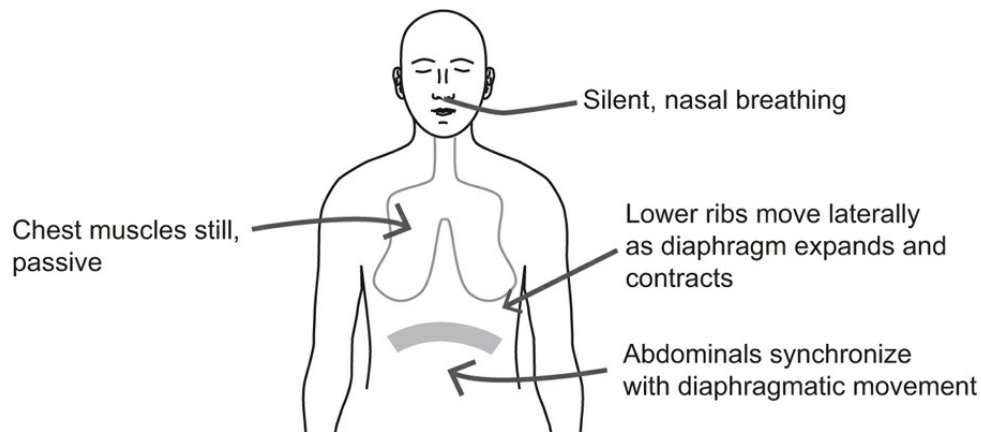
The yogis recognized long ago that the patterns we repeat have a way of owning us. They leave their imprint, forming a rut that grows deeper with every repetition. The deeper the groove, the more easily we fall into it and the harder it is to climb out. Bottom line: we get good at what we practice. This includes conscious and unconscious acts like breathing.

When we consider the tapas, the transformation of the breath saṃskāra, we can illuminate the challenge by comparing it with the difficulty in changing our dietary habits. Eating is a habit we engage in a mere 3–5 times per day, with regular meals and a couple of snacks. If you have ever tried to initiate portion control or a new dietary regime, then you likely have experienced the fundamental resistance to change that can accompany this process. Compare this dietary saṃskāra with the unconscious subtle saṃskāra of breathing that is happening thousands of times a day whether we are awake or asleep. From this perspective, it is easy to understand both the potentially hazardous impact of unhealthy breathing patterns and the incredible fortitude it takes to change them once they have been set in motion.

## Functional versus Dysfunctional Breathing

Healthy breathing is often referred to as functional, whereas dysfunctional breathing is an indication that a BPD is disrupting the normal flow. Functional breathing has specific parameters. The description given below is based on the resting breath of a healthy adult in a seated position (see [Figure 4.1](#)).

- The breath is conducted in and out through the nose.
- Normal respiratory rate is between 10 and 12 breaths per minute.
- Normal minute volume is 5–6 liters of air.
- The upper chest and accessory breathing muscles (scalenes, sternocleidomastoid, intercostals) are completely relaxed and passive.
- Movement is contained in the lower rib cage and reflected in a small lateral flare of the diaphragm itself; arcing out on the inhale and in on the exhale.
- The breath is completely silent, inaudible.
- There's a steady oscillation to the breath: rhythmic, but not rigid.
- A natural resting pause punctuates the end of the exhale.<sup>13</sup>



*Figure 4.1 Functional Breathing*

In contrast, these characteristics have been identified as dysfunctional, and are symptomatic of a BPD:

- The breath is often conducted in and/or out through the mouth.
- Respiratory rate is between 15 and 20 breaths per minute.
- Minute volume is 10–20 liters.
- The upper chest and accessory breathing muscles are actively engaged.
- Abdominal-diaphragmatic engagement is limited or paradoxical to normal function (explained fully in [Chapter 6](#)).
- Muscular movement of breath is visibly vertical (chest and shoulders lifting up and down) rather than lateral (ribs moving out and in).
- At rest, the breath is audible and often accompanied by frequent sighs, sniffs, coughs, or yawns.
- The breath has a chaotic rhythm to it, e.g., alternating between rapid breaths, sighs, and apnea (periods of involuntary non-breathing).

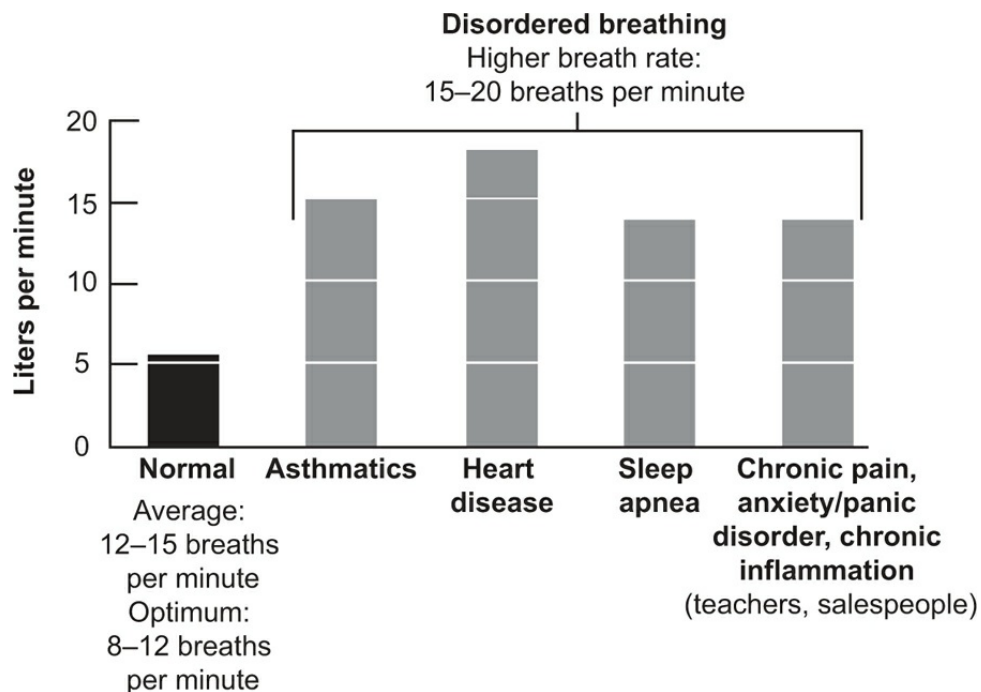
To summarize, key elements that differentiate functional from dysfunctional breathing include: nose versus mouth breathing; breath rate and volume; chest versus abdominal-diaphragmatic movement and direction; sound and rhythms of the breath. All of these elements in combination contribute to various physiological outcomes, from biochemical changes to the capacity of the nervous system and other systems' ability to maintain homeostasis. A short list of the benefits of functional breathing is offered here:

- Acquires O<sub>2</sub>.
- Eliminates excess CO<sub>2</sub>.
- Efficiently exchanges O<sub>2</sub> and CO<sub>2</sub>, enhancing cellular function and facilitating normal performance of the brain, organs, and tissues.
- Maintains pH balance.
- Helps maintain normal functioning airways.
- Contributes to a state of calm.



- Permits normal speech.
- Maintains normal dilation of smooth muscle.
- Assists in movement of body fluids (e.g. lymph, blood).
- Helps maintain spinal mobility and stability through regular mobilization of the lower rib cage via the diaphragm and abdominals.
- Enhances digestive function via rhythmic positive and negative pressure fluctuations with normal diaphragmatic function.
- Supports the balance of the autonomic nervous system, and also supports healthy immune and cardiovascular function.

Based on this list, one can assume that any deviation of breathing from functional to dysfunctional will potentially produce negative effects on these physiological processes.<sup>14</sup> People with asthma, heart disease, anxiety, depression, sleep apnea, or chronic pain and/or those who talk for a living (e.g., salespeople, receptionists, and teachers) frequently breathe at a rate of 15–20 breaths per minute and at volumes 2–3 times normal (see [Figure 4.2](#)).<sup>15</sup> While that may not seem like a significant difference, consider this quote from Jennifer Stark, an Australian trainer in the Buteyko method, summarizing the hazards of this level of hyperventilation: “When done over a week, 30,000 liters of extra air will have been breathed—enough to fill a small swimming pool.”<sup>16</sup> To add to this burden of hyperventilation, our breathing rate can rise due to lack of exercise and a sedentary lifestyle inside overly insulated, well-heated homes. Sugar, caffeine, and many prescription medications can also increase respiratory rate.



*Figure 4.2 Breath Volume and Rate Comparison Chart*

When we weave in the components discussed in [Chapters 1](#) and [2](#) regarding the prāṇic enrichment or depletion of our environment and how consciously we manage our prāṇamaya (the energy dimension), we begin to see that the odds of being a 24/7 functional breather in

these modern times are strikingly low. The ancient yogis in their prāṇāyāma experiments were starting with an arguably less polluted environment at a baseline of healthy function. They were then manipulating the breath to achieve highly altered states of consciousness. As a society, today we are starting far below the line of health; getting to normal is already an arduous and worthy task. As yoga teachers it is vital that we provide our students with the correct information and practices to support them (and ourselves!) in becoming functional breathers first and foremost.

## **Identifying Chronic Hyperventilation**

The challenge with identifying HVS or over-breathing is that unless one is trained to know how it presents, it is easily missed. Low-level hyperventilation isn't dramatic like a full-blown panic attack. Instead, the person may breathe a little rapidly or may sigh, yawn, sniff, or cough frequently. They may gasp regularly during speaking (which tends to be rapid run-on sentences) without pausing to breathe through their nose. Mouth breathing and chest breathing often accompany hyperventilation, although one can also over-breathe and still primarily be a nasal breather.

The list of symptoms associated with hyperventilation include:

- shortness of breath
- chest breathing
- anxiety/panic
- asthma, COPD
- insomnia
- snoring/sleep apnea
- restless leg syndrome
- anaphylactic reactions
- temporomandibular joint disorder (TMJD)
- chronic cough
- stuffy nose, sinusitis, hay fever
- anterior head carriage
- postural issues
- heartburn/GERD
- migraines
- muscle cramps
- multiple chemical sensitivities
- muscle pain
- myofascial pain
- mood swings
- poor exercise tolerance

- poor immunity
- poor memory
- swollen lymph glands
- dry skin/mouth/eyes
- high blood pressure
- low blood pressure
- food allergies
- constipation
- bloating
- excessive flatulence
- brain fatigue
- abdominal spasms
- anal irritation
- hemorrhoids
- food cravings
- sluggishness
- depression
- chronic fatigue
- osteoporosis
- seizure disorder
- dizziness
- cold hands/feet, Raynaud's syndrome
- recurrent bladder infections
- recurrent vaginal infections
- recurrent skin rashes.<sup>17</sup>

When I first encountered this list, I had a near come-to-God moment. If I were to put together a symptom list that encompassed the sum total of my yoga therapy clients over the years, it would pretty much be a duplicate of the list above. I think of how many of my students complained of dizziness or feeling light-headed in class or during our sessions together, particularly in response to prāṇāyāma practices back when I taught big breathing. Anxiety, brain fog, migraines, muscle spasms, food allergies, fatigue, and insomnia are consistent issues among my prospective clientele. They often spend much of their lives going from doctor to doctor, enduring seemingly endless and highly sophisticated and invasive tests, only to be told after seeing several specialists that there is essentially “nothing wrong with them.” Hyperventilation and BPD need to be considered as causative factors and not simply symptoms, otherwise these people may be labeled as hypochondriacs or malingerers.<sup>18</sup>

The challenge is that BPD like hyperventilation can fluctuate in level of severity or chronicity due to lifestyle factors and genetics. This makes diagnosis more of a challenge. While each doctor examines the patient from his or her specialty, collectively they may miss the common precipitating factor that pervades the bigger system picture: dysfunctional breathing. For example, multiple studies suggest that up to 90 percent of non-cardiac chest pain may be induced by hyperventilation or BPD.<sup>19</sup> According to respiratory experts such as Dr. Claude Lum, it is important that hyperventilation as a syndrome be validated by the medical profession so that those who suffer with symptoms are offered effective treatment and support.”<sup>20</sup>

## How Chronic Hyperventilation Impacts Our Health

How much air we breathe, i.e. our minute volume, determines our PaCO<sub>2</sub> levels. Intermittent heavy breathing, as happens during periods of excitement or short-term stress, can easily be negotiated by our body; and once the trigger has passed, the system will return to homeostasis. With sustained periods of hyperventilation, assessed at spans between 6 and 72 hours, however, a chemical shift occurs, due to the consistently lower level of CO<sub>2</sub> and its impact on blood pH.<sup>21</sup>

Over-breathing initially causes the blood to become too alkaline, yet with sustained stress the kidneys reactively excrete bicarbonate to normalize blood pH. This effectively changes the set point of the medulla, making the body less able to tolerate the acidity brought about by higher levels of CO<sub>2</sub>. As the medulla resets the new norm down to say 37 mmHg or even lower, any attempt to raise CO<sub>2</sub> levels back up to the normal amount of 40 mmHg will result in intense resistance as the body tries to maintain a liveable pH. You can think of this as a cultivated “intolerance” to CO<sub>2</sub>. The resistance is felt as a stronger ventilatory response (or urge to breathe), accompanied by a feeling of *dyspnea*—shortness of breath that is often described as an intense tightening in the chest, breathlessness or a feeling of suffocation.

Lower levels of CO<sub>2</sub> also maintain a sympathetic state of arousal. This means the body is primed as if to take action against a predator. However, as is the case for many of us in these modern times, we are breathing heavily while chained to our computer monitors or stuck in a traffic jam. The physical exertion being called for by our body to meet the psychological threat isn’t being actuated. Rather than replenishing our CO<sub>2</sub> reserves by running or fighting, we sit and sit and sigh and gasp, all the while sinking ourselves deeper into the trench of hyperventilation.

Let’s look at an example of the effect of long-term stress on the breath pattern of a previously healthy person who incurs a motor vehicle accident which results in severe back pain. For a period of months, she is unable to sleep comfortably or work fully. She is battling insurance companies and spending much of her time going to doctors, the chiropractor, and massage appointments. Financial pressures are adding to her woes and she can’t garden, ski, or salsa dance the way she used to in order to off-load stress.

Her sympathetic nervous system is consistently cranked, ready for action. The medulla responds to this long-term activation by resetting its minute volume. Now, instead of ten breaths per minute at rest, it calls for 15–20 breaths—and instead of five liters of air per minute, it’s pushing 15–18. The medulla is responding as if the person is running a 5K all day long, while in fact, she is even more sedentary than before. This will lower her CO<sub>2</sub> levels even further.

The challenge with the medulla is that it doesn't automatically reset itself once she is out of pain and back on the dance floor. Once it has adapted to a lower set point, over-breathing becomes an ingrained habit—a new *samskāra*—that is not easy to change. The body becomes intolerant of increasing CO<sub>2</sub> as this will promote acidity. This condition is known as respiratory alkalosis, and it correlates with many of the symptoms listed on the hyperventilation checklist (see [Figure 4.3](#)). When we are in this state, we are more easily affected by acidic foods and more prone to conditions like GERD, IBS, and other inflammatory conditions. Irritable bladder and frequent urination may also be symptomatic of this condition, as the kidneys are being constantly called on to dump bicarbonate (HCO<sub>3</sub>) in order to maintain proper pH.

The medulla is very slow to recalibrate. The longer the abnormal pattern has been in place, the more arduous the retraining process will be. Once chronic hyperventilation is set in motion, one could slowly breathe in a large volume of air (as with one big sigh, a series of yawns, or performing big *ujjayi* breathing throughout a yoga class) and yet sustain or *even further the imbalance*.<sup>[22](#)</sup>

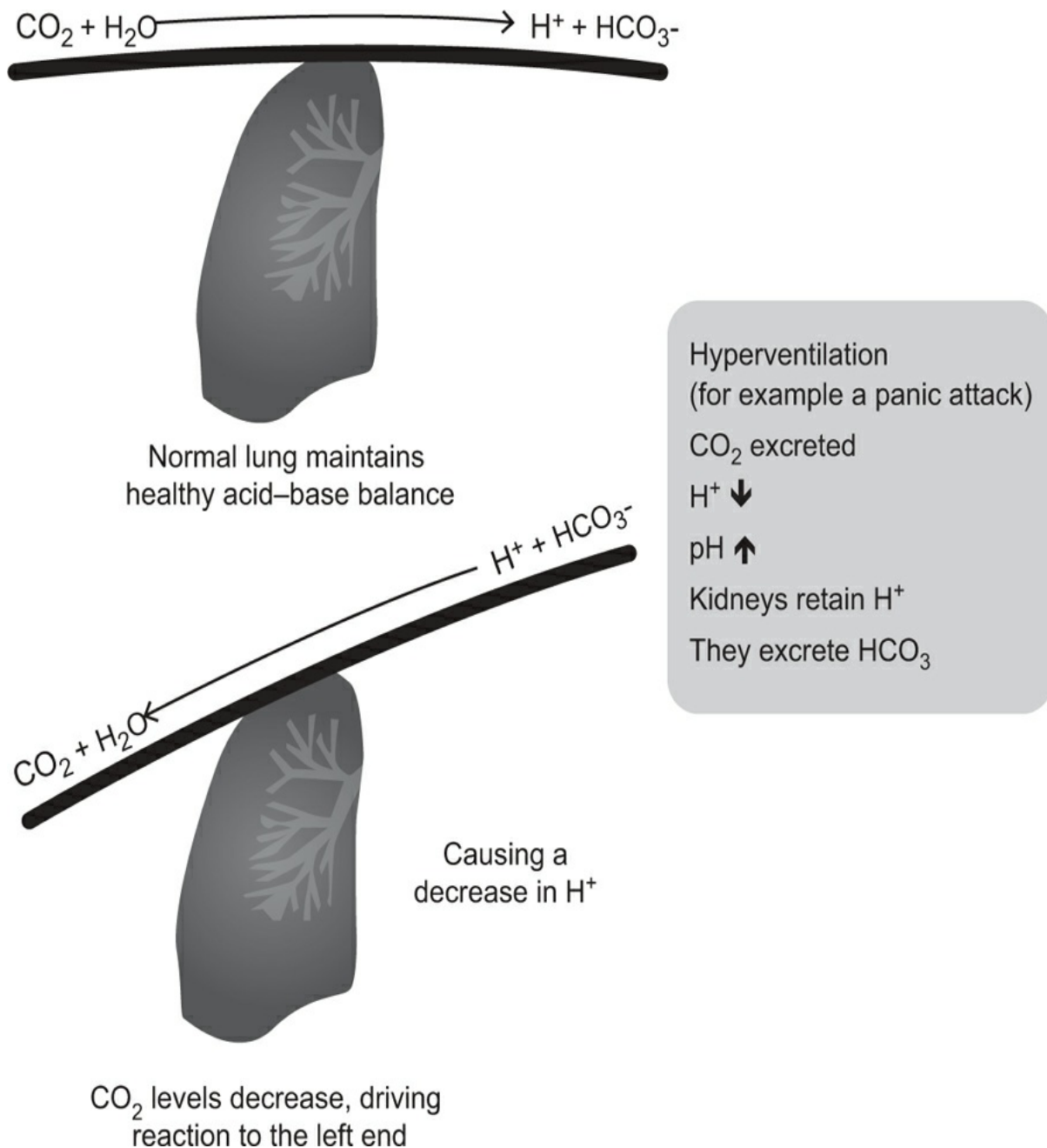


Figure 4.3 Respiratory Alkalosis

Note:  $\text{H}^+$  = hydrogen;  $\text{HCO}_3$  = bicarbonate

### THE “COMPLETE YOGA BREATH”

In my research, I looked but could not find a single reference in the original texts to anything resembling the “full or complete yoga breath,” which is popular today. The oldest reference I found is the 1903 text *The Science of Breath*, by Yogi Ramacharaka. The complete yoga breath is commonly characterized as a 1–2–3/3–2–1 breath pattern (see Figure 4.4). It emphasizes muscular expansion from the thorax to the abdomen on inhale, and contraction from the abdomen to the chest on exhale. Sometimes the exhale is directed through the mouth rather than the nose, and students are encouraged to make it audible, as in a large sigh. I’ve also heard the inhale described as expanding the muscles in the abdomen or the lower rib cage first and then the chest. This variation is often referred to as “Bucket Breathing.” Regardless of the order and effort of muscular activation, air is not a liquid but a gas and as such cannot fill from the bottom first. Whichever direction the breath is initiated, this type of breathing draws in more oxygen because it actively recruits the accessory respiratory muscles. The “bucket” analogy may in fact help to facilitate a primary action of diaphragmatic breathing, which would avoid hyperinflation of the chest. In that sense, the analogy may be more useful than the chest to belly variation, which will be discussed more in Chapter 5.

The complete yoga breath accompanied by an audible ujjayi is probably the most common form of breath practice shared in yoga classes. However, it appears that this is a fairly contemporary idea about breathing that has no roots in the original writings from Yoga Sūtra, Yoga Rahasya, Yoga Yajnavalka, Gherandha Samhita, or the Hatha Yoga Pradipika, which are my primary resources for reference. Furthermore, this style of breathing runs contrary to the ideas espoused throughout this text based on physiology and established studies that define the parameters of functional versus disordered breathing. I would go so far to say that the complete yoga breath, if practiced regularly, demonstrates another form of dysfunctional breathing which over-utilizes the accessory breathing muscles, encourages hyperventilation, and potentially de-oxygenates the body. If practiced in a very warm environment, as with hot-yoga, the breath and heart rate will already be increased due to the ambient air temperature, which will amplify the hyperventilatory tendency.

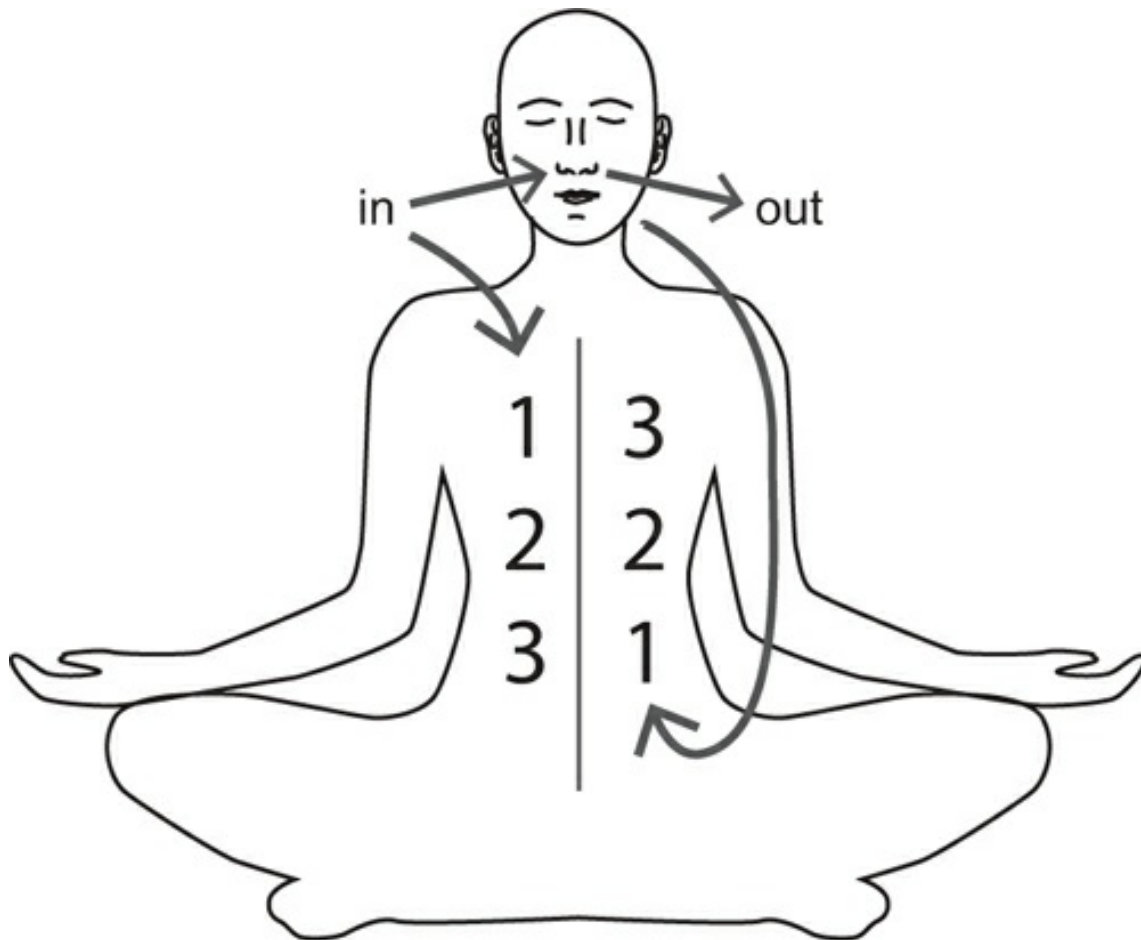


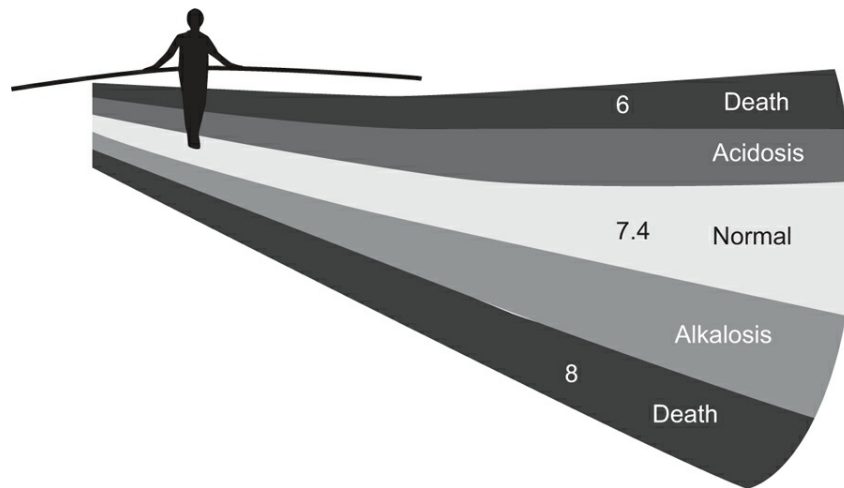
Figure 4.4 Yoga Breathing

## Hyperventilation and Exercise

Reducing breathing volume or increasing physical activity will increase  $\text{CO}_2$  and thus trigger dyspnea in hyperventilators. If the breathing rate at rest is higher than normal, when that person begins to exercise there will be a mismatch between metabolic rate and breath rate, causing the person to gasp for air. In addition, they may have consistently low levels of bicarbonate, which have been correlated with high levels of lactic acid, contributing to feelings of premature fatigue, breathlessness, and muscle pain.<sup>23</sup> This means there is a low threshold before exercise, and the metabolic increase of  $\text{CO}_2$  with exercise (if accompanied by heavy breathing) will not bring the system into balance.

This fits the symptom picture for people with chronic fatigue and fibromyalgia. They frequently complain of low vitality and a low threshold for exercise, and they experience

higher than normal pain levels post-activity due to increases in lactic acid. The Bohr effect further compounds the problem, in that muscles will be under-oxygenated, which adds to the fatigue. At the same time, attempting to reduce breath volumes (particularly during exercise) will feel near to impossible without proper preparatory practice. A common confusion occurs because off-gassing the CO<sub>2</sub> that accumulates with exercise by taking big gasps provides an immediate feeling of relief; however, it also further perpetuates the chemical imbalance.<sup>24</sup> Leon Chaitow, ND, DO, and prolific author, made this claim: “We live in a narrow zone of homeostasis bordered on both sides by physiological disaster. Much of what goes wrong with breathing involves attempts to prevent this disaster.”<sup>25</sup> (See [Figure 4.5.](#))



*Figure 4.5 The Delicate pH Balance of Life*

## Hyperventilation and Muscular Recruitment

There is an additional cost to the chemical imbalance of hyperventilation. The muscular effort required to breathe harder also lowers the level of oxygen available to be utilized. Normal functional breathing consumes less than 2 percent of the oxygen that's inhaled. During episodes of hyperventilation, that number could increase to 30 percent.<sup>26</sup> This is due to the added load required to recruit accessory breathing muscles to actively draw air into the lungs. Consumption of more oxygen just to breathe means there is less O<sub>2</sub> available for delivery to the rest of the body. Having lower amounts of O<sub>2</sub> available to disperse through the body adds to the feeling of “not enough air,” and further perpetuates the big breathing habit. Optimal breathing at rest is achieved at a 1:1.5 ratio (inhale to exhale) and is known as coherence,<sup>27</sup> with the *least* amount of mechanical effort from the respiratory muscles.<sup>28</sup>

The law of diminishing returns goes far to explain why people may feel tired long past their supposed recovery from an illness, traumatic event, surgery, or period of stress. Post-recovery, people may feel unmotivated to exercise and have difficulty sleeping, digesting, or processing cognitively. If some kind of breath retraining program has not been instilled, the medulla will continue to breathe at the new “stress” rate and volume and the biochemical ship will continue to tip towards acidity.

## Hyperventilation and Sleep-Disordered Breathing *Snoring, Obstructive Sleep Apnea, and Central Sleep Apnea*



How we breathe during the day greatly affects how we breathe at night. As our bodies prepare for sleep, our breath rate naturally slows down. In the case of someone who has been hyperventilating throughout the day and has an increased ventilator response, the natural rise in CO<sub>2</sub> levels at night will lead to them quickly hitting their CO<sub>2</sub> threshold. Heavy breathing, or as we have come to know it—snoring—is the result. Snoring can be a way for the body to off-load CO<sub>2</sub> and maintain the medulla’s programmed set point during the hours of sleep, much like frequent sighing or yawning can do during the day.

Apnea is the medical term to describe slowed or stopped breathing. During sleep, a person may experience two types of apnea: central sleep apnea occurs when the brain does not send muscles the message to breathe; obstructive sleep apnea (OSA) occurs when the relaxed soft tissue of the tongue and throat block the airway. Excess weight and obesity often play a role in OSA, which is more common than central sleep apnea. Sleep apnea is characterized by frequent periods where the breath stops altogether, and the most common symptoms are loud snoring, gasping for air during sleep, awakening with a dry mouth, morning headache and difficulty staying asleep (insomnia).

Central sleep apnea may be triggered by large drops in CO<sub>2</sub> resulting after a bout of heavy snoring. While apnea allows for the body to restore or replenish its CO<sub>2</sub> to viable levels, it is a challenging method for doing so: as soon as the threshold of intolerance is hit, the person wakes with a big snort and gasp, exhaling deeply, and then the whole cycle begins again. While there can be mechanical issues that factor in, as with OSA, it is valuable to understand the role that excessive breathing plays when it comes to disordered breathing during sleep. Breathing plays a key role in both central and obstructive sleep apnea and people can suffer with a combination of both types. Sleep apnea and the use of continuous positive airway pressure (CPAP) machines will be discussed more in [Chapter 5](#) as we explore the biomechanics of breathing. Heavy breathing, especially in the early morning hours, has been implicated in clinical observations and medical studies with high mortality rates for asthma, cardiac arrest, strokes, and seizures.<sup>29</sup>

Of course, we all know that without good restful sleep, it is hard to have much pep or *udāna* (positivity) in the morning. When we don’t sleep well, we experience a *prāṇic* drain that systematically breaks us down and leaves us even more vulnerable to stress, to illness, to emotional upset. More stress leads to faster breathing during the daylight hours, which is a set-up for dysfunctional breathing patterns at night. Multiple comorbidities have been associated with poor sleep, from cardiovascular disease to obesity. Identifying and transforming BPD and bringing breath rate and volumes down to normal levels will greatly help to increase the quality of sleep.

## **Hyperventilation Syndrome and Buteyko**

Dr. Buteyko’s work centered on the exploration of hyperventilation syndrome (HVS) and he designed a rigorous breath retraining regime that required 24/7 attention to counter it. Most of his patients were critically ill in hospital and were closely monitored as they went through treatment. Dr. Buteyko’s protocol emphasized what he termed “reduced breathing,” a practice of intentionally breathing “less than desired” for 10–20-minute blocks of time, multiple times per day. He punctuated these sessions with various levels of breath holds of increasing difficulty. As patients improved, he encouraged them to get up to 5–6 hours of easy exercise every day.<sup>30</sup>

Through the process of reducing and holding the breath (which in the Buteyko method is always done on the hold after exhale), CO<sub>2</sub> levels in the system build. While initially this practice feels suffocatingly hard, once CO<sub>2</sub> levels begin to rise, the practice becomes easier, even quite pleasant, and the positive effects can be readily experienced. Buteyko educators today are incredibly knowledgeable and highly skilled at adapting this practice to work with serious health conditions, as well as with athletes interested in increasing sports performance. If you believe that you or your students would benefit from the Buteyko practice, I strongly encourage you to contact the Buteyko Breathing Educators Association (BBEA) or the Buteyko Clinic International to find a qualified educator in your area.<sup>31</sup>

## KEY CONCEPTS

---

- Chronic hyperventilation is one of several BPDs.
- The average person breathes 15,000–20,000 times a day. People with chronic pain, illness, or anxiety and/or those who talk for a living often breathe 2–3 times more than normal (both faster rate and more volume).
- The symptoms of HVS mimic many of the common maladies described by yoga students and yoga therapy clients.
- Taking a big sigh or gasp will alleviate the immediate sense of dyspnea, but it perpetuates the chemical imbalance that promotes hyperventilation.
- Subtle Breathing (described below) is a reduced breathing practice and the basis for all prāṇāyāma practices offered in this text.

## — PUTTING IT INTO PRACTICE —

### Subtle Breathing

As suggested by both the ancient yogis and Dr. Buteyko, practicing prāṇāyāma multiple times during the day in a reduced way (creating slight air hunger) will eventually alter your autonomic nervous system response and blood chemistry. Perhaps even more importantly, this way of practicing maintains a level of svādhyāya (self-awareness) effectively reinforcing the intention to keep the breath slow and low, and illuminating how you breathe through the day. This, more than anything, has the potential to help you recognize the habituation or saṃskāra of over-breathing and its impact on your body and mind.

Consistent practice also helps with the management of your Energy Bank Account (as detailed in [Chapter 2](#)), as focus on the breath synchs your mind with all of your physiological functions. At this point in your exploration of the breath, you hopefully have a good sense of your daily breath patterns and your average **CP**. While current standards of testing have identified only 10 percent of the population as being affected by HVS, the number is probably far greater. You may or may not identify yourself as being a chronic hyperventilator, however I would still recommend working with the **Subtle Breathing** practice to experience how it feels to refine the breath to a state of sūkṣma (subtlety).

In Swami Saraswati's book *Prāṇa and Prāṇāyāma*, I was very pleased to encounter a description for **Akasha Breathing** (*akasha*, pronounced ah-kah-sha, meaning space—the

most subtle of all the elements), which matched the Buteyko method albeit without the emphasis on creating air hunger.<sup>32</sup> It affirmed my trust that this knowledge existed in the Vedic tradition. Swami Saraswati suggests that developing awareness of the *swara* (pronounced sva-rah), the subtle flow of the breath, is the starting point for understanding the progressively more refined breathing practices delineated in the Hatha Yoga Pradipika and other texts. My description of Subtle Breathing merges Akasha Breathing and Buteyko's Reduced Breathing together. It forms the basis for all the other prāṇāyāma practices that will be described in later chapters of this book.



*Photo 1 Subtle Breathing on Chair with Hi-Low Hand Position*



*Photo 2 Subtle Breathing with Prop Support*



*Photo 3 Subtle Breathing Sitting on Floor*

This can be practiced seated upright in a chair or on a bolster/cushion on the floor—whatever position is most comfortable and relaxing for the practitioner. If the seated position is accompanied by pain or discomfort, it is best to work semi-reclined or even supine with ample support under the neck and knees, to relax the spinal musculature and facilitate undistracted focus on the breath.

To gain the most *svādhyāya* from this practice, I recommend you take your **CP** before starting and again at the end (see Putting It into Practice at the end of [Chapter 3](#)). For those with a CP below 10, as well as those with any kind of cardiovascular conditions, please build the practice slowly and resist the urge to push as this could elevate your heart rate or bring on feelings of anxiety. Even those with a higher CP will discover that pushing beyond your tolerance will likely result in you taking a large gasp of air reflexively, defeating the intention of the practice.

Taking your heart rate (**HR**) before and after practice is another way to self-monitor and gain awareness of how the practice is serving you. At the end of a good practice your CP will go up by a few seconds and your HR will lower or remain unchanged. If the CP is lower and HR higher, this is an indication that you pushed beyond your capacity. Please note that daily fluctuations in both CP and HR are normal within 1–4 seconds/beats. This

process is non-linear, in that over time your lifestyle, sleep patterns, dietary habits, exercise routines, emotional states and *vṛttis* (whirlpool of thoughts) will all affect your numbers and the felt sense during the practice.

## RECOMMENDED PRACTICE: 4–6 TIMES A DAY (FOR 5–10 MINUTES A SESSION)

---

- Begin by taking your **CP** and **HR** using a timer or stopwatch, and make note of them in your **Svādhyāya Breath Journal**.
- Place one hand on the chest and the other hand just below the front of the rib cage (in the area of the solar plexus).
- If the arm position is uncomfortable, use pillows or towels to prop the arms, so the neck and shoulders can relax fully.
- Breathe softly through the nose, pacifying the muscles of the chest so there is no movement of the upper rib cage or tension in the neck.
- Emphasize a soft lateral flare of the lower ribs with the inhale, and a gentle inward contraction with the exhale.
- Place attention on the sensations of the breath moving through the nostrils.
- Progressively make the breath lighter as if making the breath “invisible.”
- Visualize the subtle breath permeating every cell within you, as if you are inhaling voluminous space rather than air.
- Consistently lighten the exhale so it becomes thread-like and imperceptible.
- The breath is silent, movement becoming less discernible with each cycle.
- Discover the soft edge of air hunger, where you are aware of a desire to take in more, yet you are not “starving” for air.
- The key to the practice is maintaining a *sustainable* level of air hunger without pushing yourself into the need to gasp or gulp more air.
- If you lower the volume too much, the rate will pick up.
- Note that if you slow the breath beyond what is sustainable, the volume will increase.
- Find the tolerable level of *low and slow* Subtle Breathing and maintain it for 2–3 minutes. Use a timer or stopwatch so you can focus on breathing for the full amount of time.
- After a round of Subtle Breathing, continue to breathe through the nose but relax the breath and release the hands from your belly and chest.
- Notice the contrast between your normal breath rate/volume and the effects of Subtle Breathing on your system; observe (1–2 minutes).
- Repeat another round of Subtle Breathing, building to 3–4 minutes as is tolerable.
- Then rest again and observe (1–2 minutes).
- If possible do another round of Subtle Breathing, building to 4–5 minutes.

- Eventually build your tolerance to sustain your Subtle Breathing time for 5–10 minutes per round (with a 1–2 minute relaxed breathing break in between).
- End the practice with a period of natural breathing for 2–3 minutes.
- Then measure your **CP** and **HR** again using a timer or stopwatch; make a note of them in your **Svādhyāya Breath Journal**.

**Note:** The lower your CP at the start, the more quickly you will experience sensations of breathlessness. Work gently, always maintaining a quality of relaxation even while experiencing the challenge of breathing less. As you practice Subtle Breathing, you may experience a variety of sensations that are quite normal responses. These include:

- sensations of warmth in the limbs or center of the body
- sensations of cold in the limbs or center of the body
- an increase of saliva in the mouth
- a sense of moistening in the eyes or slightly glazed/diffused gaze
- draining of the nose—especially if there is light congestion
- an opening of the sinus passageways
- a feeling of calm, alert awareness in the mind
- relaxation in the body without sleepiness.

If you feel sleepy or drowsy, it is likely that you were not riding the edge of air hunger but rather stayed in a comfortable, relaxed breath zone. Gaining the benefit of **Subtle Breathing** requires dropping below the level of pure comfort to another state, where every breath requires attention and fine tuning. The practice of Subtle Breathing is much like riding a surf board—you need to stay alert and observe every wave so as to constantly adjust your balance to stay afloat. You want to learn to calibrate as you practice, in order to keep yourself in the *zen-zone of tolerable discomfort*.

Patrick McKeown offers a downloadable reduced breathing app that has served many of my students well, as they are learning to practice breathing less. With his lovely Irish accent, this app is like listening to a yoga *nidra* (pronounced ni-dra, sleep), and is a fabulous way to begin the day or help you reduce the breath to prepare for sleep. It is available at the iTunes app store: ButeykoClinic Self Help Program.<sup>33</sup>

## CHAPTER SUMMARY

---

- The definition of hyperventilation is breathing in excess of metabolic production of CO<sub>2</sub>, resulting in PaCO<sub>2</sub> levels dropping below normal (40 mmHg).
- Hyperventilation syndrome (HVS) is often missed by routine medical examinations.
- Approximately 10 percent of the population have been found to present with HVS.
- Children who hyperventilate often exhibit symptoms such as asthma, behavior problems, sleep disturbance, and chronic respiratory infections.
- Stress and pain both increase respiratory rate; chronic, can instigate HVS.



- Many yoga students and yoga therapy clients seek out yoga for relief from chronic stress and pain. However, many yoga breathing techniques as currently taught can exacerbate HVS and therefore stress and pain.
- Breathing is a difficult saṃskāra to change because of its pervasiveness—you breathe constantly.
- Functional breathing is associated with healthy vital physiological processes.
- Dysfunctional breathing is an indication of a breathing pattern disorder and can disrupt vital physiological processes.
- Chronic hyperventilation (over-breathing) changes the set point of the medulla, leading to sustained low levels of CO<sub>2</sub> and bicarbonate, which changes the body's pH.
- The effects of chronic hyperventilation create a cultivated “intolerance” to CO<sub>2</sub>, experienced as a feeling of dyspnea (breathlessness).
- HVS sustains sympathetic arousal of the autonomic nervous system.
- Respiratory alkalosis results from HVS and makes the body less able to tolerate acid.
- People with HVS are more prone to chronic inflammatory conditions like IBS and GERD.
- Frequent urination can be a symptom of HVS.
- The medulla doesn't reset easily—the longer the pattern of hyperventilation has been set, the more arduous the breath retraining process.
- People with HVS have low exercise tolerance and tire quickly.
- Recruitment of accessory breathing muscles, as is necessitated with hyperventilation, consumes large quantities of oxygen.
- This lowers the amount of O<sub>2</sub> available for dispersion and increases the feeling of dyspnea.
- Hyperventilation during the day is correlated with snoring at night and sleep apnea.
- Similar to the yogic method of Akasha Breathing, Dr. Konstantin Buteyko prescribed a practice of reduced breathing combined with breath holds multiple times a day (to bring CO<sub>2</sub> levels back up to normal).
- **Subtle Breathing** forms the primary foundation for prāṇāyāma practices in this book.

## Chapter 5

---

# BIOMECHANICAL CONSIDERATIONS NOSE VERSUS MOUTH

*If you can breathe through your nose for a minute, you can breathe through your nose for the rest of your life.*

Patrick McKeown

When I was just beginning to practice yoga 30 years ago, one of my favorite yoga teachers, Ramanand Patel, used to shout out, “Breathe through your nose! If you continue to breathe through your mouth, I’ll feed you through your nose!” I appreciated both Ramanand’s humor and his straight talk. I was quite obedient. Ever since then, I have obediently breathed through my nose, never my mouth, while on my yoga mat.

The most disconcerting discovery I made during those first few weeks that I practiced Buteyko was that apparently when I wasn’t on a yoga mat, I was a habitual mouth-breather and had been one my whole life! If I wasn’t teaching or socializing, I was talking to myself. As I paid attention, I realized I perpetually had my mouth open as if prepared to speak at a moment’s notice.

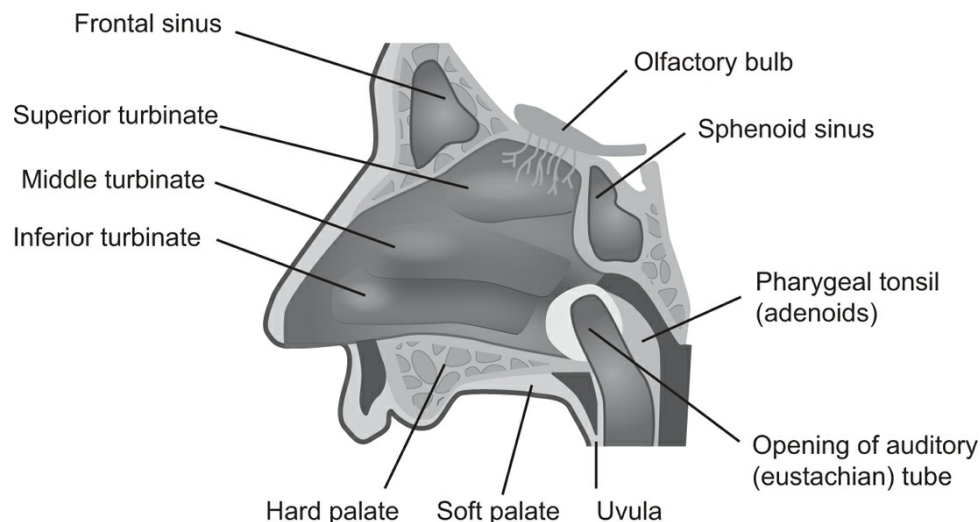
Connecting the dots, I could see that my health began to deteriorate precisely at the same time that my teaching schedule escalated and my first grandchild was born. My work days were spent lecturing, chanting, or guiding people through sequences. On my days off, I was singing lullabies and cooing to my sweet granddaughter, Amirra. When I was on my yoga mat, I was taking big ujjayi breaths in āsana, followed by prāṇāyāma sessions centered around extending inhale and exhale. I ended my days with a rousing chorus of intense snoring.

Twenty-four-seven my mouth was open, and prāṇa was pouring out. I now understand that metaphorically I was leaking a vast amount of energy. Learning that my excessive over-breathing actually induced physiological instability—leading to a complete health crisis—finally motivated me to shut my mouth. I learned to become a full-time functional nose-breather. I finally understood the truth and wisdom behind the yogis’ call to “Talk less and eat less”—ensuring that the mouth be kept closed except when absolutely necessary, the prāṇic hatch sealed.

## In the Beginning There Was the Nose

Before encountering Buteyko, I had little appreciation for how much the nose—or rather I should say, the nasal cavity—does to ensure our health. It turns out that the nose has more than 30 unique functions, from acting as the body’s humidifier, sterilizer, and temperature regulator to ensuring optimum oxygen uptake in the lungs.<sup>1</sup> Its job is much bigger than simply being a passageway for air coming in and out of the body. In fact, the protuberance we identify as our nose is merely the awning out in front.

The nasal cavity itself is quite large. If you run your tongue along the upper hard palate and follow it front to back until it reaches the soft, spongy tissue, that entire space is the floor of your nasal cavity (see [Figure 5.1](#)).



*Figure 5.1 The Nasal Cavity*

A thin wall of bone and cartilage called the septum divides the nasal cavity into two separate “noses” (right and left) that are heavily engaged in a variety of processes that ensure that your lungs, heart, and other organs are well supported in maintaining your health.<sup>2</sup> Here are just a few of the primary jobs of the nose:

- preparing the air to enter the lungs (by warming, cleaning and humidifying)
- controlling air flow (movement)
- providing opposition to the air flow to slow its force (i.e. nasal resistance)
- providing the mechanism to trigger nasal reflexes (e.g. sneezing, histamine release)
- initiating the smell reflex
- encouraging nasal flow during sleep.

## Preparing the Air

The nose warms, moistens, and purifies the air we inhale to prepare it for delivery to the lungs. Temperature control may not be what most of us consider the nose’s chief employment, but it actually provides approximately 90 percent of the air-conditioning requirements for the respiratory system and retains 33 percent of exhaled heat and moisture.<sup>3</sup> In addition, the nasal passageways are lined with sticky mucus layers and tiny hair-like structures called cilia, which circulate antibodies and act as the immune system’s first line of

defense. These cilia and mucus layers—along with the lymphatic system, arteries, and veins—provide a protective barrier to keep out bacteria, microbes, and airborne pollutants.<sup>4</sup>

Each day we inhale between 10,000 and 20,000 liters of air laden with foreign particles. The nose removes these deposited particles within 15 minutes, while it can take 60–120 days for them to be removed from the alveoli within the lungs.<sup>5</sup> Our lungs serve as our primary physiological contact with the external environment; the lungs’ surface area is 30 times greater than that of the skin.<sup>6</sup> Nasal breathing ensures our body’s innate humidifying and sterilization system functions as intended to protect us from noxious and infectious substances.

## ***Control of Flow***

Thin networks of bone, vessels, and soft tissue within the nose called turbinates help to regulate and direct the velocity of the air stream as we breath. Turbinates create “whirls and eddies” designed to trap dust particles and other unwanted visitors and deposit them into the mucosal lining.<sup>7</sup> Nitric oxide (NO)—another very important gas for our respiratory and immunological health—is released from the maxillary sinuses and helps support oxygen uptake from both the nasal passageways and the dead space of the upper airways. This increases ventilation to the lungs.<sup>8</sup> NO also appears to have bacteriostatic properties, in particular in the prevention of staph infections.<sup>9</sup>

The nasal mucosa has a keen hydraulic system designed to clear out harmful agents, while providing safe passage from the upper airways to the lower airways for that which is beneficial. Colds, flus, and allergens can temporarily disrupt this flow by clogging the system, further exposing an already compromised immune system to greater attack.

Under normal conditions, the flow of the breath oscillates from one nasal cavity to the other approximately every 1–4 hours, depending on the person and circumstances. These changes are part of a rhythmic, cyclic flow, which responds to the size of the turbinates, the position of the head (upright or supine body position), and respiratory demand.<sup>10</sup> According to the yoga tradition, the shifts in nasal dominance directly relate to subtle energy flow and sympathetic versus parasympathetic dominance in the nervous system. This will be examined more fully in [Chapter 9](#).

The science of prāṇāyāma utilizes techniques that require sealing one nostril while creating a flow valve through the other. These techniques (which will be described in [Chapter 9](#)) were used for at least three major purposes: to alter perspective, direct prāṇa, and activate or sedate the autonomic nervous system. One interesting study done at the Kaivalyadhama Institute in India validated the efficacy of an ancient device called “yoga danda.” A stick placed under one armpit manipulates the flow of the breath in the nostril. The study verified that the breath in the nostril opposite to the yoga danda became markedly freer than that of the nostril of the same side. The results were the same in all subjects, irrespective of age or sex.<sup>11</sup> You can do your own yoga danda experiment by placing your right hand under your left armpit and observing the shift in flow through the nostrils—or vice versa.

## ***Nasal Resistance***

Breathing through the nose increases nasal resistance to twofold that of the open mouth.<sup>12</sup> The nose creates a much smaller funnel for the air to pass through, which streamlines the flow and boosts the efficiency of oxygen uptake. This supports better perfusion and increases

elasticity of the lungs. It also improves diaphragmatic function.<sup>13</sup> Additionally, nasal resistance expands the expiratory phase of respiration, slowing it down and lengthening the exhale. This is known to support parasympathetic activation or the relaxation response.<sup>14</sup> Nasal resistance helps the airways stay hydrated and provides good mucus clearance.<sup>15</sup>

In the case of serious conditions like emphysema and COPD, excessive resistance results from structural damage to the respiratory tissues. This can result in poor ventilation and lung dysfunction.<sup>16</sup> However, these types of conditions would, in general, be beyond the scope of yoga therapy without additional training in respiratory pathology. They will not be addressed specifically in this text.

## ***Nasal Reflexes***

The nerves of the nose are highly attuned to other structures in the body, specifically the ears, throat, larynx, heart, lungs, and diaphragm. These are all part of the pathway of the vagus nerve, the primary nerve modulating the autonomic nervous system. Diaphragmatic breathing with healthy recruitment of the abdominal muscles correlates with activation of the parasympathetic system.

People who have a nasal blockage due to a severe deviated septum, nasal polyps, chronic congestion, or asthma have diminished nasal reflex on the side that is more restricted. This will subsequently restrict diaphragmatic function. There is evidence, in fact, that narrowing or stenosis of one nasal passageway can decrease the play of the diaphragm on the same side by 2–5 cm.<sup>17</sup>

One study by Bartley (2006) found that people who are anxious typically present with nasal congestion and are likely to have lower than normal arterial levels of CO<sub>2</sub>.<sup>18</sup> Nasal breathing has been shown to increase partial pressures of both O<sub>2</sub> and CO<sub>2</sub>.<sup>19</sup> Slow breathing through the nose, at a low volume, elevates arterial CO<sub>2</sub> levels, which can greatly help alleviate nasal congestion.<sup>20</sup>

## ***The Smell Reflex***

The nose is responsible for our olfactory system, the bodily structures that serve the sense of smell. Mammals make strong use of their olfactory centers, as smell is intricately linked to survival. Through our evolution as a species, however, we have become heavily reliant on our visual and auditory centers, thus diminishing our primitive connection to the sense of smell. The olfactory center is located within the oldest and most primitive (reptilian) part of our brain and it is a structure called the rhinencephalon (smell-brain), which interacts directly with our autonomic nervous system.<sup>21</sup> The limbic (reptilian) brain is our emotional center, which is why memories of tragic or joyful events in our lives often conjure up smells. Vice versa, odors and aromas can also remind us of past events. Our autonomic system was designed to utilize the sense of smell to “read the terrain” on an immediate and subconscious level, raising an alarm in the presence of danger and enemies, signaling a food trail, and even identifying potential mating partners.

Physiologists have found that olfactory stimulants can alter respiratory rate—either increasing it or depressing it to the point of temporary apnea (cessation of breathing). Some olfactory irritants have been shown to cause arrhythmia or hypertension.<sup>22</sup> Therefore, both nasal reflexes and nasal resistance are linked to increased efficiency of the lungs and proper rhythmic action of the heart.<sup>23</sup>

In yoga philosophy, the chakra system correlates with the first or root chakra (energy center)—with survival and the sense of safety, grounding, and trust. Interestingly, the first chakra is also associated with the sense of smell. When a baby searches (via sense of smell) for its mother's nipple, it is said to be rooting. [Chapter 9](#) explores prāṇāyāma and the chakra system and will develop this association further in relation to the usefulness of aromatherapy to balance and modulate nervous system reactivity.

## ***Nasal Flow during Sleep***

During sleep, breathing is unilateral. When side-lying, which is optimal for proper breathing, the lower nostril becomes congested. It is the shift in nasal congestion that initiates movement of the head, and signals the body to flip over like a rotisserie chicken during the night. A poorly functioning nose, where one side is consistently blocked—or nasal flow is completely eclipsed by mouth breathing—may keep the body and head in one position for hours, which can result in backaches, cramps, circulatory problems, and limb numbness.<sup>24</sup> Normal functioning of the nose is an important part of ensuring a good night's sleep. Observing your sleep position and its impact on quality and duration of sleep is another useful means for svādhyāya.

## **The Nose versus the Mouth**

Over the years, mouth-breathers have suffered a significant amount of disparaging and none-too-complimentary commentary in books and the media. They are often referred to as being “slack-jawed” and “less than intelligent.” As a life-long mouth-breather, I have compassion for people who breathe through their mouths. At the same time, the mouth was never intended to be the primary breathing apparatus, as consistent mouth breathing accompanies a wide range of physiological, psycho-emotional, and structural problems.

Mouth-breathers show cognitive impairment that can negatively affect memory, concentration, attention, learning, and sensorimotor integration.<sup>25</sup> Children who mouth breathe often display excessive daytime sleepiness and have close to ten times the risk of learning difficulties.<sup>26</sup> Migraine and tension headaches, as well as temporomandibular joint pain have been associated with mouth breathing and breathing pattern disorders.<sup>27</sup> Mouth breathing increases acidity in the mouth resulting in high rates of dental cavities and gum disease; it also contributes to bad breath due to altered bacterial flora.<sup>28</sup> Furthermore, mouth breathing is highly correlated with hyperventilation, anxiety, depression, fibromyalgia, and IBS.<sup>29</sup>

When we breathe in through the mouth, the air spends far less time being properly conditioned, i.e. warmed, cleaned and humidified, in the dead space of the upper respiratory tract. In asthmatics, inhaling cold, dry air via the mouth can, in and of itself, trigger bronchoconstriction and spasms.<sup>30</sup> Mouth breathing on exhale impacts our humidification and ability to maintain proper body heat. The nose humidifies and warms the air to correct moisture content and temperature before it is drawn into the lungs, and breathing out through the nose allows the body to recover both the moisture and heat, which conversely promotes nasal decongestion. Mouth breathing doesn't support proper respiratory function. As discussed in the previous chapter, mouth breathing is associated with the activation of the accessory muscles of the chest. Consistently, mouth breathing (even when the nose is

obstructed by a cold or a structural impediment) tends to be faster, bigger, and less diaphragmatically regulated, leading to poor ventilation in the pockets of the lungs.<sup>31</sup>

There is a direct link between nasal breathing and proper diaphragmatic action, which ensures better ventilation/perfusion by bringing the air deep into the lungs where blood flow is highest. In fact, nasal resistance doubles the movement of the lungs relative to mouth breathing. The absorption of nitric oxide from the nose also increases perfusion throughout the lungs.

Alternately, mouth breathing is correlated with chest breathing and may negatively impact on lung function.<sup>32</sup> Chest breathing—that is, the use of accessory respiratory muscles of the upper torso—tends to activate the sympathetic nervous system, increasing both heart and respiratory rate. In order to activate the accessory muscles, chest breathing requires greater consumption of oxygen.<sup>33</sup> The nostrils are small relative to the mouth so if yogis want to reduce vata and retain prāṇa by keeping the volume of inhaled air low, nasal breathing is the far better choice.

To summarize, mouth breathing:

- often increases ventilation, leading to possible hyperventilation
- bypasses the immune system's first line of defense
- results in the air taken in being cold, dry, and dirty
- exposes us to toxins and infectious matter
- limits the function of the respiratory system
- decreases perfusion and diaphragmatic movement
- correlates with chronic nasal congestion and inflammation in airways
- lowers CO<sub>2</sub> levels
- de-oxygenates the brain and muscles
- dehydrates the body
- correlates with sympathetic nervous system activation
- relates to anxiety, tension, chronic pain, cognitive impairment, and sleep disorders.

Mouth breathing is really designed as a back-up system, when there is nasal obstruction or in the case of increased exertion as during stress or intense exercise. Replacing mouth breathing with nasal breathing, even without any other type of breath retraining, has been shown to improve lung function and reduce asthma exacerbations.<sup>34</sup>

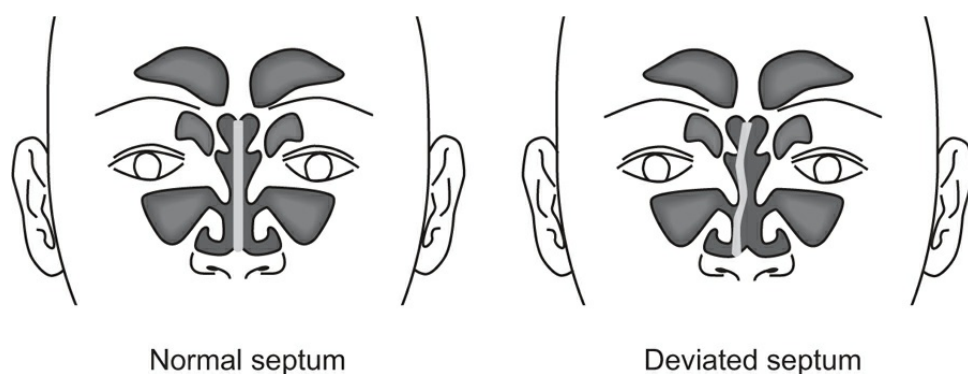
## Why Do People Mouth Breathe?

There are a variety of reasons why people become mouth-breathers. Some of it starts—as it did with me—in early childhood with obstruction of the airways due to enlarged adenoids and tonsils. Although my adenoids were removed when I was four, the doctors opted to spare my tonsils, which continued to block my airflow, and since nobody taught me to breathe properly through my nose, mouth breathing prevailed. For some, there may be hypersensitivity to airborne allergens like dust or pet dander, which clog the nose. Food



sensitivities can also increase mucus production and nasal congestion. Genetics may play a role in some of the allergic and structural predispositions to mouth breathing.

I have often had clients claim that a deviated septum makes it impossible for them to nasal breathe (see [Figure 5.2](#)). In fact, a small percentage of people have a severe deviation that inhibits sufficient airflow through the nose and requires surgical intervention. If you or one of your clients have a structural blockage at this level, it is worth investigating surgery. Prāṇāyāma, or breathing retraining techniques, will simply not be applicable until the nasal passage is open for business.



*Figure 5.2 Normal and Deviated Septum*

For most people, however, it is the habituation of mouth breathing itself which becomes a self-fulfilling prophesy. The more one breathes through the mouth, the stuffier the nose becomes.<sup>35</sup> Chronic mouth breathing easily becomes chronic hyperventilation, and then lower CO<sub>2</sub> levels will compound nasal congestion.

As compelling as it may be to switch over to nose breathing, convincing those who are stuffed up to make the change is a tough sell. This is especially true if people have other complicating symptoms like asthma or anxiety, as nasal breathing can initially incite a sense of panic or suffocation until the airways fully unblock and CO<sub>2</sub> levels begin to rise. Just closing the mouth and breathing through the nose is already a form of reduced breathing. Breath retraining must be done slowly, and with lots of encouragement to allow for a re-acclimation of all the variables from the biochemical components to the structural and emotional. (See the **Nose Clearing** exercise in the Putting It into Practice section at the end of this chapter.)

### AN AYURVEDIC PERSPECTIVE

Congestion, infection, and inflammation in the upper airways (nose, nasal passageway, and trachea) can cause reciprocal irritation in the lower airways (the bronchioles and lungs). Increased histamine levels and edema (swelling) in the bronchioles can translate to congestion in the nose and chronic post-nasal drip.<sup>36</sup> Although the upper and lower respiratory tracts are parceled out into separate medical specialties—ears, nose, and throat (ENT) and pulmonology—they function as a unified system. What inflames one will set off a chain reaction of inflammation in the other. There is evidence to indicate that optimal management of the disease processes in the upper respiratory tract may benefit the lower tract as well.<sup>37</sup>

This chain reaction forms the basis for Dr. Buteyko's theory with regard to hyperventilation syndrome. He proposed that respiratory inflammation, congestion, and bronchiole constriction—as seen in conditions like asthma—are actually in reaction to the excess volume of air blowing through the airways, due to hyperventilation. In essence, he suggested that in the asthmatic, the airways constrict as a defense mechanism to prevent the body from breathing too hard in an attempt to preserve vital CO<sub>2</sub>!

When I was first introduced to the idea that excessive breathing induces inflammation, which leads to congestion, what came to my mind were the five elements and the Ayurvedic doshas. To review, the doshas are the three subtle energies that are each a composite of two of the natural elements. Each dosha embodies the qualities of the elements it contains.

- **Vata** comprises air and ether. It is dry, cold, mobile, subtle, and light.
- **Pitta** comprises fire and water. It is hot, pungent, sharp, subtle, and penetrating.
- **Kapha** comprises earth and water. It is dense, heavy, solid, stable, cold, and oily.

From an Ayurvedic perspective, the trauma created by over-breathing would be assessed as an excess of vata dosha, or excessive wind. What happens to our skin when it is exposed to an excess of wind, and in particular a cold, dry wind? Immediately, what comes to mind is chapped hands and lips on a ski-slope. The skin becomes inflamed and red, maybe even cracked and swollen (pitta). What I want to do in that circumstance is coat my lips with some luscious emollient to protect, soothe, and heal them (kapha).

So, one way to think of chronic inflammation and congestion in our lower and upper airways is to think of it as our wise body's response to excessive amounts of deconditioned air. When we mouth breathe, it is as if we are blowing a tornado over the surface of our airways. They become raw and inflamed, or pitta-deranged, and the innate protector of our system—kapha—sends help in the way of mucus.

If we keep up the heavy breathing, there's no opportunity to walk back the process, so the airways feel continuously clogged and we're ever more convinced that we need to breathe through our mouth. Complicating all of this is the reaction to the loss of CO<sub>2</sub> on the smooth muscles that surround the airways; they constrict. As the chest walls tighten and nasal passageways narrow, the overwhelming urge to breathe harder causes bigger mouth gulps of air. Thus, the process continues with seemingly no end in sight.

Following the counsel of the Ayurvedic masters, the first order of business would seem to be to reduce vata. In other words: *breathe less, lighter, and through the nose*. The less breath moving through the airways, the less inflammation and loss of CO<sub>2</sub>. As CO<sub>2</sub> levels increase, the big squeeze on the airways loosens, congestion reduces, the body relaxes, and the urge to breathe hard dissipates.

Figure 5.3 depicts the increase in pitta (inflammation and swelling) as well as kapha (increase in mucus) in direct response to the derangement of vata in the airway.

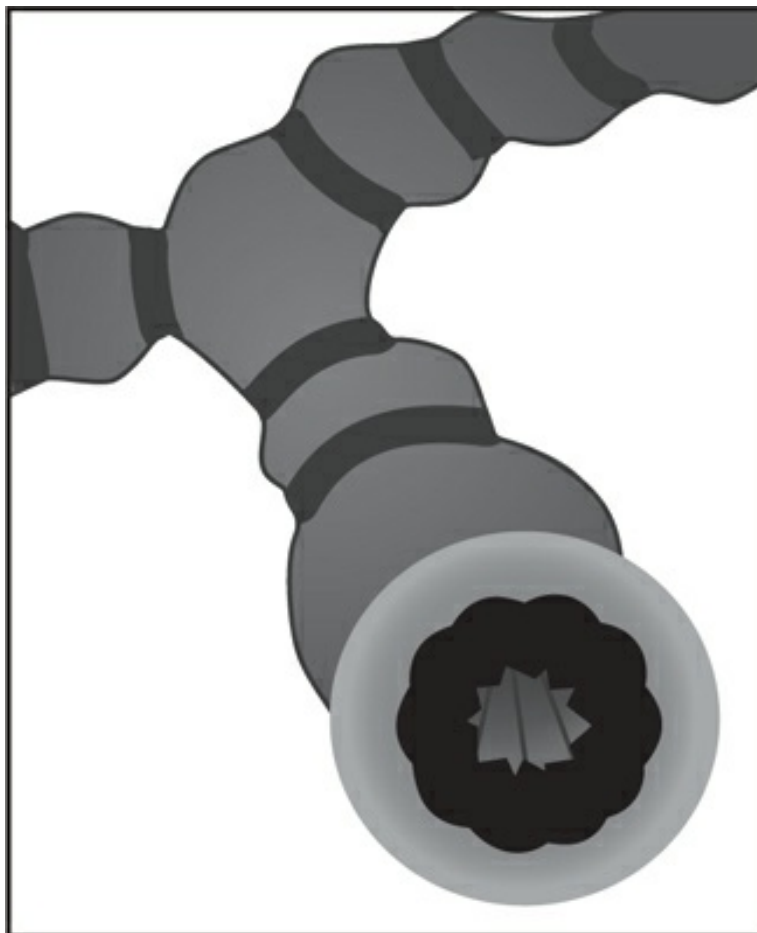


Figure 5.3 Asthmatic Airway: Ayurvedic Perspective

## Shutting Your Mouth: Harder Than It May Seem

Even though it seems, with this information, that there is plenty of impetus to train yourself to become a full-time nose-breather, switching over is not so easy. When someone is a life-long mouth-breather, muscles in the face, nose, and mouth can actually become deconditioned, as with any muscle that is underutilized. These muscles have to be retrained along with the breath.<sup>38</sup> Tongue placement also plays a vital role. In mouth-breathers, the tongue tends to rest flaccidly on the lower palate, as opposed to pressing up into the hard palate and staying parked up top at the roof of the mouth. It takes regular effort and consistent practice to keep the tongue in place.

Traditional yoga prāṇāyāma practices can be practiced with various tongue positions or *mūdras* (pronounced moo-drahs) that require a certain tonicity in the muscles of the tongue. Perhaps the yogis were looking for ways to develop the strength to maintain proper tongue placement 24/7? In children, proper placement of the tongue is the primary determinant of jaw and facial development. This has been shown to have a significant effect on sleep, behavior, and cognitive function in child development. For all these reasons, addressing mouth breathing in children is an extremely important issue.<sup>39</sup>

Along with retraining the tongue, becoming a nose-breather also means retraining your speech patterns. Speaking and breathing are interconnected. It may seem obvious, but somehow it didn't occur to me that the incessant verbiage that flew from my mouth when teaching contributed to my exhaustion. Over-breathers often tend to deliver their thoughts in an unrelenting torrent of fast, intense speech punctuated with swift, open mouth gasps. My Buteyko teachers taught me to pace speech in the following ways: keep phrases short; close the mouth with every comma and period; breathe in only through the nose. What a revelation. Initially, it felt as if I was speaking so s-l-o-w-l-y. I was concerned that if I didn't spill it all out at once, I might lose my audience's attention. To the contrary, people commented that it was easier to take in what I was saying because my pauses gave them time to consider and reflect.

I have found that this new way of speaking is calming. It keeps my mind more in charge of my mouth, allowing me to think before I continue. I also find it is far less dehydrating and I feel less fatigued, even after lecturing for 3–4 hours. I've included a few simple tongue and speech exercises at the end of this chapter, as well as some ideas of how to learn more about working with these muscles via speech therapy (focused on mental and physical aspects of language production) and myofunctional therapy (which targets the facial muscles used to perform physical tasks such as chewing and swallowing).

## Mouth Breathing, Alignment, and Core Engagement

Yoga teachers know the value of good alignment. *Tadāsana* (pronounced ta-dah-sa-na, Mountain Pose) rules! Balancing the pelvis over the heels, the shoulder girdle over the pelvis, and centering the head in line with the shoulders is a fundamental part of training and instruction for yoga students. Entraining the core muscles to support this verticality is a key part of āsana practice and usually requires a continuous flow of reminder cues. The next two chapters explore the core in great detail.

Western culture does very little to support good alignment. Cushy sofas and chairs with backs that do the work of our spinal muscles contribute to the ubiquitous posture that I call “slump-āsana.” Computers and now cell phones that demand we dip our heads forward and down have created the phenomenon known as “text neck.” This repetitive stress injury is described by my chiropractor friends as resembling severe whiplash on an X-ray. Forward

head posture which accompanies “sag and sway”—the postural misalignment I see most commonly in my work—is a challenge to transform, as people seemingly have very little awareness of where their head is in space.

One could ask which came first: poor breathing or poor alignment? The fact of the matter is that both sides of the issue have to be addressed. Chronic mouth breathing affects the musculature of the upper body, particularly the upper traps, pectorals, and scalenes, which become overactive and hypertonic. They then become locked in a shortened position. Doing chest opening asanas like Fish Pose, Upward Dog, and other kinds of postures to realign the thoracic and cervical structures will temporarily relieve strain from shortened muscles, but if the mouth-breathing habit is not addressed, once out of the pose, the anterior head position will return. This is because a lifetime habit of mouth breathing actually alters the construct of the upper airways.<sup>40</sup> According to osteopath and Buteyko Educator Rosalba Courtney, who has published numerous papers on breath retraining, any tendency of the head to be carried forward of the body should be considered in relation to accompanying breathing pattern changes. She points out that forward head posture “is a well-known response to obstructed breathing and is common in children with chronic nasal allergy and mouth breathing because this head position opens the upper airways.”<sup>41</sup> As with other saṃskāras, once established, forward head thrust can become a demon of its own and difficult to transform.



With this in mind, it is critical to address mouth-breathing patterns. This may mean exploring whether there is a physical obstruction preventing nasal breathing and tending to it medically, or discerning if it is a matter of habit. Either way, attempting to change the structural alignment of the neck and shoulders without giving significant time and attention to the breath will potentially create stress in the client and produce poor results.

#### **MOUTH-BREATHING EXPERIMENT**

To understand the symbiosis of mouth breathing and anterior head carriage, open your mouth and breathe for the next few minutes. Notice that your jaw juts forward and your neck hyperextends. This is because the mechanics of mouth breathing requires a displacement of the upper airways. In response, the head has to move forward to alleviate the strain. Now, continue to mouth breathe and attempt to draw your head back into a proper placement over the midline of the shoulders. One of two things will likely occur: either you will feel a great deal of strain in your neck in the attempt to do this, or you will find that your breath feels cut off at the throat. A third option is that you automatically close your mouth because it is near impossible to both maintain proper head alignment and simultaneously mouth breathe.

### **Mouth Breathing at Night**

While consciously practicing nasal breathing during the day can go far to change mouth-breathing habits, what happens at night when we sleep? Mouth breathing has been proven to significantly increase the number of occurrences of snoring and obstructive sleep apnea. Apnea is defined as the cessation of breathing for ten seconds, five or more times a night. It is often accompanied by a drop in oxygen in the blood, and disruption of sleep.<sup>42</sup> Heavy snoring is a serious health hazard and has been associated with an increased incidence of high blood pressure and heart attack. Women who snore during pregnancy have higher than normal incidents of pre-eclampsia and may produce babies with low birth weight and low Apgar scores. Snorers of both sexes also report reduced sexual drive—and among men, snoring and erectile dysfunction are correlated.<sup>43</sup>

Sleep-disordered breathing is a growing epidemic and encompasses everything from snoring, snorting, and erratic breathing to stop-start breathing and apnea. The breathing pattern is uneven and volume levels can shift widely between forceful gusts to complete cessation of breathing altogether.<sup>44</sup> Sleep disorders are diagnosed medically through a variety of testing procedures. Symptoms include daytime sleepiness and/or complaints from life-partners regarding snoring as well as sleep disruption due to apnea. The seriousness of this condition cannot be over-emphasized. If you suspect that you or a loved one suffers with sleep-disordered breathing, undergoing a sleep study is highly recommended.

Continuous positive airway pressure (CPAP) machines are often prescribed for those with moderate to severe sleep apnea. These machines can do much to lower breath volume and help to regulate CO<sub>2</sub> levels at night, however they have a major drawback in that they are cumbersome to use. The CPAP device provides a constant flow of pressurized room air through a tube to a face mask that has to be worn all night; compliance is very low—somewhere around 50 percent.<sup>45</sup> Oral appliances can also help, but unlike CPAP machines they don't regulate the breath and they too can be uncomfortable to wear consistently. Even if you are already using one of these devices and find it helpful, consciously changing your daytime breathing and working with prāṇāyāma practices at night before sleep can facilitate a better night's sleep.

If you are a daytime mouth-breather or if you wake up regularly with a dry mouth, it is likely you are a nighttime mouth-breather. It can help to work with a reduced prāṇāyāma breathing practice before sleep (see the Putting It into Practice section in [Chapter 4](#)). Using hypoallergenic medical paper tape to seal your lips during sleep may also help to keep you nose breathing at night. The idea of mouth taping at night is often met with alarm by my students; however, it can be a real game-changer. The first night I taped my mouth, my husband was afraid I had died during the night because I was silent for the first time in all our years together. I woke up refreshed, and felt a profound difference in my energy and mental clarity! I now love my tape and wear it nightly.

Taping without addressing daytime disordered breathing can put stress on your system due to the biochemical imbalance associated with chronically low PaCO<sub>2</sub>. It is better to work gradually with this shift, especially if you identify yourself or your student as a chronic mouth-breather or over-breather. Therefore, I recommend working on the breath retraining process holistically, as described in the previous chapters. Specifically, work on increasing svādhyāya while developing awareness of your breath saṃskāra, tracking your CP, and practicing Subtle Breathing throughout the day. If you want to eventually experiment with mouth taping, I offer Ways to Build Your Tape Tolerance at the end of this chapter in the Putting It into Practice section.

Augmenting daily prāṇāyāma practice by taping at night will greatly support your intention to transform your breath pattern. It will sustain your CO<sub>2</sub> levels during the night and facilitate a return to homeostasis. An inexpensive taping option to use is hypoallergenic paper tape (found in the first-aid section of the drugstore). Application of mouth tape is more thoroughly detailed in the Putting It into Practice section below.

There are some new products out now, including Lip Seal,<sup>46</sup> which some people find preferable. Another option for those who are uncomfortable with taping is a chin strap. There are many varieties of these available online.

## Mouth Breathing in Children

If you are a parent or grandparent, have students who are parents of young children, or you actually teach yoga to children, I believe the following information is critically important to pass along. The prevalence of mouth breathing among elementary-school-aged children is now well over 50 percent according to multiple international studies. This is not good for their present and future health!<sup>47</sup>

According to these studies, the impact of mouth breathing on facial alterations of a majority of the children range from incomplete lip closure, fallen eyes, high palate, anterior open bite, hypotonic lips, and circles under the eyes. Increases in dental cavities, gum disease, sleep disruption, cognitive impairment, learning disabilities, anxiety, and behavioral problems are also found to be correlated with mouth breathing.

When I learned about the ramifications of mouth breathing in children, my heart lurched with concern for my granddaughter, who at the time was seven years old and a chronic mouth-breather. Constantly stuffed-up, she suffered from ear infections, allergies, and skin rashes. Her eyes were marked with pervasive purple shiners, the kind that accompany poor sleep and hay fever symptoms.

From early infancy, Amirra was a snorer and helicopter sleeper. She wrestled with her sleep position, circling the bed, thrashing like a dog, and building a nest out of the blankets. Just as she'd seemingly settle in, she'd rouse again and toss and turn while occasionally



throwing her head side to side. During my Buteyko training, I learned that these are signs associated with nasal obstruction, the kind commonly linked to fibrotic swelling of the adenoids and tonsils, which can block the upper airways. As most of us know from having tried to get comfortable in the horizontal position with a bad head cold, it becomes a trial to find a position where it is possible to breathe with ease.

When I returned home, we began to address Amirra's breathing issue in a twofold way: I taught her how to do the nose clearing exercise (see Putting It into Practice below) and began training her to become a nose-breather. Second, we had her assessed by an ENT specialist who determined that her adenoids and tonsils were in fact blocking her airways. She had them removed four months later and has since become a proficient nose-breather. Her sleep has improved, she no longer snores, and her health has been stable and strong ever since. The first night she taped her mouth, she jubilantly announced when she woke the next morning that she felt "Absolutely wonderful!"

Here are some of the potential problems associated with mouth breathing in children:

- A receding chin, which can lead to snoring and sleep apnea.
- The dental arches are contracted—narrow and v-shaped.
- The teeth are in malocclusion (misalignment), often crowded.
- The mouth and throat are dry in the morning.
- Frequent headaches.
- Restless sleep: difficulty settling in, staying asleep, and resting deeply.
- Frequent bedwetting.
- The bones of the face are underdeveloped.
- The face looks dull and expressionless.
- Children may display attention deficits, learning disabilities, behavior problems, and moodiness.<sup>48</sup>

One study done in 2011 examined 137 children ages 7–12 and concluded that cognitive and academic function are impaired in children who are mouth-breathers.<sup>49</sup> The relationship between mouth breathing, poor school performance, and sleep disorders in children is prevalent enough to suggest that only a "complete" correction to nasal breathing—both day and night—can adequately address the problem.<sup>50</sup>

### ***Jaw Development and Facial Construct***

When children are born with conditions that predispose them to become mouth-breathers, tongue, jaw, and facial development are impacted. Infants are born to suckle from a breast, which requires a great deal of muscular recruitment of the tongue and jaw. Proper latching depends upon the tongue's ability to press firmly against the roof of the mouth to draw milk out from the breast. In the case of tongue-tie, the frenum—that little fold of tissue that connects the underside of the tongue to the base of the lower palate—can be short, making it difficult for newborns to latch properly. In the old days, midwives would keep one pinky fingernail long and sharp, to give it a swift surgical remedy as needed. Nowadays, babies often don't nurse, and the condition of tongue-tie is not always considered to be serious. However, suckling from a bottle requires far less from the tongue and the jaw, and is linked

to poor development of these primary structures. A floppy tongue can potentially set up a situation for mouth breathing as the child develops. As mouth breathing ensues, the nose becomes congested, and the upper airways become inflamed. This can, as noted earlier, create inflammation in the lower airways, a set-up for allergies and asthma.<sup>51</sup> Figure 5.4 illustrates the dramatic difference in facial development in mouth-breathers and nose-breathers.

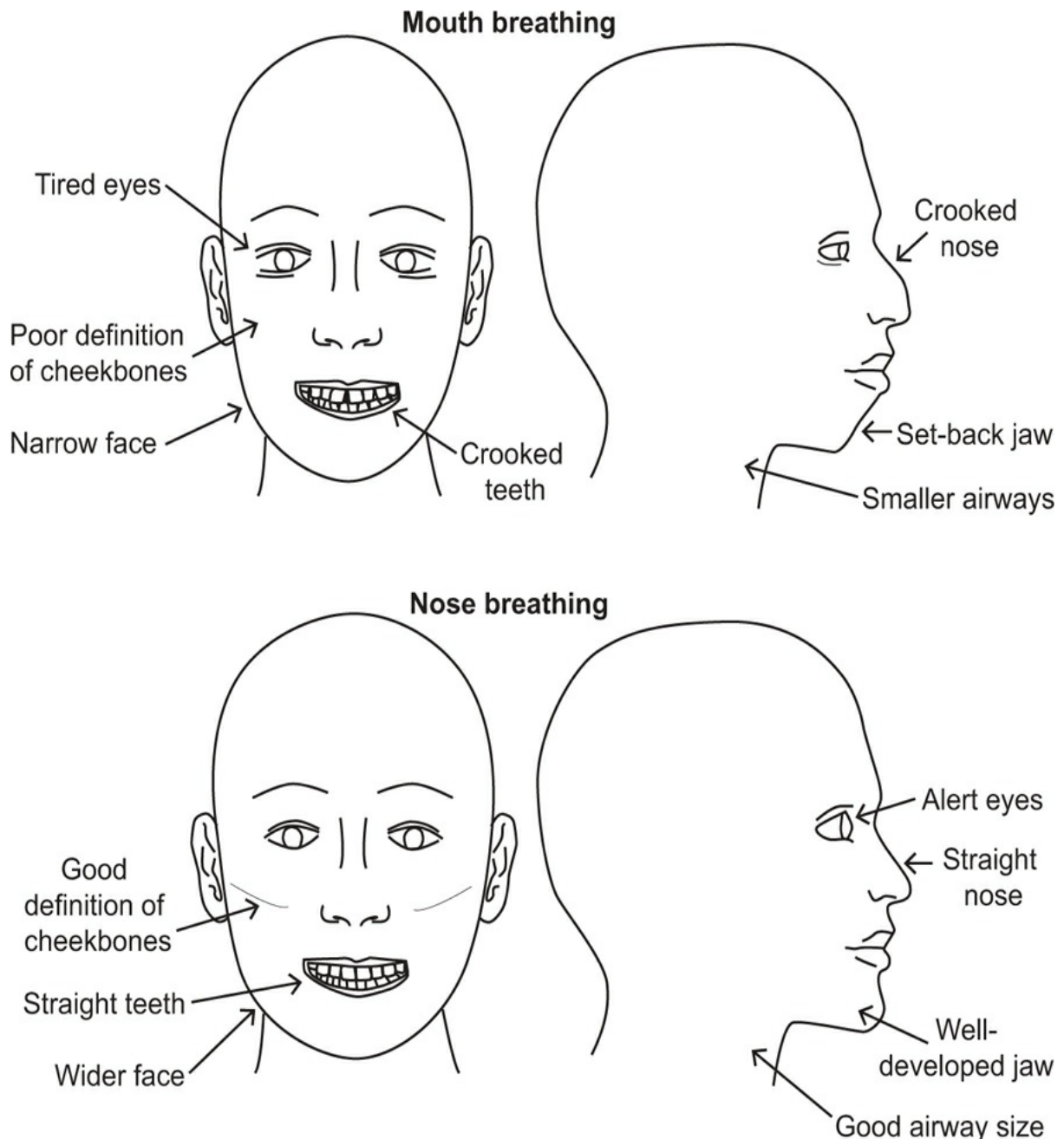


Figure 5.4 Facial Development with Mouth versus Nose Breathing

In the years leading up to adolescence when a child's jaw and facial structure undergo the greatest amount of change, the mouth-breathing habit can severely affect proper development. With a slack jaw and flaccid tongue, the upper palate will tend to develop narrowly, leading to crowding of the teeth. The lower jaw will recede in response, making the face grow long and narrow. Most parents these days assume the need for braces is the result



of the jaw being too small, not that the habituation of dysfunctional breathing is to blame. Unfortunately, orthodontists often address the issue by removing more teeth (to relieve “crowding”), effectively narrowing the jaw even more.<sup>52</sup>

The long-term effect of a narrow, receded jawline on sleep apnea, and the comorbidities associated with that—in particular hypertension, obesity, and diabetes—are of grave concern. Addressing nasal obstruction and teaching children to become nose-breathers from an early age is imperative to their long-term health. Habits that contribute to mouth breathing, like thumb sucking and tongue thrusting are also worth addressing.

*It is important for the entire health care community (including general and pediatric dentists) to screen and diagnose for mouth breathing in adults, and in children as young as 5 years of age. If mouth breathing is treated early, its negative effect on facial and dental development, and the medical and social problems associated with it can be reduced or averted.*<sup>53</sup>

As yoga teachers, we can provide information and resources to our students so they can support the children in their lives to develop healthy breathing habits from an early age. Instructors who specialize in teaching yoga to children have fabulous access to parents and can incorporate nose-breathing games and tongue mūdra activities into their class regimes. They can even assign nose breathing as an important home practice in between classes. One of the key components to emphasize, whether we’re discussing breathing in the context of child development or adult mental and physical stability, is this: how we breathe *off the mat* has the greatest impact on our health. It’s the 24/7 breathing habit that will transform our lives at any age!

To learn more about the effect of mouth breathing on children, please refer to McKeown and Mew (2011)<sup>54</sup> and Buteyko Clinic International (2018).<sup>55</sup>

To further help you or your family and students transform these habits, I recommend researching myofunctional therapists in your area. Myofunctional therapy is a growing field made up of highly skilled professionals, many of whom are dental hygienists and speech therapists. They specialize in assessing and retraining children and adults with poor tongue and jaw development. The Academy of Orofacial and Myofunctional Therapy can assist you in finding a specialist in your area.<sup>56</sup>

Functional orthodontists are another specialty worth investigating. These practitioners look for ways to support healthy jaw development by expanding the dental arch (the curve of the row of teeth in each jaw), rather than simply straightening teeth for cosmetic purposes. They utilize devices that help widen the jawline and bring the lower jaw forward, prioritizing proper bite alignment. This goes far to address jaw pain, upper airway obstruction, tension headaches, migraines, and preventing structural problems that can lead to sleep apnea. To learn more about the field of functional orthodontics, visit An Advanced Field of Orthodontic, an information website about orthodontic and dental care.<sup>57</sup>

## KEY CONCEPTS

---

- The nose was designed for breathing and is our immune system’s first line of defense.
- The nose prepares air for the lungs by warming, humidifying, and cleaning the air.
- Mouth breathing is associated with cognitive impairment, memory and concentration difficulties, headaches, and TMJD, as well as sleep issues.

- Breathing less, lighter, and through the nose reduces vata, thus balancing prāṇa.
- Breath retraining must be done slowly, as multiple factors—most critically the impact of the breath on the nervous system—need to be kept in mind.

## — PUTTING IT INTO PRACTICE —————

### **Exercises for Exploration and Transformation**

As you explore these various practices, keep notes in your **Svādhyāya Breath Journal** to track your experiences.

### **NOSE CLEARING EXERCISE (PHOTOS 5 AND 6)**

---

This exercise is useful when the nose is stuffed up due to colds, hay fever, allergies, or chronic congestion. It can be done intermittently throughout the day to comfort level. *Keep the lips closed throughout the process.*

- Take a gentle breath in and a gentle breath out through the nose.
- Pinch your nose and hold, maintaining a tight seal.
- Rock your head side to side or up and down—move gently to avoid any kind of discomfort or pull on the neck.
- When you feel the need to breathe, stop the rocking, release the nose-pinch and take a gentle breath *through the nose*.
- Pause. Feel. Repeat 4–6 times until the nasal passage feels more open.

This exercise can be taught to young children as well as adults. It was my granddaughter's favorite. Every time she did it, her airways opened, making it easier to breathe. She experienced it as a kind of magic trick.



*Photo 5*



*Photo 6*

## **WHEN THE NOSE CLEARING EXERCISE ISN'T ENOUGH**

If the Nose Clearing exercise doesn't seem to be working, try turning up the body's internal heat. Jogging in place while holding the nose, or briskly walking up and down your hallway, will increase CO<sub>2</sub> levels, and help open the airways. Never hold the nose to the point where you find yourself gasping, or having to open your mouth to breathe. After each short breath-hold, be sure to breathe in through the nose to help nitric oxide circulate. Remember, NO is a vasodilator and increases oxygen uptake.

Sometimes, the nose is so plugged, more help is needed. A neti pot sinus wash can help tremendously with clearing out extra mucus from the sinus passageways. It is highly recommended that you use sterile saline for your neti pot to ensure safe use. Keep in mind that if over-breathing (vata derangement) is causing inflammation, mucus is the body's way of protecting the irritated airways and maintaining CO<sub>2</sub>. Saline wash can clean, but also strip the natural protective coating from the nasal cavity. It is important to follow up your neti pot washes with a light coat of olive or nasya (nasal) oil. Apply to the inside of

the nose, much like you would hand lotion to chapped hands after washing. Banyan Botanicals has aromatic, organic nasya oil available.<sup>58</sup>

## Tongue Exercises

### JIVA MŪDRA

---

A toned tongue can go far to alleviate jaw pain, reduce tension headaches, and facilitate nasal breathing. **Jiva Mūdra** (pronounced jee-vah moo-drah, tongue lock) is a practice that supports proper placement of the tongue in the mouth. Imagine that you are saying the letter “N” silently, and feel the flat of the tongue parked to the upper palate. This creates space in the jaw joint, preventing clenching and grinding. Employ this position of the tongue consistently throughout the day to help reduce mouth breathing and condition the muscles of the face. Hold this position as you are able during your āsana, prāṇāyāma, and meditation practices. If you are a mouth-breather, create specific times for remembering to do jiva mūdra during the day, for example stopped in traffic at every red light, when you use the bathroom, before you check your cell phone, while washing dishes or folding laundry. Eventually, with practice, you will develop the saṃskāra and the tongue will stay parked up top.

### WASHING THE TEETH WITH THE TONGUE (PHOTO 7)

---

- Close your mouth.
- Place your tongue on the right side of the outer gums at the upper back of the mouth.
- Slowly wash your tongue across the upper teeth over to the left side.
- Stretch the tongue to the left lower gumline and proceed to wash across to the right.
- Circle right to left 5 times.
- Then reverse the direction and circle left to right.

Practice 2–3 times a day.



*Photo 7*

## **TONGUE EXTENSIONS (PHOTOS 8 AND 9)**

---

This is a great one to bring out the kid in all of us. Who doesn't love sticking out their tongue—especially at the teacher!

- Stick the tongue straight out as far as you can, holding it parallel like a plank for 10 seconds.
- Stretch it out and as far to the right as you can and hold 10 seconds.
- Stretch it out and as far to the left as you can and hold 10 seconds.
- Try and touch your nose with your tongue and hold 10 seconds.
- Try and touch your chin with your tongue and hold 10 seconds.

You may be surprised at how quickly your tongue fatigues. If ten seconds feels too long, start with five and build up your endurance. Start with this series once a day and then build to twice a day.



*Photo 8*



Photo 9

## KECHARI MŪDRA (**PHOTOS 10 AND 11**)

---

*Kechari Mūdra* (pronounced kay-char-ee moo-drah) is considered to be the king among mūdras. You could think of it as a “tongue lift,” as it requires stretching the tongue up into the cavity of the soft palate. In its most extreme forms the tongue was stretched to roll back to the uvula at the back of the throat. Kechari is mentioned in the Gheranda Samita, and the Hatha Yoga Pradipika, and was touted as having remarkable healing capabilities. It was said to enable the practitioner to taste the *amrit* (pronounced ahm-rit) or divine nectar that flows from the sinuses down into the back of the throat.

The form of kechhari offered here is designed to support healthy tone of the tongue, and to increase awareness of how and where the tongue is placed in the mouth as it relates to breathing.

- Sit comfortably.
- With the mouth closed, extend the tongue up until it touches the back of the upper palate.



- Reach back as far as you can to touch the soft palate.
- If your frenum is short, it may take weeks or months to stretch it out.
- As you are able, slip the tongue up into the cavity of the soft palate, reach the tip up as high as you can, and hold it there for 10 seconds.
- Repeat 4–6 times or until fatigued.

Once you are able to perform Kechari Mūdra comfortably, build your endurance, so you are able to sustain it for longer periods of time.



*Photo 10*



*Photo 11*

### CLUCKING WITH MOUTH CLOSED

Clucking was shared by a couple of fabulous myofunctional therapists at a Buteyko Breathing Educators Conference that I attended some years ago, and is to this day one of my favorite tongue exercises. The initial challenge of it took me by surprise and made me aware of how deconditioned my tongue actually was. Start with the mouth open and “cluck” by thrusting your tongue against the hard, upper palate. Make the sound crisp and clear. Now repeat the exercise with the mouth closed. Cluck until tired. Rest. Repeat. Have fun! Imagine clucking while holding Tree Pose or Warrior 3!

### SHĪTALI/SHĪTKARI—TONGUE BREATH (**PHOTOS 12 AND 13**)

These two variations on breathing use the tongue as a funnel, or as a valve to channel the inhalation. The moisture of the tongue helps to cool the body when it is over-heated or to soothe the mind when agitated. These techniques ventilate us much like a damp cloth in front of a fan helps to aerate a stuffy room with a cool breeze. They may also be useful in bringing more awareness to the action of the tongue and its placement in the mouth. For

those who tend to be mouth-breathers, however, I do not recommend them as a starting point. It would be better to focus on developing nose breathing as your default setting and return to these prāṇāyāmas once you've mastered that.

**Shīṭali:** If you are able to curl your tongue into a tube like a straw, draw the breath lightly in this way. At the end of the inhale, close the lips and curl the tongue back, so the bottom of the tongue presses into the upper palate. Exhale gently through the nose.

**Shītkari (pronounced sheet-kar-ee)** is an adaptation of this practice for those who are unable to perform the tongue curl. In this variation, you press the tip of the tongue into the backside of the top teeth at the gumline and gently suck in. Exhalation is the same as with Shīṭali.



*Photo 12*



*Photo 13*

## Speech Exercises

Learning to speak without over-breathing is a vital part of the breath retraining process, especially for mouth-breathers. It is important to listen and hear whether your breath is audible as you speak. Below are three simple practices that can be helpful to anyone who

speaks for a living (teacher, salesperson, receptionist, or any other job where you are talking a lot), particularly if you find yourself exhausted at the end of the day.

## ALPHABET PRACTICE

---

- Take a gentle nose breath in. Say the letters: a, b, c, d, e.
- Close your mouth.
- Take another gentle nose breath in. Say five more: f, g, h, i, j, k.
- Close your mouth and continue.

You can gradually extend the number of letters. However, always pause and breathe in silently through your nose following your recitation. If you hear a gasp, no matter how small, you spoke too long.

## READING ALOUD

---

Read aloud to yourself, keeping your phrases short, perhaps even shorter than marked in the magazine or book. Similar to the **Alphabet Practice**, observe your breath during and after your speech. If you find your breath agitated or feel the slightest bit breathless, cut your phrases to accommodate a quiet and smooth inhalation breath. Allow yourself resting breaths between phrases whenever you experience breathlessness in this process.

## MANTRA

---

Prāṇāyāma and mantra (pronounced mahn-trah) were traditionally taught together. The use of mantra to support the heart and mind will be discussed more fully in [Chapters 8 and 9](#). In the context of reworking speech patterns to maintain functional breathing, you could use a favorite mantra in the same way as the **Reading Aloud** exercise above, letting the breath cue you as to how long to chant. Employ a solid lip seal to ensure a nasal breath in between lines of mantra. The intention of this practice is different than working with mantra to extend the breath. Instead, the exercise is intended to make you more aware of and comfortable with breathing within your prāṇic limits, and not pushing into breathlessness.

**Note:** Patience is required for re-patterning speech. As you practice, your increasing self-awareness will enable you to naturally pause when speaking conversationally or professionally. Make a habit of tracking your heart and breath rate when you are lecturing for extended periods of time, as when teaching. Accelerated heart and breath rate are indicators that the breath is pushed, and you may be squeezing a few too many words in at a time. Practice allowing the breath to settle by adding pauses between your instructions. This will give your students time to process what you just said, and allow you to calm your system down as you teach.

Notice the effect on your prāṇa at the end of teaching with this kind of svādhyāya (self-awareness) on speech and the breath. Notice the quality of attention in the room among your students. How have the pauses, and the slower delivery of instructions from you, affected their practice?

## Mouth Taping Explanation ([Photos 14 and 15](#))

Mouth taping, as suggested earlier in this chapter, can be very helpful to curb mouth breathing at night, reduce snoring, and maintain CO<sub>2</sub> levels during sleep. That said, it is not always the most comfortable idea for people and may take some getting used to. The kind of tape matters. Use a hypoallergenic medical paper tape, like 3M Micropore Tape, or my favorite, Nexcare First Aid Gentle Paper Tape.

If you don't experience concern or fear around mouth taping, then proceed, giving yourself an opportunity to try different ways of taping to find what is most comfortable for you. For example, you may try any of the following:

- a horizontal strip across the lips
- an X across the lips
- small vertical strips across the lips
- a single vertical strip across the lips.

Always apply a light lip balm to the lips prior to putting the tape in place. Pull the lips in, so the tape is in contact with the skin rather than the lips. Fold over one end (or both) to make a tab that is easy to pull when you remove the tape in the morning.

In the first week or two when you are adjusting to the mouth tape, you may find the tape stuck to your finger, your pillow, or your bed-stand in the morning. It is fairly common for people to discover in the morning they've removed the tape unconsciously while sleeping. This is part of the acclimation process as your body and brain are getting used to the new process of nose breathing. Stay with it. I'd recommend cutting a couple of extra strips of tape and prepping them on your bed-stand, so if you do wake up mid-sleep and are tapeless, you can reapply another strip without fuss.



Photo 14



*Photo 15*

### Ways to Build Your Tape Tolerance

Some of you may need a little more support in building your tolerance and overcoming the feeling of anxiety associated with taping. Here are a few suggestions my students have found useful.

Choose a few daytime activities of short duration to wear the tape and get used to the feel of it. Any activity that doesn't require you to eat or talk is fair game. Twenty or 30 minutes spent washing dishes, folding laundry, watching TV, or engaged in social media might provide an appropriate way to introduce this practice while encouraging *svādhyāya*. If 20 minutes feels like too long to start with, begin with 10 minutes. Be sure to make the fold-over tab that allows for easy removal of the tape, to avoid any delay when you feel the need to take it off. Gradually, build your comfort level with the tape. You can also tape during *prāṇāyāma*, meditation practice, or even *āsana*. If you have a habit of exhaling through the mouth during your exercise or yoga practice, this will help you to break that habit, while also acclimating you to the tape and higher levels of CO<sub>2</sub>.

### Taping with Kids

Kids actually do quite well with taping; it tends to be the adults who freak out over the idea. My first exposure to using tape on children took place in Dublin where I was observing Patrick McKeown teaching a Buteyko class for children. The kids ranged in age from 3 to 15. As they walked into class accompanied by at least one parent, each child took a piece of tape and placed it over their mouth—where it stayed in place for the remainder of the hour-long class.

As an American, I was shocked. None of the parents seemed the slightest bit perturbed. None of the kids complained. All of the children were there because they suffered with asthma or chronic rhinitis, had trouble with sleep at night, or reduced sports performance due to breathlessness. The tape was helping. I was the only one who seemed to be concerned about child protective services, or accusations of abuse. They approached the mouth tape as medicine, no different than an internal mouth appliance (except much less cumbersome and far more cost-effective). This reflected back to me my own cultural bias, and how easily we can take something that is neutral—or even quite positive—and spin it in our mind.

Children are much quicker to learn new habits than adults. However, they can't always remember to apply consciousness to their daily activities, so a little tape during the day can go far to help transform the mouth-breathing habit. Encourage taping during screen-time or while doing homework to help children develop the habit of keeping their mouth closed during those passive activities.

**Taping precautions:** Do not tape at night on children under five. Do not tape if you are nauseous, ill, or feel the potential to vomit during sleep. This is especially true for children. Do not tape after heavy alcohol consumption.

## CHAPTER SUMMARY

---

- The nasal cavity controls the flow of air through the upper airways, and is linked to both the autonomic nervous system and diaphragmatic movement.
- Our sense of smell is linked to our limbic or emotional center, and our sense of survival.
- Nasal resistance (that is, breathing through the nose as intended) supports oxygen uptake in the lungs and a healthy increase in partial pressure of both O<sub>2</sub> and CO<sub>2</sub>.
- Chronic congestion not only blocks nasal passageways but impairs the ability of the diaphragm to activate fully.
- Chest breathing and anxiety are correlated with chronic nasal congestion.
- Mouth breathing contributes to high rates of cavities, gum disease, and bad breath.
- Mouth breathing lowers the movement of the lungs and diaphragm by half, relative to nose breathing.
- Mouth and chest breathing are also linked to sympathetic activation of the nervous system.
- Mouth breathing exacerbates nasal congestion. The body will continue to produce mucus to block the upper airways as a defense mechanism for excessive loss of CO<sub>2</sub>.
- In Ayurvedic terms, over-breathing can be considered an excess of vata dosha (air/ether). The “excess wind” creates inflammation (pitta dosha—fire) and that increases mucus production (kapha dosha—earth/water).
- Jiva Mūdra reinforces the correct placement of the tongue, pressed to the upper palate. This is an important part of breath retraining, especially in the case of chronic mouth breathing.
- Slowing speech patterns and pausing to nose breathe in conversational speech is a significant aspect of breath retraining.
- Mouth breathing in children affects facial and jaw development, sleep, and behavior issues.
- If not addressed early in life, mouth breathing can have serious health ramifications as children reach adolescence and adulthood.
- Mouth, chest, and paradoxical breathing patterns are disorders that as yoga teachers we can train ourselves to identify in our students, and we can support them in retraining their breathing patterns through education and reinforcement during our yoga classes.

- Simple exercises for the nose, jaw, tongue, and speech can be woven into daily personal practice or yoga classes. These will increase svādhyāya and support more functional breathing patterns in life.



## Chapter 6

---

# CENTER STAGE

## THE DIAPHRAGM

### ***Sthira-sukham āsana***

*The posture is to be stable and relaxed.*

Patañjali's Yoga Sūtra, 2:46

I assumed that with all my years of yoga practice, I was a proficient diaphragmatic breather. I certainly talked that talk in my breath instructions to students and felt confident that my diaphragm was in good working order. I had dutifully practiced the “full yoga breath” by inflating the chest down to the abdomen on inhale and gathering the abdominal muscles in to support a full complete exhale from the bottom up. I was taught to believe that the greater the expanse of the muscles of the chest, the more oxygen I was taking in. Conversely, the more forceful my exhalation, the more toxins I was releasing.

In my Buteyko training, I was coached to completely pacify the chest. With one hand on the heart center and one hand on the lower rib cage—home of the dome of the diaphragm—I was encouraged to make the movement of breath subtle and low, leaving the upper torso neutral, undisturbed. The saṃskāra of large chest movement loomed over me and it was a constant process to remind myself not to fall into my habit. Focusing on the containment of movement at the lower rib cage led to my discovery of the diaphragm itself. I found by using my abdominal muscles actively on exhale, releasing them with control on inhale and thinking of the action of breathing happening only from the lower rib cage down, the biomechanical infrastructure of my breath was changing.

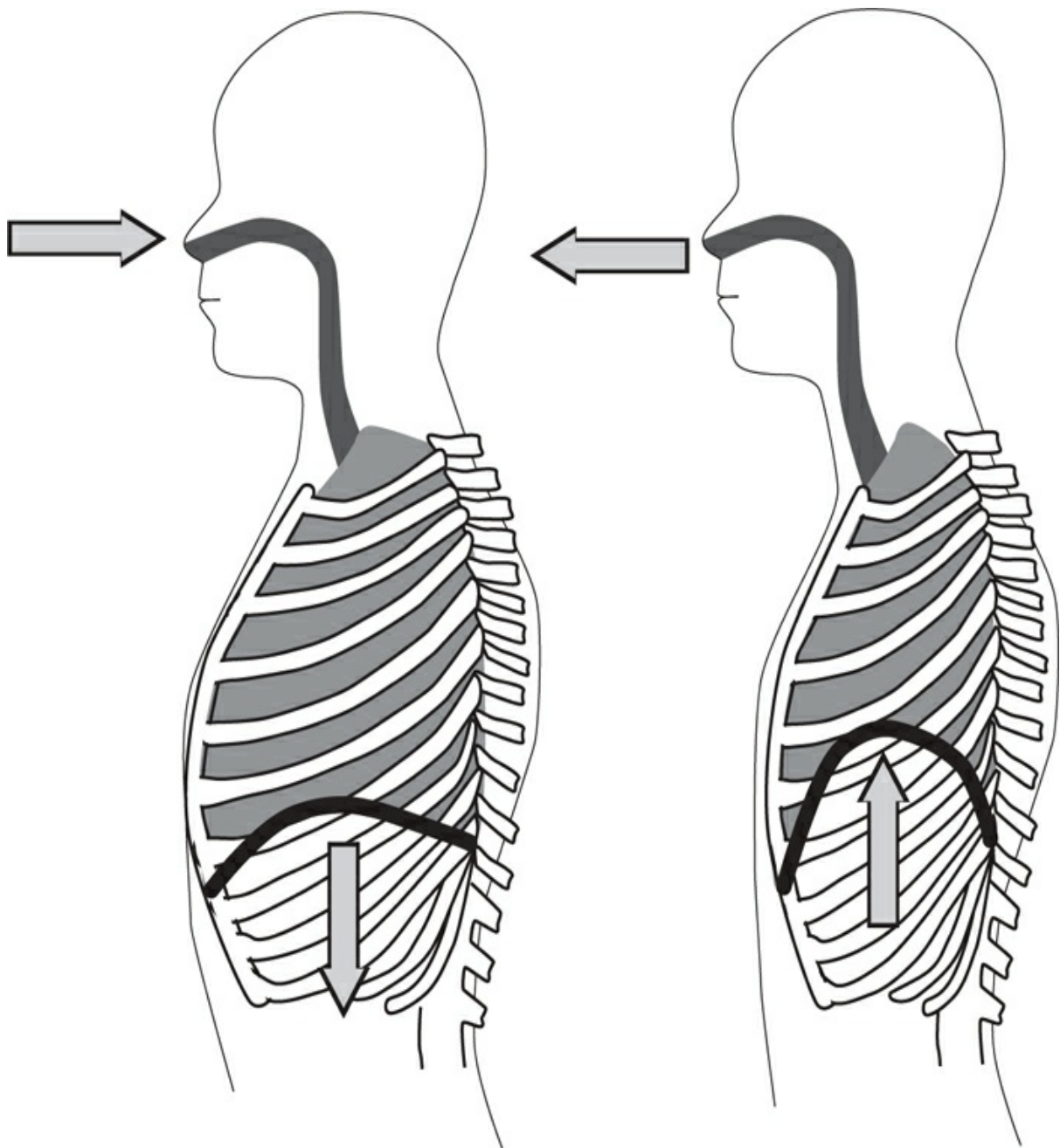
The less I activated the intercostal and pectoral muscles, the more relaxed my inhalation became and the more fully I experienced a cylindrical expansion around the circumference of my lower ribs. Neck tension released, the sense of effort softened. I developed a natural activation from the pelvic floor and abdominal core, similar to the yoga bandhas (pronounced bahn-dahs (locks/seals) employed to distribute prāṇa. This experience created a solid, rooted foundation. Additionally, there was a visceral sense of synchronization—like being in rhythm with myself. This contrasted with the willful pressure exuded through my prior thoracically driven inhalations.

When I settled the accessory muscles of the chest, it seemed I could “hear” my diaphragm breathing. I was able to activate it with refinement, dialing down the movement to a whisper. As I took this Subtle Breathing into āsana, I found I had more strength and endurance and a

higher degree of mental focus in my postures. I hadn't realized how much "space" or prāṇic energy the dramatization of the breath had occupied. Synching my movements with a light breath and relying on core support to hold me up allowed my shoulder girdle and chest to move with more freedom and ease. I now consider the diaphragm to be the conductor's baton: the breath is the music and the abdominal core is the orchestra providing resonance, rhythm, and hue.

*Core stabilization starts with proper function of the diaphragm.*<sup>1</sup>

In a fundamental way, all breathing is diaphragmatic. Inhalation is the result of the downward contraction of the diaphragm, which creates a vacuum, drawing fresh air into the lungs. Exhalation occurs as the diaphragm relaxes upwards, pressing on the lungs, deflating them in what is known as a "passive recoil" (see [Figure 6.1](#)). That said, the diaphragm is not a soloist. It works in tandem with accessory muscles, either above or below, or both. Efficient biomechanics of breathing involves recruitment of these accessory muscles as is necessary and appropriate in context to the load on the system at any given moment in time.



*Figure 6.1 Basic Breathing Mechanics*

Ideally, at rest or with simple exertion, the diaphragm teams up with the abdominals—specifically the pelvic floor, transversus abdominis, and obliques—which contract gently with exhalation. Together, these create a stabilizing band of support at the base of our torso. When the movement of the breath coordinates with well-conditioned core muscles and good alignment, the diaphragmatic movement helps maintain visceral function and supports heart rate variability.<sup>2</sup>

Muscles in the chest and neck—the intercostals, pectorals, upper traps, and scalenes—are not intended to be recruited for respiration when we are at rest or engaged in light activity. They are designed to kick into action with the exertion of physical load (heavy lifting or walking briskly uphill) or at times of emotional distress, thus enabling us to vocalize a loud shout for “HELP!” To the degree that the abdominals are conditioned to intelligently synch

with the diaphragm, the neck and shoulders are freed from the act of breathing in our day-to-day activities.

Chest breathing at rest contributes to hypertonicity of the neck and shoulder girdle as well as to anterior head posture. It triggers sympathetic activation of the nervous system driven by a rapid, shallow breath pattern. As previously mentioned, chest breathing also utilizes considerably more oxygen.<sup>3</sup> However, uncoupling the upper accessory muscles from the breathing process once it is engrained is not as simple as cuing these muscles to relax. Like all our other *samskāras* (habits), this one takes conscious application in order to establish new recruitment patterns.



*Photo 16 Chest Breathing*

In this chapter, we will explore the diaphragm in relation to the abdominal core and how together they provide stability for functional movement, breathing, and physiological health. Chest, paradoxical, and belly breathing will be addressed as common breathing pattern disorders. At the end of the chapter, I will describe a series of practical exercises that address the systematic release of upper body recruitment, as well as the means to establish abdominal-diaphragmatic synchronization. Together these practices establish the ABCs of proper breathing biomechanics.

## The “Mind” of the Diaphragm

The word “diaphragm” is derived from the Ancient Greek word “phren” and has two separate yet correlated meanings. One is the feeling center for thought or contemplation. The other meaning is the brain or mind itself. Words like “schizophrenic” or “frenzy” (formerly spelled “phrenzy”) are derived from this meaning.<sup>4</sup>

These references imply an understanding of the intrinsic role of the breath, and the respiratory diaphragm in mind–body connectivity—a gateway between thought, feeling, and action. The phrenic nerves arise from the cervical spine at C3–C5 and provide both sensory and motor function to the diaphragm. If either of the phrenic nerves are paralyzed (there is a right and left phrenic nerve) diaphragmatic activation on that side ceases.

The diaphragm is our primary breathing muscle. Shaped like a lopsided parachute, it cross-sections the entire torso with a muscular sheath that drapes the lower half of the rib cage. The costal or outer edges attach to the rib cage, and the central tendons, the “crura,” attach to the anterior longitudinal ligament that runs along the front face of the spine (see [Figure 6.2](#)). The muscle itself is divided into right and left hemispheres, enervated unilaterally by the phrenic nerves. It acts as a horizontal separation point within the body: a thin, yet powerful screen positioned between the thoracic and abdominal cavities.

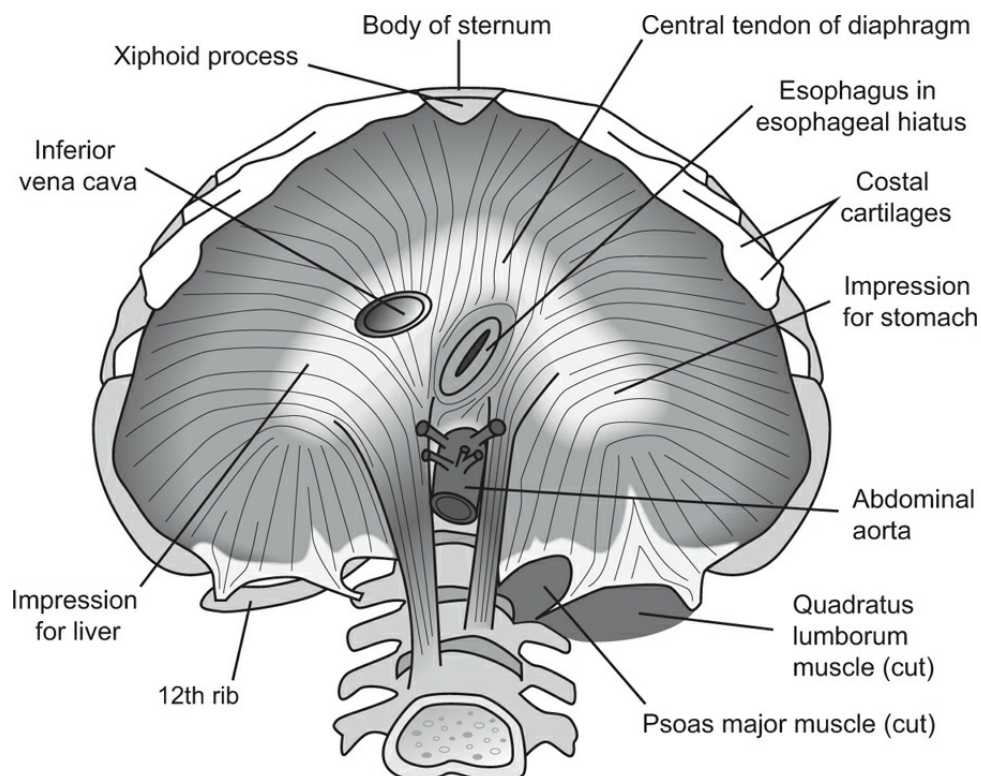


Figure 6.2 The Diaphragm

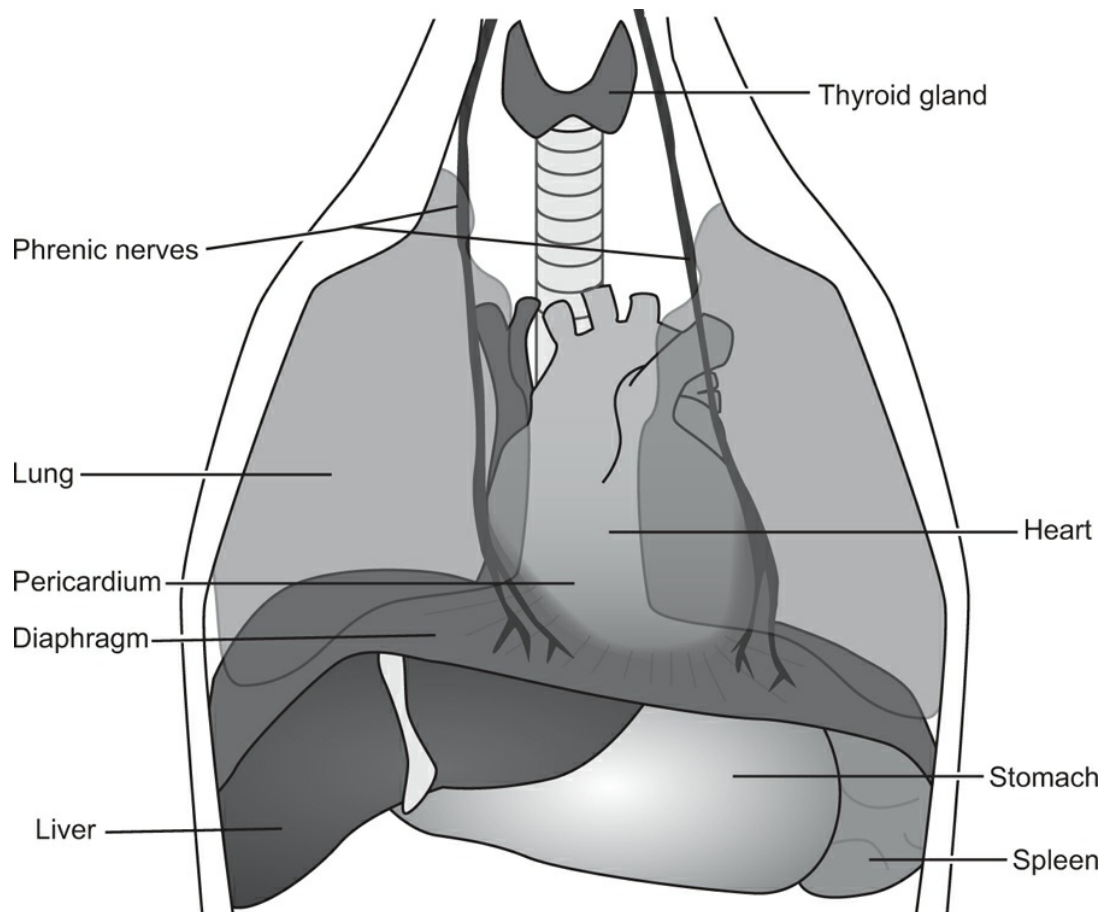
However, the diaphragm is also a great connector. The body’s two primary blood vessels, the aorta and vena cava, run through it, connecting the circulatory system below to the heart above. The iliopsoas and quadratus lumborum, primary muscles of mobility and stability for the pelvic girdle, attach fascially to the diaphragm. This fascial connection essentially means that there is no real separation between these muscles and the diaphragm. They are all part of the same interwoven fabric meeting at the thoracolumbar junction, the solar plexus (T12–L1).<sup>5</sup>

The esophagus threads through the diaphragm, transporting what we ingest from the outside world in the form of food and drink directly into our digestive system, to make what we consume a part of us. The phrenic nerves interface with the kidneys and adrenal glands, relaying immediate and direct communication with the sympathetically driven adrenaline response of fight or flight. The vagus nerve passes through the diaphragm, linking the breath to parasympathetic function, digestion, and relaxation, as well as the dorsal vagal “freeze” response (the older, more reptilian vagal response, associated with trauma).

The heart itself rests on the dome of the diaphragm, just to the left of center (in most people). As with the psoas, the diaphragm and pericardium are part of the same contiguous fascial sheath, swaddling the heart like a protective blanket. [Figure 6.3](#) depicts the diaphragm in relationship to the primary organs and the pericardium. Each time the diaphragm moves, it tugs on the heart. Imagine a game of balloon toss, with the heart gently bounced on this elastic trampoline, rocked with each breath, approximately *20,000 times a day*. Within the cave of the ribs sit the viscera: the stomach, liver, spleen, pancreas, kidneys, and the upper portions of the intestines. With each hug and release of the breath these organs are gently massaged by the diaphragm’s rhythmic pulse. Twelve to fifteen times a minute, 600 times an hour, it links what is above with what is below: our stomach with our brain; our legs with our heart; our viscera with the outside world.

Imagine if this wave of life is interrupted or restricted in some way. If the muscles of the abdomen are held tense and taut, as in a military-type posture, the central tendon’s ability to transmit its natural downward and outward force will be limited. Conversely, if the abdominal core muscles and pelvic floor are so flaccid that they lack the necessary tone to contain the diaphragm’s movement and give it power, the accessory muscles of the chest and neck will take over. Consider for a moment how a negative shift like this in the biomechanics, multiplied out over thousands of repetitions each day, would impact heart rate, blood pressure, digestion, the stress response, and overall health.





*Figure 6.3 The Diaphragm and Organs*

As the ancient Greeks knowingly implied, the act of breathing synchronizes mental and physical action. Positioned in the center of the body, the respiratory diaphragm orchestrates communication on every level of the panchamaya (five dimensions) via the winds of the breath. It is easy to observe how moments of emotion, interruption of attention, states of calm or distress impact breath rate, depth, and regularity, and body affect. For instance, anxiety prompts hyperventilation, and hyperventilation can trigger feelings of anxiety. Controlling the movement of the diaphragm through breath retraining and awareness can interrupt this pattern and help all systems return to homeostasis. When we consider our gut reaction (often a felt sense that cues us to be cautious or to trust before our prefrontal, “thinking brain” catches on), we can see how emotion and breath coalesce here in the phrenic cradle of heart–mind: the diaphragm.

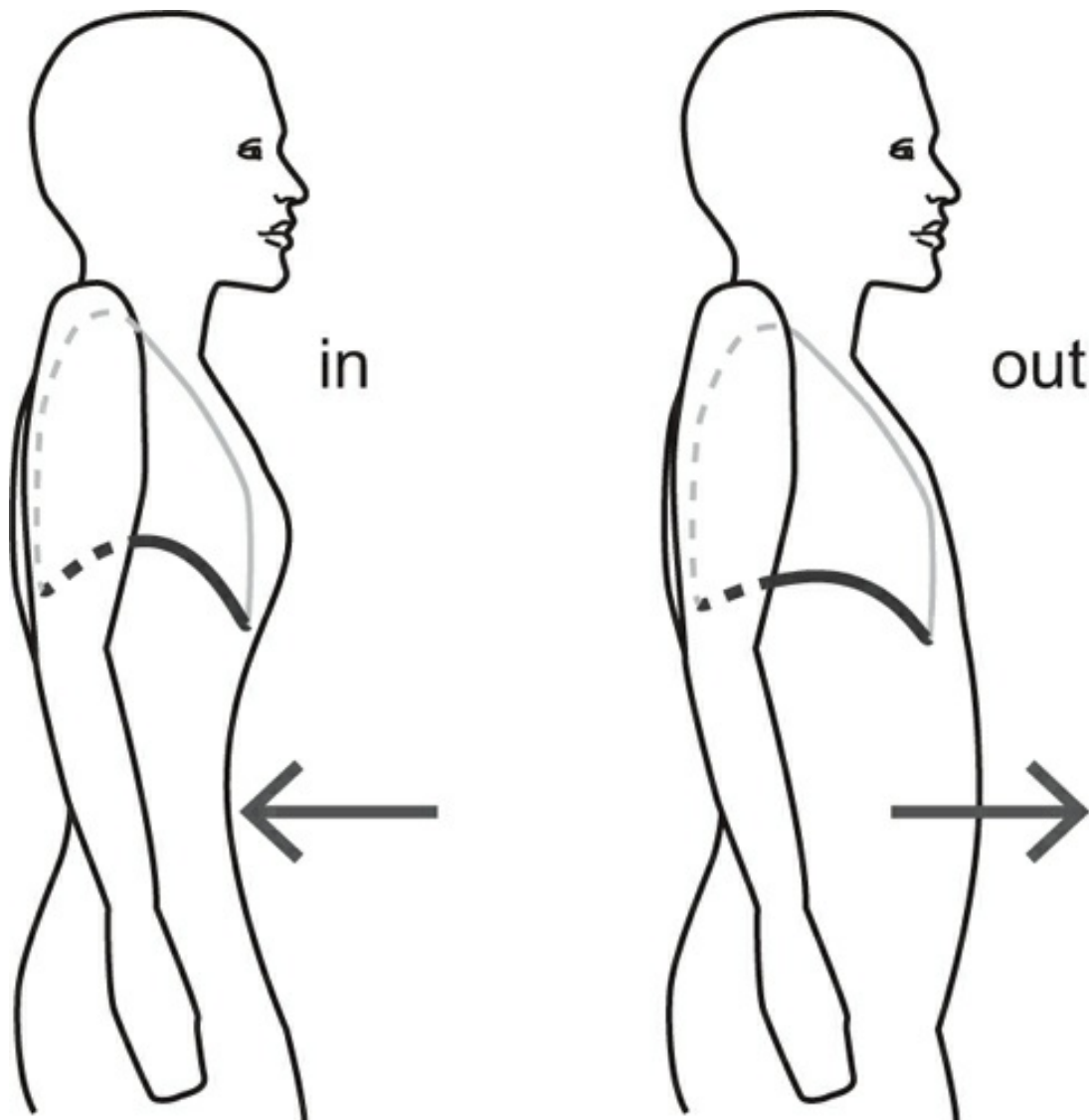
## **Chest Breathing and Paradoxical Breathing**

Thoracic or chest breathing is a common breathing pattern disorder which often accompanies mouth breathing and/or hyperventilation. With chest breathing, the accessory muscles, in particular the intercostals, upper traps, pecs, levator scapula, and scalenes, are used as primary breathing muscles. This can create chronic muscular strain in the upper body and contributes to the dysregulation of healthy diaphragmatic and core recruitment.

Dysregulation is reflected in a lift of the spine on inhale and slight drop on exhale. This type of up/down movement is an indicator of overworking chest muscles, accompanied by abdominals that are either flaccid or held excessively taut. In fact, the technique of expanding the upper rib cage with inhalation by recruiting the intercostal muscles is in and of itself a

dysfunctional breathing pattern. The intercostals' primary job is to act as lateral stabilizers rather than primary respirators as many of us were taught.<sup>6</sup> Ideally, the spine remains neutral during breathing practices and with low-exertion activity.

Paradoxical breathing can be considered a type of trauma breathing (see [Figure 6.4](#)). The movement of the diaphragm is actually reversed with an upward and inward contraction on inhale and a small outward release on exhale. To understand paradoxical breathing, imagine that you were walking down a dark hallway and someone jumped out and yelled, "BOO!" How does your respiratory system respond? Notice the quick intake of breath and how your diaphragm automatically pulls up and locks into place under your rib cage, blocking the impulse to breathe.



*Figure 6.4 Paradoxical Breathing*

In evolutionary terms, this paradoxical action could serve as a life-saving mechanism, a kind of protective shield: With the threat of a potential predator nearby, even the breath could give you away. As an infrequent stop-gap measure, paradoxical breathing has its place. However, in the case of childhood or later-onset trauma where real or perceived threat is constant, paradoxical breathing can become the norm. The long-term ramifications of this on the psyche, the nervous system, and respiratory biomechanics can be devastating.



Chest and paradoxical breathing may underlie many other stress-related syndromes, like anxiety. If these patterns are not addressed and transformed, every breath reinforces sympathetic hypervigilance. Once the breathing mechanism is set on a hair-trigger response mode, the slightest elevation of stress, whether that be physical or psychological or due to a biochemical shift, can easily tip the whole system into sympathetic overdrive.<sup>7</sup>

## **Posture, the Abdominals, and the ZOA**

To understand the mechanics of breathing it is important to understand how posture, positioning of the rib cage, and the action of the abdominals facilitate diaphragmatic movement. During inhalation the diaphragm contracts (pulling it down) and the abdominals stretch outward, which collectively broadens the lower rib cage. This increases intra-abdominal pressure. With exhale, the abdominals contract, drawing in towards the spine. This effectively narrows the rib cage, pressing the diaphragm into a dome. The muscles directly involved in this action are the transversus abdominis, iliopsoas, and obliques which attach to the lower ribs. Biomechanically, this movement of the diaphragm happens most effectively when the spine is in a neutral position, neither hyperextended nor flexed. In this position, the rib cage is arranged evenly front to back on the horizontal plane.

The vertical space between the diaphragm's attachment to the bottom ribs and the peak of its dome up top is known as the zone of apposition (ZOA). The ZOA is controlled primarily through the activation of the abdominal muscles and the positioning of the rib cage. Optimal ZOA is signified by a pronounced diaphragmatic arch in its resting position at the completion of the exhale. Restriction of the full capacity of the diaphragm to contract inward diminishes the ZOA. Whenever the abdominal muscles are not fully integrated into the movement of the diaphragm with the breath, the ZOA is negatively impacted (see [Figure 6.5](#)).

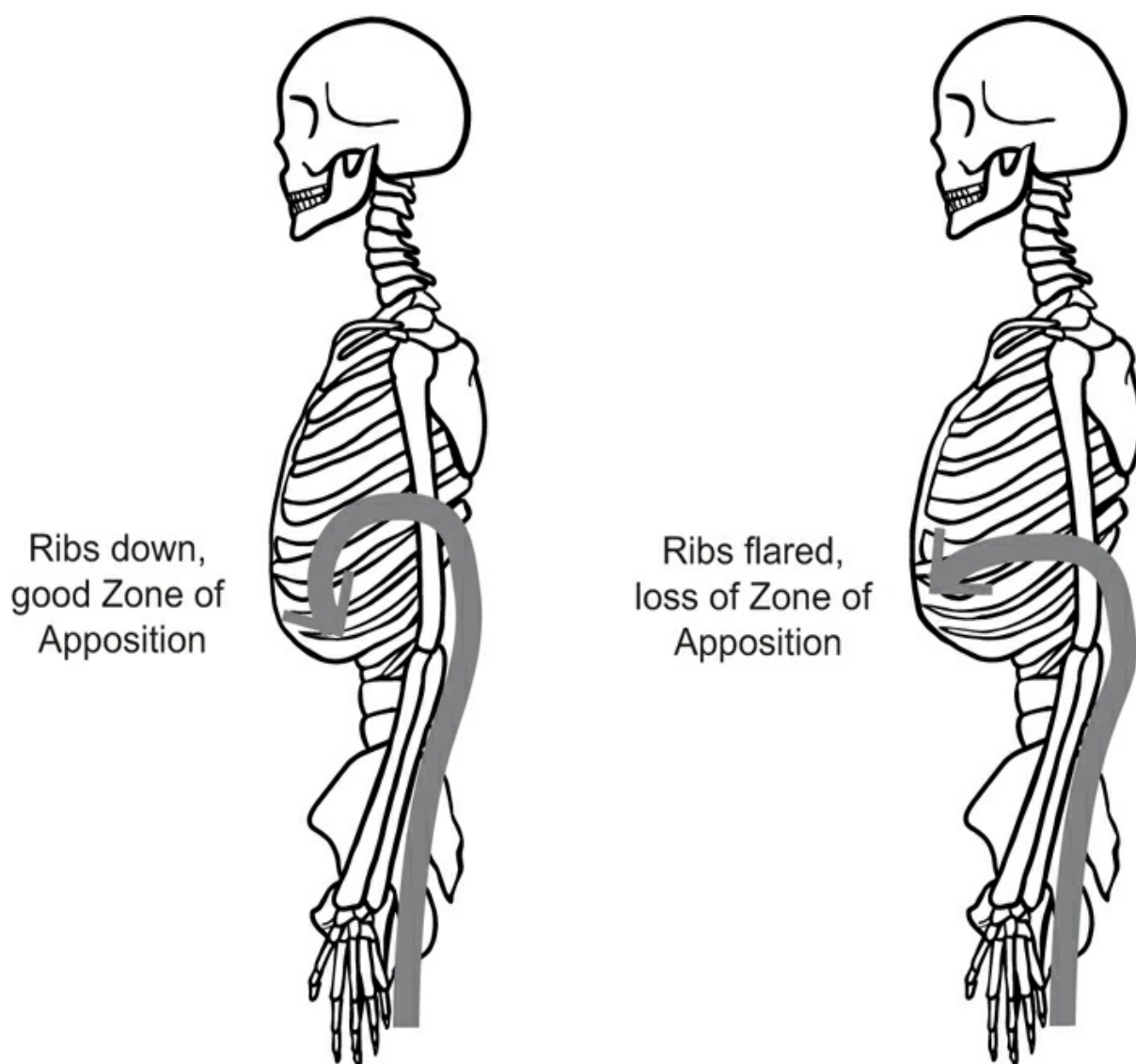


Figure 6.5 Zone of Apposition

If the ribs are jutted forward, as when the spine is in hyperextension (a very common postural misalignment in yoga āsana—particularly backbends), the dome flattens, just as a parachute would if you pulled the edges apart and held them rigidly. This decreases the ZOA, because the rib position disengages the movement of the upper transversus abdominis, restricting the diaphragm’s ability to fully contract. On inhale, the upper chest will expand as the intercostals take over, while the lower ribs will either stay fixed or narrow slightly in response. Likewise, on exhale, the lower abdominals may engage (below the navel), but the upper portion that directly facilitates the movement of the diaphragm will be immobilized by the anterior displacement of the ribs.

While the hyperextension posture is a common concern in the world of yoga, the more common postural imbalance is to sit or stand with the spine in a hyperflexed position. “Slump-āsana,” as I think of it, is fraught with all kinds of structural anomalies: For instance, it reverses the lumbar, lordotic curve, accentuates kyphosis in the upper back, and pushes the head into an anterior, forward position. This forces the neck into either hyperflexion or hyperextension, neither of which is conducive to health. In a slumped position, the rib cage is collapsed inward. This inhibits the downward and outward movement of the diaphragm on inhale, and effectively mutes the abdominals. The ZOA will decrease due to the restriction of

movement in the diaphragm and reduction of intra-abdominal pressure. The result is that the thoracic muscles take over and act as primary breathers. The upper traps, scalenes, and pecs will tighten and lift in order to draw breath in. This action will move the rib cage vertically, rather than laterally as intended, creating the dysfunctional up-and-down movement with breathing, mentioned earlier.

It is interesting to note that both the puffed-up chest position and the common slump can drive us into chest breathing. Both positions push our nervous system into a more sympathetic activation, but in different ways. The hyperextension position replicates a kind of startle reflex, with more of an anxious overtone. The slump tends to correlate with more of a depressive, withdrawn emotional tone. Imagine the impact of thousands of breaths each day, taken while locked into either of these postural patterns. Then, compound that with the stress load that comes from sitting at a computer, in hours of traffic, or scrolling through the news feed. If you add a bit of financial and relationship stress into the mix, you've got a landmine waiting to explode. Consider the influence of posture and position of the rib cage on our breathing saṃskāra. Together, these two are large determinants as to whether we develop a dysfunctional breathing pattern by restricting the diaphragm's ability to do its job.

How will this affect the Energy Bank Account over time? Remember the yoga maxim: We become proficient at what we practice! Addressing the biomechanical aspect of breathing is at least as important as considerations of biochemical imbalances, especially as one tends to drive the other. "Alternations in posture profoundly influence breathing function. It is also well established that altered breathing patterns, such as hyperventilation, have immediate negative effects on postural stability and balance."<sup>8</sup>

### FINDING YOUR ZOA

To have a sense of the ZOA in your own body, try this experiment:

Sit or stand in *Tadāsana* (Mountain Pose). Place the thumb and middle finger of one hand to touch both sides of the rib cage simultaneously. (Photos 17 and 18) Intentionally hyperextend your lumbar spine so that the ribs push forward and the front of the rib cage is elevated relative to the back side. Hold this position while taking a diaphragmatic breath. Isolate the lower ribs and expand them as far apart you are able. Feel the restriction in lateral movement. You may even feel the lower ribs pull in slightly, while the rib cage lifts. Notice expansion of the upper chest and gauge the level of tension in the muscles of the neck.



*Photo 17*



Photo 18

Maintain the hyperextension posture and exhale, engaging the abdominal muscles, hugging them in as much as you can *without lowering the front ribs*. Again, notice that your ability to narrow the rib cage with the exhale and move the diaphragm up into its resting dome is also restricted in the hyperextended position.

Let go, and take a few relaxed breaths.

Now, tug the lower front ribs in slightly, so the front and back rib cage sits neutrally in a horizontal plane. (If you are a chronic “rib-jutter” this may initially feel awkward.) Some of you may notice the lumbar curve is more relaxed in this position. With fingers touching into the lower ribs as described above, once again draw in a diaphragmatic breath. Focus on increasing the lateral expansion of the lower ribs. Compare your experience with the previous position. You should feel considerably less resistance, and a greater degree of global expansion around the base of the ribs.

Activate the abdominals on the exhale and hug them in. Notice how much easier it is to narrow the lower rib cage. Depending on your interoceptive awareness, you may even feel the diaphragm moving upward inside the cavern of the ribs.

Let go, and take a few relaxed breaths.

Now move into a typical postural slump. The lower rib cage will collapse inward, shortening the front waist, and rounding the spine in a C shape. Place your fingers once again on the lower ribs and do the experiment. Notice that the lower rib cage stays static and the abdominal muscles flaccid, unable to recruit

with either inhale or exhale. The breath tends to move high up into the chest, becoming shallow and more rapid.

With conditions like COPD, emphysema, and severe asthma, the lungs often hyperinflate. This means air gets trapped inside, restricting the diaphragm's movement, and lessening the curvature of the dome. Hyperinflation happens when inhalation supersedes a complete exhalation, forcing the lungs to continuously expand with each successive breath before exhalation is completed. Studies have shown that hyperinflation reduces the ZOA, restricting the diaphragm's power and efficiency.<sup>9</sup> According to Rosalba Courtney's article, "Breathing training for dysfunctional breathing in asthma: Taking a multidimensional approach":

Hyperinflation changes the operating conditions of respiratory muscles, making them shorter and weaker. In the case of the diaphragm, hyperinflation and abnormally elevated resting tone lead to loss of the zone of apposition, reducing the ability of the diaphragm to generate inspiratory force. This results in greater recruitment of accessory muscles of respiration in the neck and upper thoracic region as evidenced by thoracic and asynchronous breathing patterns.<sup>10</sup>

Chronic emotional stress and chest breathing also lead to over-recruitment of the thoracic area by elevating the upper rib cage and decreasing the ZOA. Fluoroscopic studies show that during times of psychological tension, the diaphragm's ability to mobilize is greatly reduced.<sup>11</sup> This decrease in tonicity and mobility impacts the diaphragm's capacity to act synergistically as a core stabilizer, resulting in a deconditioning of the abdominal core as well as tending to exacerbate chest breathing (see [Photo 16](#) above).<sup>12</sup>

The diaphragm, like any other muscle in the body, responds to function, and can therefore develop strength, flexibility, tension, weakness, or any combination of these. When a muscle has good resilience, it means that it moves well throughout its potential range, while also retaining resting tonus, or the ability to relax. If it is held taut or immobilized, as in the examples of the diaphragm with a restricted ZOA, the fibers become hypertonic (chronically tight), and the fascia dehydrates, which leads to rigidity, weakness, and the inability to relax. To get a sense of this, imagine holding your hand in a tight fist for hours at a time. Not only would this be an exhausting endeavor to maintain, it would also become difficult—even painful—to attempt to open the palm and near impossible to relax it fully for some time afterwards. It would have literally molded to the contracted position. Sometimes people mistake chronic tension for strength, but actually chronically contracted muscles are fatigued from over-recruitment, and simultaneously unable to let go or remember how to rest. Just like our mind, muscles need to be able to rest in order to rejuvenate.

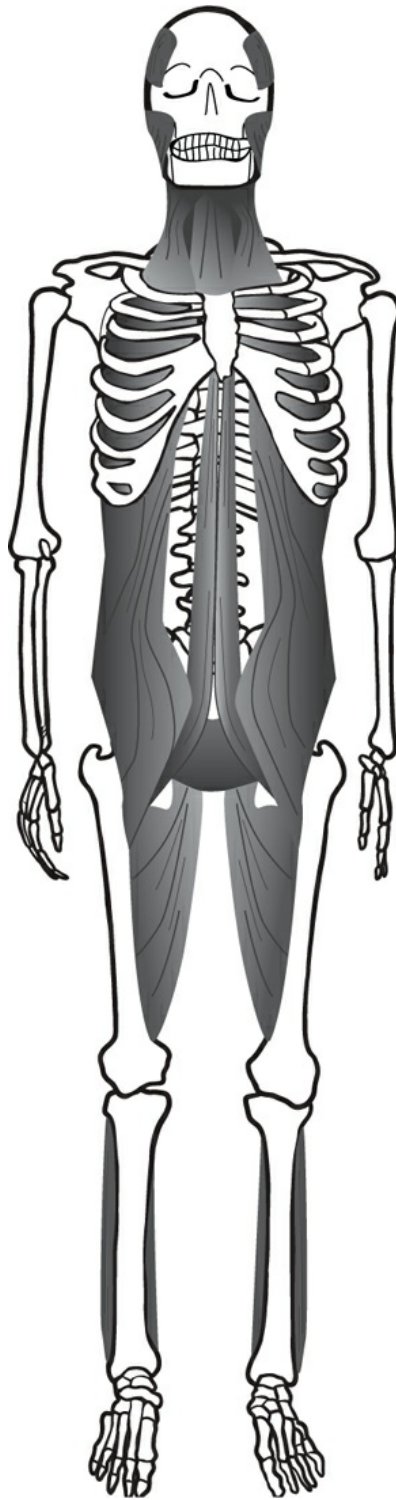
When the diaphragm is fixed over time, it loses its elasticity and resilience. This state is correlated with a hyper-activation of the phrenic nerve.<sup>13</sup> This means in essence the nerves become "pre-set" and on the look-out for potential threats, triggering the impulse to breathe at a higher and faster rate as if there's a predator looming. Furthermore, when the diaphragm is slow to relax or unable to fully release into its resting position, perfusion of the blood is limited, decreasing oxygenation, leaving one feeling breathless. This of course feeds right into the hyperventilation cycle as discussed in the previous chapters.<sup>14</sup>

All of these variables need to be considered in the process of breath retraining. As we attempt to slow the rate of breath and lower the volume, the diaphragm may initially hiccup or spasm much like any overactivated muscle. It will have lost its resting tonus—its ability to relax to neutral—and consistently be called into recruitment. This will create a feeling of

dyspnea (breathlessness), making the person feel compelled to chest breathe more, or gasp with big sighs. Postural alignment, along with consistent and proper recruitment of the abdominals with the breath, can help to reestablish a healthy ZOA. This will go far to restore structural stability, calm the nervous system, and thus reduce the breath drive, returning respiration rates to normal levels.

### **The Deep Front Line—The Pathway to Stability**

In *Anatomy Trains*, author Tom Myers examines the connections of body structures through the myofascial meridians. From the feet to the head, he illustrates how the connective tissue (fascia) contains us in a web-like matrix that may be more responsible for holding us upright than the skeletal bones.<sup>15</sup> In Meyer's model, The Deep Front Line (DFL) links the inner arches of the feet, through the tibialis posterior, the adductor complex, pelvic floor, iliopsoas, diaphragm, and pericardium, to the longis colli in the neck. In essence good DFL alignment facilitates a solid Mountain Pose/Tadāsana from the ground up, like the central rod of a maypole. [Figure 6.6.](#) offers a visual representation of the Deep Front Line as described by Myers.



*Figure 6.6 Deep Front Line*

Sometimes I say to students in my training program that I feel like I teach the same thing every day: DFL, DFL, DFL. Once they've worked with me for a while, they begin to understand. Without awareness and engagement of the DFL, our bodies are at risk of injury in our āsana practice. One of my colleagues, Jill Massengill, who is a chiropractor and yoga therapist, describes the DFL as the batting in a rag doll that keeps the doll from flopping in on itself. To my mind, the DFL is absolutely the scaffolding that provides stability to the rest of



the annamaya (the physical sheath) and is key to maintaining upright posture and functional movement without undue strain or stress.

## **The Diaphragm as a Core Stabilizer**

While breathing is the diaphragm's primary job, it is also a vital member of our DFL and is intended to be utilized as a trunk stabilizer. As discussed above, when the diaphragm is functioning well, it acts synergistically with the abdominal muscles. This provides solidity to our upright stance and also an ability for us to haul, lift, bend, and twist effectively without straining our spine.

The diaphragm swaddles the center of the DFL. As a trunk stabilizer it co-acts with the transversus abdominis, obliques, the iliopsoas, quadratus lumborum (QL), the multifidi, and the pelvic floor. The psoas and QL, deep structures within the lumbar area, are critical for sustaining healthy movement in the lower back and pelvis along with autonomic function.<sup>16</sup> Together all these muscles form the abdominal core and support balanced alignment of the rib cage. In the ideal, they are positioned in a fairly symmetrical orientation side to side.

Right/left imbalances, which are fairly common, reflect a one-sided shortening of some of these structures. In conditions like scoliosis, an ipsilateral (one-sided) shortening of the psoas is common. Likewise, repetitive activities or postural habituation can result in pelvic rotation and lateral contraction, creating asymmetry in the muscles of the pelvis. These kinds of postural imbalances place an additional strain on the diaphragm, and consequently diminish both respiration and core stability.<sup>17</sup>



*Photos 19 and 20 Student with scoliosis and leg-length difference. This demonstrates the right/left muscular asymmetries that can develop as a result.*

As yoga teachers we need to understand the annamaya to prāṇayamaya (physical to physiological) connections between these asymmetries, and the value of shifting the status quo from both angles. This means consciously linking structural imbalances to the impact on the diaphragm and breath, rather than simply stretching or contracting muscles in an isolated, “annamaya-exclusive” manner. Intentional engagement of the breath during movement may prove a more effective means to break the postural saṃskāras that lock in asymmetries in the first place.

One common example of this would be the use of a low lunge as a means to stretch a shortened psoas muscle. By bringing the focus on the breath, repositioning the rib cage to maximize the ZOA, the abdominals can be more effectively engaged. This will facilitate core support, by creating a DFL brace for the lower back. It will also provide a more effective stretch of the iliopsoas. By recruiting the abdominals, it will help free tension from the upper torso, by relaxing the accessory muscles of the chest. Conversely, the typical “sinking lunge”—with jutting rib cage—will have just the opposite effect. The abdominal-diaphragmatic adaptation provides a useful means to transform a common yoga saṃskāra (habit pattern) and translates well into other back-bending positions.



*Photo 21 Sinking Lunge*



*Photo 22 Lunge with DFL Engaged*

## **The Diaphragm and Functional Movement**

The diaphragm's role as a core stabilizer has been well studied. It has been demonstrated that functional breathing, defined here as healthy diaphragmatic movement in correspondence with normal breath rate and volume, is a good measure of core strength. Functional breathing has been paired with the ability to perform postural activities, such as lifting light weights, side-bending, and twisting under load without strain.

One study by Kolar demonstrated that during postural activities, the diaphragm moves deeper into the abdominal cavity than during rest, eccentrically contracting, which increases the ZOA. The more challenging the postural tasks, the greater the demand on the diaphragm's expiratory position. This increase in intra-abdominal pressure provides stabilization for the lumbar spine. According to this study, the key to core stabilization relies on the diaphragm's ability to maintain optimal intra-abdominal pressure, regardless of activity. This requires synchronization between the diaphragm, pelvic floor, and the abdominals.<sup>18</sup> Smith, Russell, and Hodges (2006) confirm that, in the absence of disease, "the diaphragm and transversus abdominis simultaneously control both respiration and posture," contributing to "core

stability.”<sup>19</sup> The central tendon of the diaphragm acts like a piston against the pelvic floor, activating the DFL from the pelvis through the thoraco-lumbar junction.

A few recent studies have further confirmed the relationship between core strength, functional movement, and breathing. Bradley and Esformes (2014) compared breathing mechanics, posture, and spinal stabilization. They cross-referenced the results of a functional movement screen (FMS) and concluded that individuals who exhibited low CO<sub>2</sub> levels and were chest-breathers scored poorly on the FMS and were more prone to injury. One of the most surprising aspects of this study was that participants comprised 34 healthy young adults, and none of them complained of breathing difficulties. They were all regular exercisers. The high correlation between low functional movement scores and breathing pattern disorders led researchers to conclude that diaphragmatic breathing has a significant impact on movement. They determined that dysfunctional breathing alone could result in muscular imbalance and movement compensation patterns.<sup>20</sup>

Another study, published in the *Journal of Orthopedics and Rehabilitation* in 2011, concluded that core strength, diaphragmatic function, and breath hold times were linearly correlated. Participants comprised 60 healthy adults between the ages of 18 and 25, with no prior history of respiratory concerns. They were measured on core stability while performing various activities requiring rapid arm movements, which increases intra-abdominal pressure. Breath-holding time was measured separately. A breath-hold measurement of 40 seconds or longer was considered indicative of normal levels of CO<sub>2</sub> and associated with functional breathing. This correlates beautifully with Dr. Buteyko’s assessment of breath-hold times as described in [Chapter 4](#). Those participants who tested highly on core strength were also able to sustain the 40-second or greater threshold. The researchers additionally concluded that proper use of the diaphragm as a core stabilizer unloads the spine and can help prevent back injuries.<sup>21</sup>

Lastly, O’Sullivan *et al.* (2002) found that individuals who presented with sacroiliac joint pain demonstrated compensatory movement patterns and dysfunctional breathing while performing a low-load task.<sup>22</sup> The diaphragm’s power and efficiency was limited, demonstrated by a decreased ZOA. Similarly, Roussel, Nijs and Truijen (2007) examined individuals with low back dysfunction and observed dysfunctional breathing patterns during movements which challenged core stability.<sup>23</sup>

All of these studies indicate that synching proper diaphragmatic activation with the abdominals during postural loading leads to better functionality with movement. Better breathers, that is, those who breathe in an abdominal-diaphragmatic pattern and have sufficient CO<sub>2</sub> levels, appear to have better movement function and are less prone to injury and back pain. This is great news for yoga teachers and therapists! Through āsana we can develop practices that consciously link diaphragmatic breathing with core support while challenging the body to sustain that regimen in various postural positions.

## Belly Breathing

Belly breathing is a breath pattern often used in yoga circles as a way to relax tension and induce a state of calm. Belly breathing emphasizes the active expansion of the lower abdomen on inhale and passive release on exhale (see [Figure 6.7](#)). This method can be useful short term to initiate the parasympathetic nervous system and lull one into relaxation. However, over the long term it is yet another dysfunctional breathing pattern, as it leads to both deconditioning of the abdominal muscles and dysregulation of the diaphragm with the

abdominals. Used consistently over time, belly breathing will force the accessory muscles of the neck and shoulders to engage more in order to pick up the slack from a weak abdominal core. Donna Farhi and Leila Stuart's gorgeous treatise on the psoas, *Pathways to a Centered Body*, offers this analogy, comparing belly breathing with proper diaphragmatic activation:

Abdominal Breathing is like putting a sleeping bag in a large stretchy pillowcase. Diaphragmatic Breathing is like compacting that same sleeping bag into a small canvas duffel. This containment of the abdominal wall increases the pressure inside the abdomen (known as intra-abdominal pressure). The resulting increased compaction through the core of the body is one of the mechanisms that stabilizes the spine. This is why the diaphragm is considered to be a key player in the activation of the core muscles.<sup>24</sup>

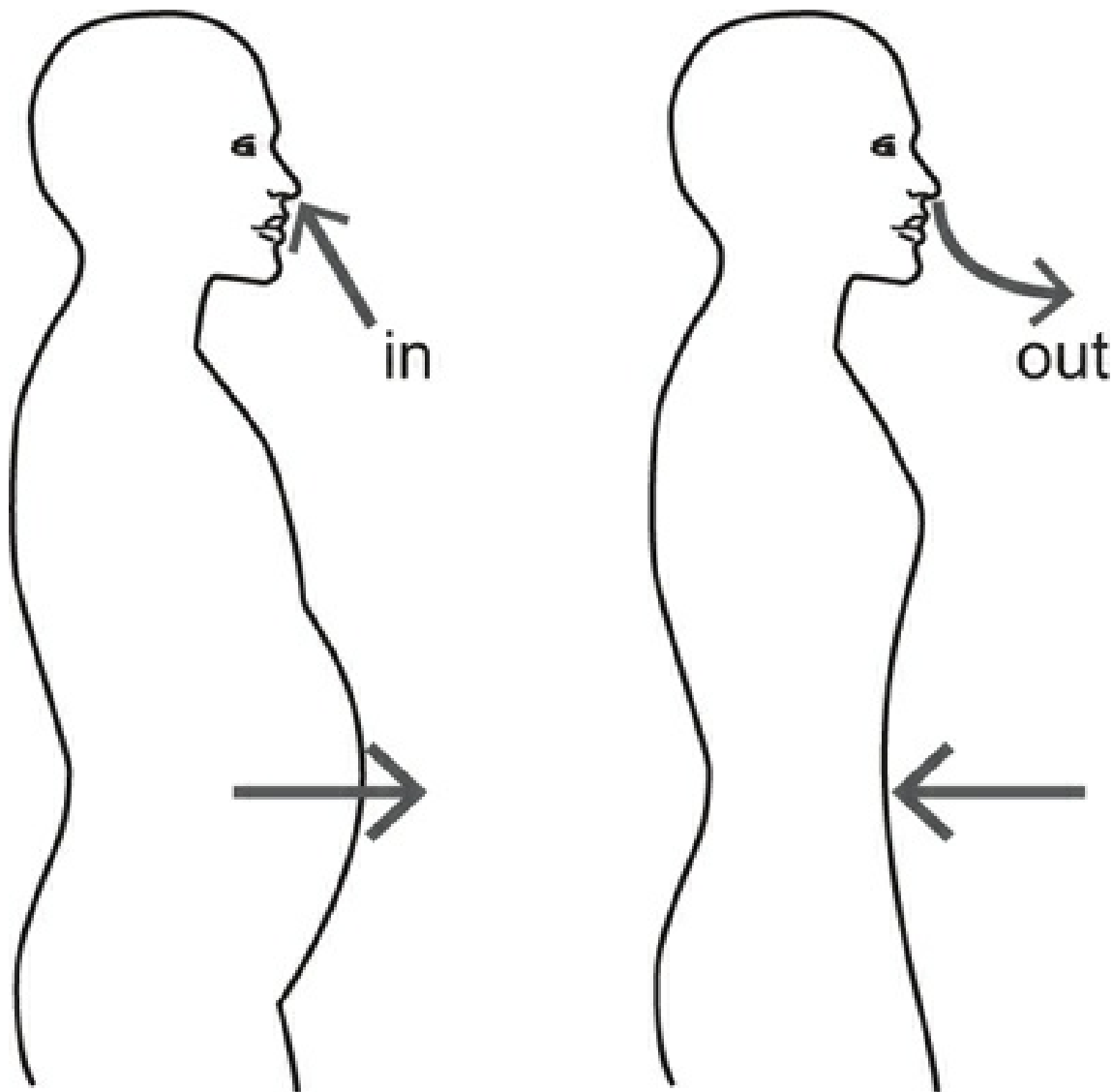


Figure 6.7 Belly Breathing

## More Yoga Considerations

Instruction of the breath in āsana matters. We want to bring svādhyāya (self-awareness) to the way we are cuing our students, avoiding calls to breathe big, inflate the chest wall, belly breathe, or audibly exhale through the mouth. Rather, it's important we teach students how to

become more efficient diaphragmatic-abdominal breathers. We also need to consider how we are facilitating students' awareness of their posture, most notably by bringing attention to the position of the rib cage in all postures. Void of these considerations, we run the risk of cultivating breath patterns in our students that may, in fact, be harmful for their health and create dysregulation.

To summarize the negative implications associated with breathing dysregulation:

- The accessory muscles in the neck and thoracic area are actively recruited.
- Diaphragmatic action is compromised by restriction of the ZOA.
- Breath rate and volume are often doubled (hyperventilation).
- More O<sub>2</sub> is utilized in the breathing process.
- Chronic tension in the scalenes, upper traps, and levator scapulae is reinforced with every breath.
- Overuse of these structures can result in pain in the upper body and neck, headaches, and jaw clenching, as well as postural imbalances like forward head position and kyphosis.
- The diaphragm and abdominal core lose tone.
- CO<sub>2</sub> levels may drop.
- The lower back and sacrum are more vulnerable to injury.

As yoga teachers we need to keep these connections in mind and understand that what we teach our students with regard to the breath impacts them much further than the 90-minute session they spend with us. The imprinting reinforced by our “expertise” as breath educators will travel with them wherever they go.

By taking students back to the ABCs of breathing, we do them a great service. Remember that the repetitive cycle of breathing will lock into place a pattern of either functional or dysfunctional muscular recruitment. As we support our students in their growing awareness of the breath, we can use our prāṇāyāma and āsana practices to teach them how to consciously link the breath with the recruitment of the abdominal muscles. This will help to uncouple the accessory muscles of the chest from the breathing process and support healthier diaphragmatic function in their daily life. Breathing this way facilitates the entire panchamaya in a return to a state of homeostasis.

## KEY CONCEPTS

---

- The diaphragm is designed to synchronize with the abdominal core in functional breathing at rest and is a primary stabilizer.
- The thoracic accessory muscles are only to be “called into action” in the case of intense physical activity (like running up a hill or away from a lion) or in times of emotional stress (e.g., to support the vocalization of a call for help).
- The diaphragm acts as a visceral muscle representing a central meeting point for the cardiovascular system, digestive system, musculoskeletal system, and the autonomic nervous system.

- Consistent and correct movement of the diaphragm with breathing plays a very important role in maintaining physiological health in the other systems.

## — PUTTING IT INTO PRACTICE —

To begin to work with this concept, I recommend combining **undulation** and **Core Breathing** (explained below). Undulation helps to pacify the upper body and increase awareness of subliminal holding patterns in the shoulders, neck, and jaw. Core Breathing (see **Core Breathing with Hi-Low Position** below for details) builds on the **Subtle Breathing** described in [Chapter 4](#). As per its name, Core Breathing consciously synchronizes the abdominal core muscles with the diaphragmatic movement of the breath. For those who have difficulty finding, feeling, and activating the diaphragm itself, I have also included specific exercises to assist with this process. The exercises in this chapter form the foundation for the recruitment of the bandha muscles as described fully in [Chapter 7](#).

**Note:** While the term “core” is most frequently associated with recruitment of the deep abdominal muscles, in the interest of cultivating an interconnected awareness of structural support throughout the body, I have created the terms “mid-back core” and “neck core” to facilitate the link between the primary pelvic, torso, and neck stabilizers. These three “cores” will be described through the exercises below. Consistent recruitment of the “cores” assists both functional movement and functional breathing.

### Undulation as a Pratikriya

*Pratikriya* (pronounced prah-tee-kree-ya), or opposite action, forms a conceptual foundation for āsana practice. Strong āsana traditionally was followed by a pratikriya. For instance, *Sarvāṅgāsana* (sar-vahn-gah-sah-nah, shoulderstand) is used as a counter pose for *Śīrṣāsana* (sheer-sha-sah-nah, headstand). Forward bends, which flex the spine, balance back extension. In a similar way, regular use of undulation provides a pratikriya for core work. Undulation is always to be done slowly with a quality of relaxation. It encourages gyration in non-linear, non-repetitive fractals of movement. Recruitment of muscles is performed at a micro-level, with mindful attention to every choice.

Undulations prepare the neck and shoulder area for breathing practice. They bring awareness to chronically taut areas within the thoracic and cervical spine, and instill a felt sense of release. These undulation exercises facilitate proprioception of patterns of tension while also providing relief. The soft swirls and rolls will help you to maintain a relaxed upper body, even while increasing the challenge in the abdominal core.

### A Few Words about Undulation

My utilization of undulation is derived from Anita Boser’s book *Undulation: Relieve Stiffness and Feel Young*.<sup>25</sup> I have taken what I have learned from studying with Anita and created my own undulation movements, which are now a routine part of my yoga therapy work. Undulation is a wonderful way of warming up and releasing chronically hypertonic muscles. It also provides the body a lovely means of releasing tension that may accrue during strong, focused movements like core work. I have taken what I have



learned from studying with Anita and created my own undulation movements, which are now a routine part of my yoga therapy work.

I often describe undulation as “claiming your real estate.” It has a way of enabling us to access places of “avidya”—unconsciousness—where we’ve not ventured before. In most āsana or movement classes we follow externally directed instructions. Instead, undulation forces us to use our own awareness to direct the movement to where it feels fresh. Like venturing down an unpaved trail, undulation beckons us to explore movement with curiosity, rather than sliding down a frequently traversed toboggan run of habit.

My students consistently express their appreciation of both undulation and **Core Breathing**, acknowledging that these two practices are accessible and easy to sprinkle throughout their day. They state that working with the breath and movement in these ways has made a considerable difference in pain reduction and has positively impacted both their physical and mental sense of well-being.

The rules of undulation are simple:

- Stay in a pain-free range.
- Keep the breath softly circulating without force or holding.
- Move into “awkward.” In other words, stay out of familiar “grooves” that feel easy and comfortable. Find new ways of moving, non-linear, unpatterned lines of connection that expose you to new possibilities for movement and simultaneously do not cause irritation to the area.
- Mix it up. Once you’ve explored a movement pattern two or three times, find another way into the area. Change the point of initiation, the direction of the movement. Add a swirl or curlicue that you hadn’t tried before. Slow it down. Make it smaller. Refine your awareness as you “bushwhack” your way into previously unknown areas of your body.

Undulation increases circulation in the area of focus, and over time smooths out the jagged edges where the tissue may be adhered (glued together) or where there may be internal scarring due to injury or repetitive stress. It hydrates areas that may have become desiccated from lack of movement altogether. Sometimes an undulation practice results in a feeling of fatigue, even though the movements seem so tiny and inconsequential. This is because movements that are unfamiliar require a great deal of mind/body concentration to sustain. Fatigue combined with a feeling of warmth, relaxation, and spaciousness are signs that your undulation movement is serving you. I highly recommend using undulation frequently before and in between the exercises listed in this section and in the following chapter.

Practice combining large and small movements. Consciously choose to move where you feel you need more awareness, a sense of spaciousness or relaxation, or desire to build new connections in your body.

## Undulation Exercises

- Scapular Swirls
- Passing Notes
- Paint the Floor

- Doodle with Your Nose
- Undulations from a Forward Bend Position
- Rapunzel

## SCAPULAR SWIRLS (**PHOTOS 23 AND 24**)

---

This undulation brings awareness to the movement of the scapula (shoulder blade) itself, where many people lack proprioception. The key to this movement is to initiate the action from the inside (medial) aspect of the shoulder blade, maintaining passivity in the upper shoulder and neck. This practice goes far to unhook the upper traps, levator, and scalenes from acting as primary movers of the shoulder, arms, and breath. Many of us live as if our scapulae are nailed to the spine. Lack of mobility and poor positioning of the scapula is unfortunately a set-up for anterior head carriage, shoulder impingement, injury, and dysfunctional breathing patterns.

Set the upper arm bones in external rotation as you lie in the supine position, with the wings of the blades tipped down and in (not pinched together). This will help initiate the movement from the bottom rather than the top of the scapular triangle. A slight bend of the elbow (as needed, use blankets or towels to prop the forearms and wrists so they rest comfortably) will enable you to link the back of the arms around the triceps to the muscles that move the lower part of the blade. This awakens the “mid-back” core (see below), specifically the serratus anterior, the lower part of the rhomboids, and the lower trapezius.

Proper set and placement of the shoulder girdle requires functional movement in the scapula. To understand this more fully, consider how a skilled pitcher throws from the center of the spine, recruiting all the muscles around the shoulder blade both in the wind-up and the thrust. Shoulder movement that is confined to the ball joint (where the top of the arm attaches to the torso) lacks power and forces the tendons and ligaments to move the arm. The muscles of the rotator cuff and mid-back stabilizers are intended to be the powerhouses of the upper body. As with all undulations, keep the breath soft, diaphragmatic, and in a continuous flow. Pause to consciously release any of the actions noted below which indicate thoracic activation of the breath:

- subtle lift of collar bones
- tightening in the neck and jaw
- jutting of the rib cage
- tension in the lower back.

Scapular Swirls are often easiest to learn in a supine position out of the gravitational pull, with the neck gently propped with a towel or blanket. The floor provides both support and feedback for the movement. Once awareness awakens, Scapular Swirls can easily be done in a **Seated** or **Standing Mountain Pose**, or even taken into standing āsanās like **Warrior 1** or **Chair Pose**.

- Lie on the floor with knees bent (you can support the knees with a bolster or chair, or have feet on the floor).
- Bring your awareness to the medial surface of the right scapula—where the wing of the scapula is closest the spine. Practice moving just one scapula at a time.

- Begin to lift, lower, and shift your shoulder blade towards and away from the spine.
- Notice what moves the shoulder. Is it the muscles along the top of the shoulder around the curve of the neck? Is the arm moving?
- Can you isolate the muscles along the inside and lower tip of the wing of the shoulder blade? Imagine only tipping the wing of the blade in and out, up and down.
- Notice if this feels challenging. The movement range will likely be much smaller if you keep it contained at the wing tip.
- Feel the wing making variable contact with the floor as you move it.
- Can you move in a different way (e.g., diagonally; in a swirl; figure 8; or in a random pattern)?
- Notice where the movement feels familiar/comfortable. Notice where it feels awkward.
- Move into “awkward.” How else can you move in this area in a way that you haven’t yet tried?
- Pause and notice. Then, repeat the practice with the left scapula.

You may find that one shoulder blade moves with more ease and awareness than the other. Use this side to “teach” the other side about potential options. Practice inviting the less mobile side to mirror the movement “felt” on the side that moves with ease, until they are more congruent.



*Photo 23*



*Photo 24*

### **PASSING NOTES (PHOTOS 25 AND 26)**

---

Once you've become fully acquainted with the movement potential of your individual scapulae, alternate the action, right to left, as if passing notes from one to the other. Keep the neck relaxed, jaw soft. Tongue parked to the roof of the mouth.



Photo 25



Photo 26

## PAINT THE FLOOR (**PHOTO 27**)

---

This undulation can be done from a supine position using the back of the head as a contact point, or it can be done in **Child's Pose** using the forehead as the contact point. The key to the movement is to vary it, so the contact point covers the widest “swath” of area possible.

- Lie supine with knees bent.
- Support the neck with a small cervical roll.
- Externally rotate the shoulders and set the shoulder blades, wings tucked.
- Notice where the head makes contact with the floor or blanket and begin to initiate movement from that connection. Imagine that you are “painting the floor” with the back of the head.
- Maintain consistent contact, so the head doesn't lift at any point.
- Pacify the neck and shoulders.
- Notice how it feels to tip or lift the chin; to swirl the head to the right or left.

- Explore non-linear movements, keeping the pattern random.
- How much of the floor beneath you can your head “paint”?
- Notice the effect of the muscles in your neck as you practice.

When **Painting the Floor from Child’s Pose**, if needed, place a block or a blanket comfortably under the forehead so the head has firm contact with support. (**Photo 28**)



*Photo 27*



*Photo 28*

## DOODLE WITH YOUR NOSE (ON THE CEILING OR WALL)

This undulation can be done from a supine position or in a **Seated Mountain Pose**. It is similar to **Paint the Floor**; however, the initiation point of the movement is the nose. Imagine you have paint on the tip of your nose! Notice how different it feels to reference movement from the nose, rather than the back of the head. In a supine position, imagine you are doodling on the ceiling. In a seated position, imagine you are doodling on the wall across from you.

## UNDULATIONS FROM A FORWARD BEND POSITION



These undulations can be done in **Child's Pose**, from a chair or from a standing position as in **Standing Forward Bend**. Once you come into the forward fold, rest your hands either on a prop or on the floor. Isolate one area at a time and work with undulating that area, noting how it feels to move the neck and shoulder girdle in the inverted position. **(Photo 29)**

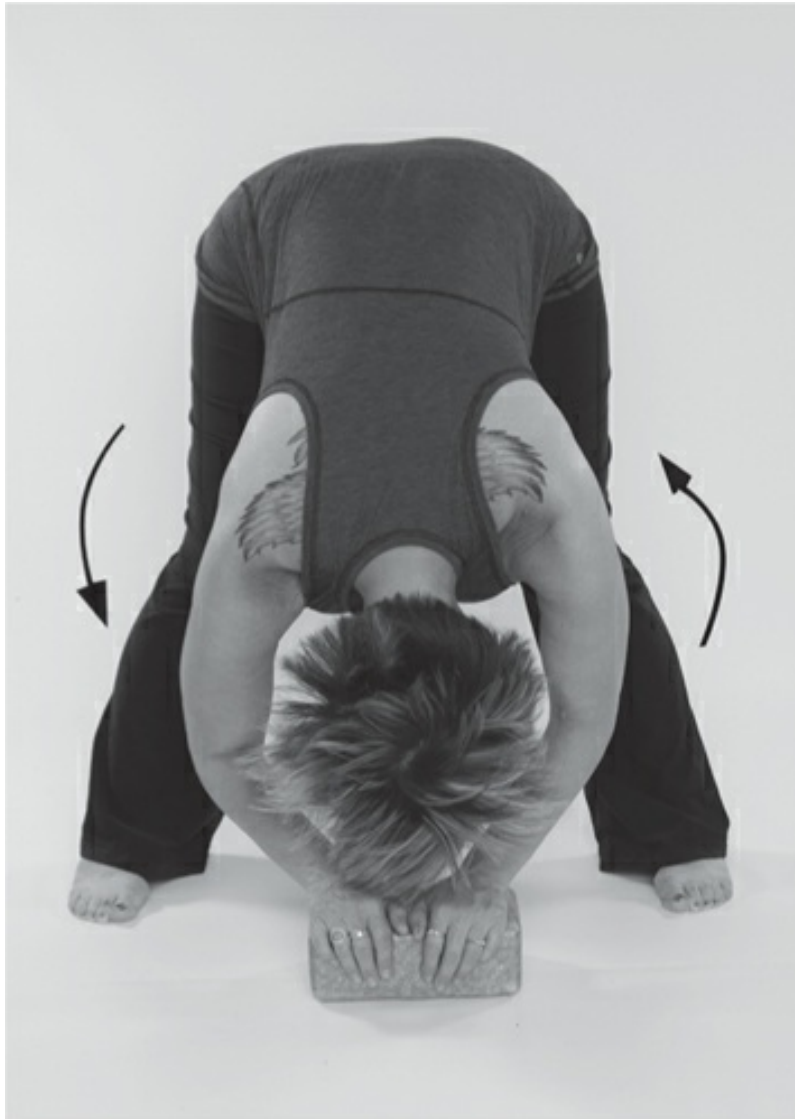


*Photo 29*

**Scapular Swirls** and **Passing Notes** are fun to explore in the forward fold to cultivate a different proprioceptive awareness than is possible in the upright or supine position. **(Photos 30 and 31)**



*Photo 30*



*Photo 31*

For the neck, try **Rapunzel**:

### RAPUNZEL (BEST DONE FROM CHAIR OR STANDING) ([PHOTO 32](#))

---

- Hang the crown of the head freely towards the floor, allowing the head to dangle from the neck.
- Imagine you have a mop of hair that hangs loosely towards the floor.
- Make slow swirls with the crown center, releasing the neck.



*Photo 32*

Intersperse any of these undulations throughout your yoga practice. Use them particularly when you are aware of the activation of the muscles of the upper chest with the inhalation breath, or you find yourself out of synch with your breath rhythm. Let the undulation relax you and help you reset the body and mind, so the learning process feels inviting and easeful.

## **Core Breathing Exercises**

### **CORE BREATHING WITH HI-LOW POSITION ([PHOTOS 33 AND 34](#))**

- Start supine with knees bent, feet on the floor, a small roll under the neck.
- Place one hand on the chest, one hand on the lower rib cage/upper belly.
- If the arm position is uncomfortable, use blankets or towels to prop the arms so the neck and shoulders can relax fully.
- Begin with **Subtle Breathing**.

- Breathe softly through the nose, pacifying the muscles of the chest so there is no inflation of the upper rib cage.
- Drawing attention to the solar plexus, emphasize the outward flare of the lower ribs with the inhale and the gentle inward contraction with the exhale.
- Take the time to consistently neutralize recruitment of the neck and shoulder girdle while inhaling.
- Progressively make the breath lighter, silent, and with less discernible movement (approximately 5 minutes).
- Shift the upper hand to the lower belly, between the navel and the pubis.
- Maintain the same passivity of the upper torso with the inhale.
- On the exhale, begin to recruit the abdominal muscles by tightening the abdominals from the pubic bone, to the navel, to the lower rib cage. Imagine that you are zipping up a tight pair of jeans, fresh from the dryer. Create a feeling as if you are hugging your spine around the entire circumference, the full 360 degrees, of the waist. Hold the contraction of the abdominals for 2–4 seconds after the exhale.
- Then slowly, with control, “un-zip” or relax the abdominals from the top down with the inhalation breath.
- Repeat 5–10 times. Then relax the breath. Observe the effect. Repeat.



*Photo 33*



*Photo 34*

**Note:** When learning **Core Breathing**, it is important to attend to the slightest increase in tension or activation of the neck, upper traps, and pectorals. If it is difficult for you or your student to uncouple the upper body from this process, work more with the neck and shoulder undulations listed above. Then, return to Core Breathing with this awareness. Sprinkle these undulations in between cycles of Core Breathing to reinforce the intention to maintain complete neutrality up top while engaging fully below.

Another common experience with Core Breathing is the unconscious tendency to increase breath volume to correlate with greater muscular recruitment. Can you instead maintain the subtle breath while working actively with the abdominals? It takes time to master this process, but it is fundamental to carrying subtle **Core Breathing** into other āsana and physical exercise activities.

### Tricks for Engagement

Sometimes it is difficult for people to feel the activation of the transversus abdominis, or the TVA. Here are a few ways I've found that can help:

- Place a block between the thighs to engage the adductors. Since they are fascially linked to the TVA, this can often help bring the lower TVA on board.
- Try a pursed lips exhale. This is just for learning purposes—like using training wheels before two-wheeling it. Pursing the lips increases positive resistance which helps recruit the diaphragm and TVA. (Adding the sound *shhh* may help here as well.)
- Place both hands on the sides of the waist and work with the expansion of the belly first. The image I use for this is making a “Food Baby.” In other words, actively stretch the entire abdomen as if you’ve just eaten a feast. Inflate the abdomen into the palms as you inhale—HOLD 1–2 seconds. Then actively contract away from the hands on the exhalation, zipping from the bottom to top. The contrast of the stretching helps some people feel the action of the contraction.

**Note:** Use anatomy texts or videos to help your students see the horizontal orientation of the TVA in the body. Educating them about how this muscle works and differentiating it from rectus abdominis, (the six-pack muscles) which are commonly misunderstood to be the core, can go far with helping people to understand how to isolate and activate the TVA.

### A Word of Encouragement

For chronic chest or paradoxical breathers, learning **Core Breathing** may take several weeks (or even months) before it feels natural. Though challenging, it is the first step in instilling proper breathing biomechanics. Sometimes I observe clients getting the rhythm, then losing it. It flows and then it doesn't. This is part of the process. If frustration arises, relax the breath completely. I recommend using humor as a distraction or doing a few repetitions of **Apanāsana** (pronounced a-pa-nah-sa-na, **Knees to Chest**) to release tension. Any of the neck and shoulder undulations offered earlier can also help reset the mind.

If you consistently find **Core Breathing** a challenge in the supine position, try it sitting up in a chair or work with the **Developing the Diaphragm** exercises listed below.

Some people learn through comparison and contrast, and exploring movement in a variety of positions, in different relationships to gravity, can often assist building these connections.

## CORE BREATHING FROM SEATED MOUNTAIN POSE (**PHOTOS 35 AND 36**)

---

Work with the hi-low hand position (first chest and diaphragm, then diaphragm and lower abs). If tension arises in the neck and shoulders, prop the arms for maximum comfort or relax with some undulation.

- If sitting in a chair, plant feet on the floor. Ground yourself firmly through the sit-bones.
- Create a **Seated Mountain Pose** with the shoulder girdle set over the pelvis.
- If sitting in a chair, place a block between the thighs to help maintain activation of the adductors. (**Photos 37 and 38**)
- Elevate the pelvis using a firm blanket so you are perched on the center of the sit-bones and the knees are slightly lower than the hips.
- Draw the chin in slightly so the connection up through the cervical spine is preserved and to avoid anterior head carriage.
- Zip-up or hug in slowly with the exhale: pubis to navel to lower ribs.
- Inhale and gently release, maintaining complete neutrality of the upper torso.
- Cue for a gentle, lateral expansion of the lower rib cage and keep the inhalation soft enough that there is no up/down movement with the breath.
- Engage the abdominals with exhalation.



*Photo 35*





*Photo 36*



*Photo 37*



*Photo 38*

**Note:** Try a side-to-side hand position, with the backs of the hands or palms resting on the ribs. Sometimes this position can quiet the upper traps and bring more lateral awareness to the movement of the lower ribs. ([Photo 39](#))



Photo 39

## Developing the Diaphragm

The yogis used techniques like *kapālabhāti*, *bastrika* (pronounced bah-streek-ah), and *agni sara* (pronounced ahg-nee sar-ah) to activate the diaphragm and upper TVA and to move *prāṇa* dynamically. (More specifics on the traditional use of these techniques can be found in [Chapter 10](#).) Use of these *kriyas* (cleansing practices) without care and proper guidance can lead to hyperventilation; however, when breath volume is controlled and the movement is slowed, the pumping action can be quite useful as a conditioning and awareness exercise. Synching the muscular contraction with the breath or isolating it separate from the breath can increase awareness of how to mobilize the diaphragm as well as strengthen it.

**Note:** In order to differentiate the traditional practice of the *prāṇāyāma* and *kriyas* named above with the exercises detailed here, I have given these practices easy-to-remember English names.

## DIAPHRAGMATIC HUGS (**PHOTOS 40 AND 41**)

---

These are best done in a **Seated Mountain Pose**. Align yourself as described in the seated version of **Core Breathing**.

- Place palms on either side of the lower rib cage.
- With a forced exhale, dynamically contract the upper abdominals. (**Photo 40**)
- Feel the rib cage hug inward with this contraction. Hold this contraction for 1–2 seconds.
- Inhale slowly and lightly, relaxing the rib cage laterally. (**Photo 41**)
- Rest. Breathe. Notice.

Find a slow pulsing rhythm that you can consistently sustain. As you are able, pump in sets of 3–6 reps, noting when the movement becomes asynchronous and the muscles begin to fatigue. Rest and relax for several breath cycles. Then, repeat 2–3 more sets, building stamina by increasing the number of reps in the set to 9–12.



*Photo 40*



*Photo 41*

It can also be helpful to practice with the hands resting palms face up on the thighs. Pulse the hands to mimic the movement of the ribs. This can help entrain the abdominals. The palms contract into a soft fist on the exhale and relax open on the inhale.

**Note:** The intention of this exercise is to synch the exhalation with contraction of the upper TVA and obliques, in order to increase the ZOA. If the chest inflates, or the shoulders lift, pause and do some of the seated neck and shoulder undulations suggested above, or try a little **Core Breathing** or a simple **Forward Bend** from a chair to relax the upper back and neck. Then try the **Diaphragmatic Hugs** again.

The sound of the forced exhale through the nostrils can sometimes become a distraction. It is actually not necessary for the sound to be pervasive. Confusion can arise when students attempt to sniff out strongly from the nose rather than initiate the action from the abdominals. This may be an indication that the accessory muscles up above are dominating the process, rather than powering the action from the diaphragm. If this happens, try the **Silent Hugs** detailed below.

## SILENT HUGS

---

These are done on the hold after exhale or suspension between the breaths. It is similar to **agni sara** for those familiar with that technique. Silent Hugs are an excellent way to prevent hyperventilation and to isolate the movement of the diaphragm and upper TVA without having to synchronize it with the breath. Separating these two actions out can be especially useful for those who are new to this process, or have been habitual thoracic breathers with little abdominal-diaphragmatic conditioning. This exercise follows the same process as detailed above; however, it is performed *without* the breath accompanying the contraction and release.

- Inhale and exhale gently and silently through the nose.
- In the pause between breaths, engage the abdominals and pump the lower rib cage in and out laterally in a repetitive rhythm.
- When the urge to breathe in arises, relax the belly and breathe gently in through the nose, without force or gasping.
- Take several relaxed breaths through the nose.
- Repeat the process 3–5 times or until the muscles fatigue.

**Note:** Once the muscles have been conditioned through Silent Hugs, return to **Diaphragmatic Hugs**, activating them in time with the breath. *Remember:* The contraction inward always synchronizes with the exhalation breath, the expansion of the ribs with the inhale.

## DIAPHRAGMATIC PUSH-UPS ([PHOTOS 42 AND 43](#))

---

This exercise uses the same pumping action as the **Diaphragmatic Hugs**, and can be done in time with the breath, or performed in the suspension between breaths as with Silent Hugs. Diaphragmatic Push-Ups, as the name implies, facilitate more active strengthening of the diaphragm. To do this exercise, lie prone and position your head comfortably, either resting the forehead on the back of the hands or on a folded blanket that allows the nose to be clear for breathing.

- Place your awareness on the diaphragm.
- As you inhale, expand the lower front ribs into the floor.
- Feel the upper abdomen expand as you do this.
- Hold the expansion for 2–4 seconds.
- As you exhale, slowly hug in and draw the lower ribs in away from the floor and hold for 2–4 seconds.
- Repeat 5–10 times or until you feel fatigue.
- Both inhalation and exhalation actively engage the diaphragm and upper abdominals.
- Rest and relax the breath in between sets.
- Practice 2–3 sets per session, increasing the length of the pauses as you become able.

Push-Ups, as indicated above, can also be performed on the hold after the exhale or suspension. In this version:

- Inhale, then exhale gently and silently through the nose.
- In the pause between breaths, actively pump the diaphragm.
- Expand the lower ribs and upper belly and then hug in away from the floor.
- Do not hold the action; rather, focus on the rhythmic repetition of the movement, gradually adding more reps, increasing the rate of contraction and release.
- When you feel the urge to breathe in, expand the belly and ribs and breathe in slowly through the nose.
- Rest and breathe in a relaxed fashion until you feel ready to do another set.



*Photo 42*



*Photo 43*

### COUNTER POSE AFTER DIAPHRAGMATIC PUSH-UPS: CHILD'S POSE WITH PAINT THE FLOOR UNDULATION (**PHOTO 44**)

---

- Shift back into **Child's Pose**.
- Let your head rest either to the floor or on a blanket or block so the neck is completely relaxed.
- Imagine you are painting the floor or prop with your forehead.
- Let your neck rock freely, your forehead swirl in gentle, non-linear, non-repetitive patterns across the floor or support.
- Allow the shoulders to completely drape, with the arms passive.



- Move very slowly and consciously, alternating between larger, more open swirls and tiny micro-movements that release and massage the back of the neck and around the occiput.

**Note:** If kneeling is contraindicated, this undulation can be done from a chair with the head resting on a bolster, second chair seat, or table top.



*Photo 44*

## CHAPTER SUMMARY

---

- The zone of apposition (ZOA) is controlled by the abdominal muscles and is critical to the diaphragm's efficiency. The ZOA is the vertical difference between the diaphragm in its domed, resting position at the end of the exhale, and its lateral contraction with the inhale.
- The greater the vertical movement of the diaphragm with the exhale, the greater the ZOA and the healthier the function of the diaphragm as an abdominal core support muscle.
- In conditions such as COPD and asthma, the ZOA is significantly reduced, resulting in hyperinflation of the lungs.
- Chronic chest breathing and emotional stress can have a similar impact on the ZOA as COPD through the over-utilization of the thoracic muscles which are then recruited as primary respirators.
- Improper positioning of the rib cage, as with rib jutting or slumping, will restrict the ZOA by impeding activation of the abdominals with the diaphragm.
- Multiple studies have correlated functional breathing (that is, proper movement of the diaphragm and appropriate levels of CO<sub>2</sub>) with core strength and functional movement, alongside reduced injury and pain.
- Breathing pattern disorders, such as chest, paradoxical, and mouth breathing, tend to lead to a dysregulation between the diaphragm and the abdominal core.
- Belly breathing is another breathing pattern disorder which slacks the abdominals on the exhale and doesn't provide an appropriate amount of resistance to ensure good diaphragmatic movement.

- Up/down movement in breathing is an indication of over-engagement of the accessory muscles.
- Undulations combined with Core Breathing provide biomechanical building blocks to develop functional breathing as a foundation for all prāṇāyāma practices.
- Returning to the ABCs of breathing is a great service to students.

## Chapter 7

---

# THE CORE, THE BANDHAS, AND THE BREATH

*When uḍḍiyāna is applied, presso-receptors situated in the abdominal viscera come into play and help maintain the stretching of the lungs and slowing down of the heart. [The] same effect is obtained by the application of mūla bandha which activates [the] parasympathetic system resulting in slowing down of the heart.<sup>1</sup>*

M. L. Gharote

Core Breathing and my understanding of the relationship between the abdominal muscles and the diaphragm amplified my experience of the Buteyko method. In fact, once I was able to reduce my breath volume and sustain breath holds of 40 seconds or higher on a regular basis, I began to incorporate more traditional yoga techniques (like alternate nostril breathing) into my practice. This eventually drew me into a deeper study of the bandhas (muscular locks) than I had previously experienced.

As a yoga therapist specializing in working with people with chronic lower back, neck, and shoulder pain, I have a deep appreciation for how the muscles associated with the bandhas provide stabilization of the annamaya (physical dimension). However, I must admit I really didn't understand the purpose of the bandhas in relation to prāṇāyāma until I began to practice stronger kumbhākas (breath suspension) through Buteyko.

Incorporating bandhas into practice had always been a struggle—and that seemed in some ways to be the point of it—they were really hard to maintain. Years ago, one of my yoga teachers impressed upon me that most Westerners don't live a lifestyle that is conducive to “real” bandha practice. The conditions for “real” bandha practice had to do with maintaining a pure and disciplined diet, sleep, and practice regime. From this, I assumed that if I wasn't ready to give up chocolate and coffee, I probably wasn't ready for the bandha experience.

As I re-examined the bandhas as a part of my prāṇāyāma exploration, I began to see how the bandhas provide much more than structural support. Combining study of contemporary texts on prāṇāyāma with my recent education in respiratory physiology, I came to understand that the bandhas were actually used to control chemoreceptors through the phrenic and vagus nerves. This means they enabled the practitioner to regulate diaphragmatic contractions and control autonomic nervous system function, thus reducing the ventilatory response. With precision, the bandhas facilitate longer retention and suspension of the breath—kumbhākas. Extended kumbhākas induce deep states of calm—known as samādhi. I realized that many of the practices I had developed to stabilize the annamaya (the musculoskeletal structure) were

actually equally effective at calibrating the prāṇamaya (physiological health), and most importantly synching the two mayas (dimensions) with one another.

The years I spent cultivating my **Deep Front Line (DFL)** and core muscles facilitated my ability to experiment with the bandhas during kumbhākas with some proficiency. Once again, the ancient teachings were validated through my own direct experience. When I used the bandhas during my breath holds, I could hold longer—sometimes up to a minute or more—without struggle or any urgency to breathe.

The capacity to engage the “bandha” muscles—the pelvic floor, the deep abdominal muscles, the diaphragm, and the core muscles of the neck—takes awareness and practice.

This chapter provides a “vinyasa krama,” a step-by-step approach for how to recruit these support structures, and then coordinate them with the breath. It builds on the discussion of the DFL detailed in [Chapter 6](#). Regulation of the breath in concert with the core muscles creates an inner scaffolding, useful for both āsana and prāṇāyāma practices. Later, in [Chapter 10](#), we’ll explore in more detail how the actual bandhas can be employed to extend breath-hold times in conjunction with prāṇāyāma.

## Core Engagement and the Bandhas

Core strength is not a new phenomenon. The ancient yogis knew the value of a strong core long ago and utilized the activation of the bandhas as the underpinning of their prāṇāyāma practice. Traditional prāṇāyāma was most often performed with all three bandhas in place.<sup>2</sup> With an understanding that prāṇāyāma is primarily about sustaining kumbhākas, retention, and suspension, emphasis on the bandhas makes sense.

Bandha means “lock” or “seal.” There is a Buddhist teaching that metaphorically represents the human condition as three imperfect vessels: dirty (impure), leaky (uncontained), and upside-down (closed off). This teaching translates well as a means to understand our relationship to prāṇā. Our body and mind tend to be full of ama—dross. Yoga practices are intended to “purify” or clean us up (mind and body), teach us to contain our prāṇā, and right our vessel so we come into a state of knowing, free of avidya—misperceptions. It offers yet another perspective on the vāyus, the winds of prāṇa, and our **Energy Bank Account**.

The bandhas symbolically help us to seal our vessel, and many of the breathing practices were designed to aid in the purification process. Of course, for the ancient yogis, it is likely that their DFL was well conditioned through the necessities of life: lifting, hauling, chopping, harvesting, and walking over uneven surfaces each day to survive. With their core muscles well toned and integrated in a functional manner, I assume when they sat for prāṇāyāma the implementation of the bandhas was neither the struggle nor strain that it is for us modern-day yoginis. Most of us require a more elementary learning process to enable us to recruit the muscles individually and then coordinate them together with the breath.

These are the three primary bandhas and the muscles they activate:

- *mūla bandha* (pronounced moo-lah bahn-dah): the pelvic floor muscles and anal sphincter
- *uḍḍiyāna bandha* (pronounced ood-dee-yaw-nah bahn-dah): the transversus abdominis, obliques, diaphragm, and multifidi
- *jālandhara bandha* (pronounced jawl-ahn-dah-rah bahn-dah): the longus colli, deep scalenes, and hyoid muscles in the neck.

It is unfortunate that in general, the muscles of the bandhas and the DFL are bypassed in most yoga classes, while much effort in āsana is directed towards stretching hamstrings and strengthening biceps. I have worked with numerous yogis who can perform many dozens of Sun Salutations but have little or no awareness of their DFL or how to engage it while saluting the sun. Unfortunately, this style of practice often results in multiple repetitive stress injuries such as sacroiliac dysfunction, shoulder pain, chronic neck tension, and headaches. As discussed in [Chapter 6](#), there is a high correlation between breathing, core stability, and functional movement.

Employment of the bandhas during prāṇāyāma can be seen, then, as an intelligent means to ensure a strong kinetic chain from the core to the brain, via the diaphragm. Jālandhara bandha (JB), the chin lock, and mūla bandha, the root lock, were traditionally employed in prāṇāyāma practice. Like a string pulled taut, they facilitate vertical lift by fixing the cervical and coccygeal points of the spine in opposing directions. Uḍḍiyāna bandha was employed primarily during bāhya kumbhāka (suspension after exhale), requiring intense contraction of the abdominal muscles. This maximizes the **ZOA**—the zone of apposition—and creates a strong visceral squeeze. The bandhas engage the core in a way that supports strength, tone, and good respiration. For the ancient yogis, the usefulness of the bandhas went far beyond the annamaya (physical), touching into the subtle and causal realms as exemplified by the following statement:

When the three bandhas are performed, jālandhara bandha stops prāṇa from ascending, mūla bandha stops apāna from descending, and uḍḍiyāna bandha creates a suction process, which affects the behavior of both prāṇa and apāna... When prāṇāyāma is practiced with inhalation, exhalation and retention, the union of prāṇa and apāna takes place at ajña chakra.<sup>3</sup>

## A Closer Look at the Bandhas

The first thing to understand with regard to traditional bandha practice is that the bhāvana (intention) of the ancient yogis and our bhāvana as contemporary practitioners are not necessarily the same. The discussion of bandhas in this section on the biomechanics of breathing is to infuse an underlying principle of the need for core strength in connection with functional breathing, and to examine it holistically in the context of breathing pattern disorders. The intensity of traditional bandha practice as a means to sustain samādhi (meditative absorption) is outside the scope for many of us given our lifestyle (chocolate and coffee aside). It is certainly beyond the ability of many of our students and therapeutic clients. That said, educating ourselves and our students about the DFL, and thereby developing healthy tone in the bandha muscles—while synching the engagement of the core musculature with the diaphragm in our breathing practices—is healthy and accessible for us all.

### ***Mūla bandha***

Mūla bandha (MB), known as the root lock, engages the pelvic floor muscles and anal sphincter. Symbolically, MB blocks the leak at the root center and the downward flow of apānavayu (the wind of elimination) to support the burning of ama (toxicity) in the agni (digestive fire). The pelvic floor muscles form a multi-layered, multi-directional sling, across the bottom of the pelvis. They are often referred to as the Kegel muscles, named after the

doctor who developed strengthening exercises to decrease incontinence. MB activation strengthens the perineal floor and increases circulation to the pelvic area, providing an excellent means to address bladder control issues and prostate problems. Both pelvic floor strengthening and relaxation can be helpful to address sexual dysfunction, lower back stabilization, and of course good posture and functional breathing (see [Figure 7.1](#)).

**Note:** While traditionally the anal sphincter is a part of MB, when I work with the pelvic floor I encourage students to practice developing connection with the anterior (forward or front) part of the sling and to consciously relax the glutes and anal sphincter. This is, in part, because muscles that are used regularly have more nerve enervation. The anus and glutes tend to tighten easily for most of us and they will often impede our ability to find the subtle layers of the pelvic floor. For more details on how to work with and engage the pelvic floor muscles, turn to the section **Developing the Inner Core** at the end of this chapter.

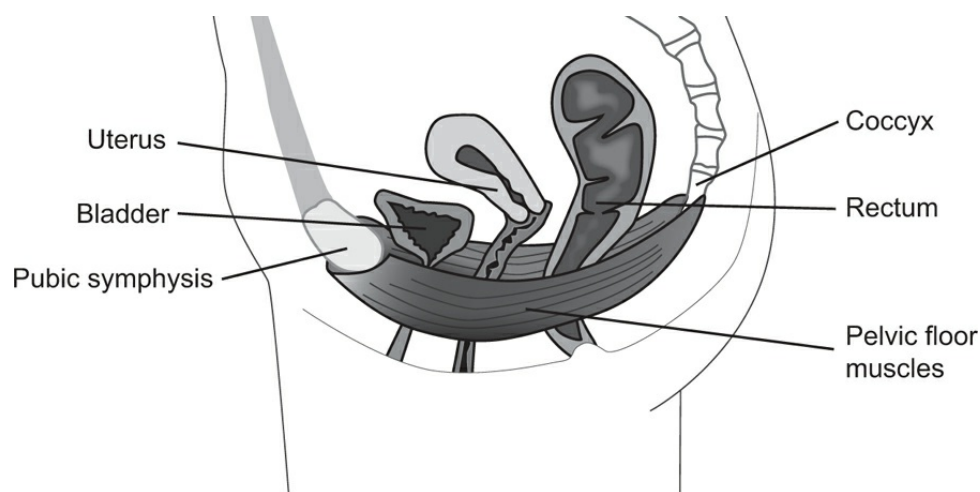
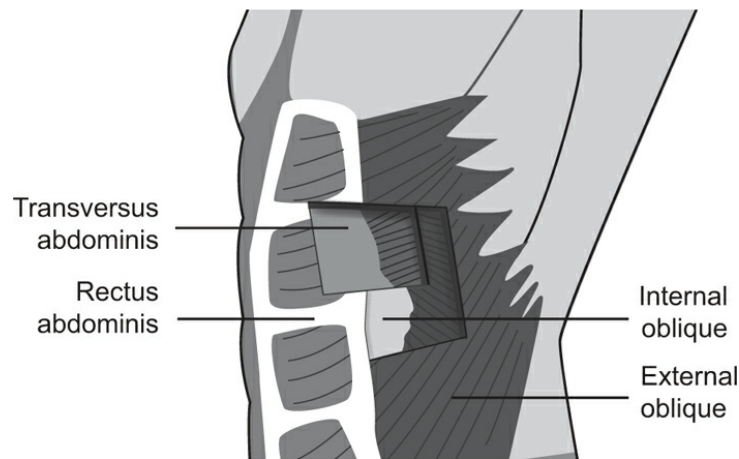


Figure 7.1 Pelvic Floor Muscles

### **Uḍḍiyāna Bandha**

Metaphorically, uḍḍiyāna bandha (UB) carries the dross—the ama—up into the fire of the agni to be burned. Located in the samānavāyu (digestive center), UB is created by an intense contraction of the entire abdominal musculature (superficial to deep) which locks the diaphragm into the dome of the rib cage (see [Figure 7.2](#)). This pacifies phrenic stimulation and the call for breath, while assertively increasing the ZOA. Performing UB enables one to hold longer kumbhākas (breath suspensions). UB is most often initiated on the hold after exhale, and held for several seconds to minutes, depending on the practitioner. It is then gradually released, *before* inhalation resumes. The intention with full employment of all three bandhas is to repeatedly engage and release UB for several breath cycles without releasing JB and MB—a worthy challenge in interoceptive awareness for any practitioner!



*Figure 7.2 Abdominal Muscle Layers*

UB provides great toning of the transversus abdominis and obliques, and develops congruency in timing of the engagement and release of these muscles with the breath. The intense muscular contraction and subsequent release around the organs of digestion, elimination, and reproduction are also excellent for healthy visceral function. While not to be practiced during menstruation, UB can be useful for some menstrual anomalies. Similarly, it can be useful for long-term digestive issues which involve congestion or constipation. For more details on how to work with and engage the UB muscles, turn to the section **Developing the Inner Core** at the end of this chapter.

### ***Jālandhara Bandha***

Jālandhara bandha (JB), the chin lock, according to the Vedic teachings, symbolically blocks the leak of divine nectar (amrit) from the “lake of the mind.” On a less esoteric level, it helps maintain axial extension of the spine so energy can flow through all the chakras. JB engages the longus colli, along with the hyoid muscles, and the deepest layers of the scalenes, creating the “neck core” (see [Figure 7.3](#)). The neck core works synergistically with the primary thoracic stabilizers, or “mid-back core”: the rhomboids, serratus anterior, and lower traps. The combined engagement of the mid-back muscles with the neck core maintains a neutral positioning for the rib cage. This creates a solid vertical alignment of the shoulder girdle over the pelvis, stabilizing the upper torso and optimizing the ZOA.



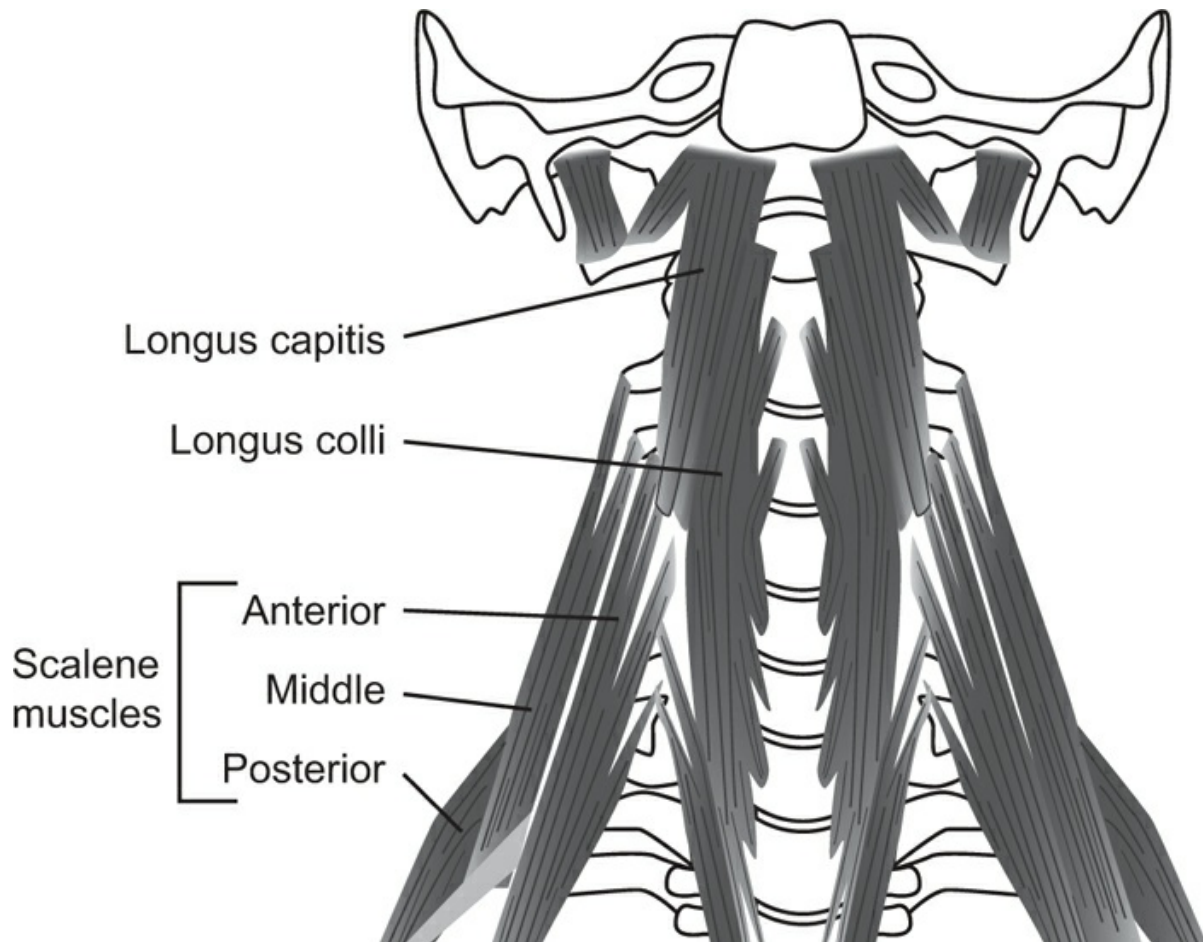


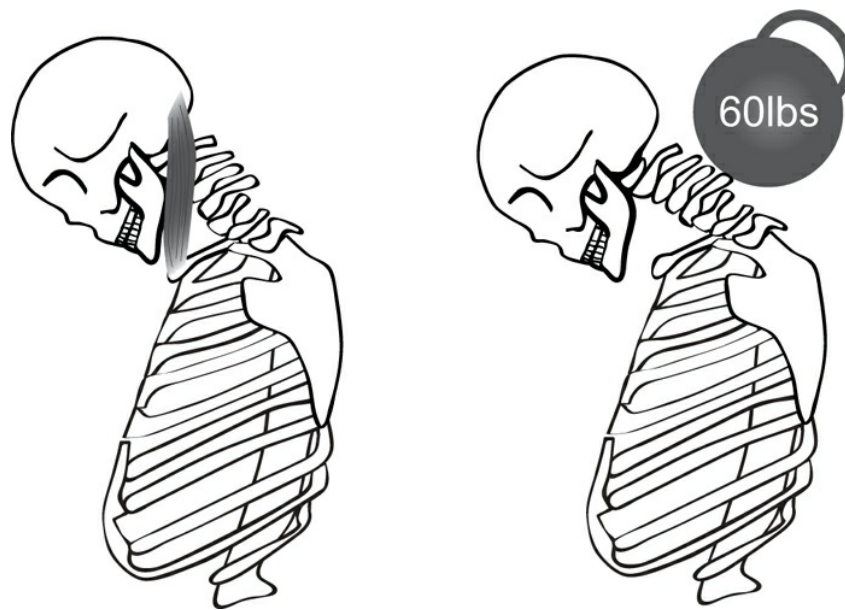
Figure 7.3 The Neck Core

Attending to proper placement of the tongue is a part of JB as well. With the chin locked in towards the throat, the tongue should press into a flattened position on the roof of the mouth. This action augments proper control of the breath. JB is initiated after inhale, then sustained throughout the prāṇāyāma practice. When JB is utilized for strong kumbhākas, the neck flexes deeply so that the chin fits into the sternal notch. This is essential for extended retention after the inhale to decrease pressure on the heart via control of chemoreceptors in the carotid arteries.<sup>4</sup> Nowadays, this level of JB is not recommended for most contemporary yoga practitioners, due to the societal epidemic of “text neck” and destabilization of the internal structures of the neck due to anterior head carriage. Traditionally, JB is held on all forward bends and axial extension postures, to keep the neck from either drooping forward or hyperextending. (See [Figures 7.4–7.6](#).)



Figure 7.4 Text Neck





*Figure 7.5 Traditional JB versus Modern Anterior Head Posture*



*Figure 7.6 Neck Core Engagement without Forward Flexion*

Even a gentle JB restricts activation of the upper chest and amplifies the diaphragmatic action of the lower rib cage. Therapeutic application of JB can build strength in the cervical area linking the musculature of the upper back and neck with proper alignment of the head. For

more details on how to work with and engage the JB muscles turn to the section **Developing the Inner Core** at the end of this chapter.

## KEY CONCEPTS

---

- The yogis used the bandhas to regulate the ANS and sustain longer breath holds.
- The bandha muscles (aka pelvic floor, as well as the neck, mid-back, and deep abdominal core) can help us maintain structural stability, functional diaphragmatic breathing, and parasympathetic regulation.
- It takes time to develop these core muscles, and they must be worked slowly, in a relaxed way with attention and awareness.
- Working the core muscles like this develops svādhyāya and containment of prāṇa in profound ways.

## — PUTTING IT INTO PRACTICE —

### Developing the Inner Core

To educate your students on how to use their bandha or inner core muscles in coordination with the breath takes time. It is not something disseminated in one class, but rather will take consistent reinforcement and integration, from the formative movements offered in this chapter, into gradually larger and more complex āsana over several weeks or months. Building on **Core Breathing**, these exercises tone and coordinate the “bandha-muscles” and are extremely useful in addressing dysfunctional breathing patterns.

The interplay of all of these biomechanical processes can shed light on how we can adapt our yoga practices to combine functional breathing with functional movement. This provides a stable foundation for our āsana and prāṇāyāma practices. Āsana in its versatility offers a multitude of ways to cultivate core stability, mobility, relaxation, and awareness utilizing the breath and diaphragm as the hub of the movement matrix. When working with the exercises detailed below, use the **ZOA**, or the neutral set of the rib cage, as your alignment compass. When lying supine, prop the head a little higher than usual to avoid popping at the ribs; or raise the feet with a folded blanket to soften the iliopsoas, allowing the lumbar spine to relax into a neutral curve. Once you’ve developed the svādhyāya (self-awareness) to work these movements individually, you can explore some of the simple sequences laid out in [Appendix I](#), which will further your exploration of a breath-centric āsana practice in preparation for prāṇāyāma. When recruiting the core muscles in the interest of breath retraining, we want to work slowly and progressively in a manner that supports endurance and maintains a quality of relaxation.

### Developing the Transversus Abdominis

The transversus abdominis (TVA) is a particularly long and broad muscle. It spans the entire area from the pubis to the rib cage, around the circumference of the body, wrapping from front to back forming an inner corset. Often people are stronger in one half of the TVA (either lower or upper), and rely solely on the stronger part for support. The

exercises described below are ways of identifying possible imbalance between the two halves and then using the divided action to “shore up” the weaker half.

Teachers and therapists can train their observation skills to note whether one or the other half of the TVA is active in their students. When the ribs poke out, it indicates that the upper TVA is disengaged. A lack of lateral (i.e., side) gathering of the area between the anterior superior iliac spine (ASIS) and the navel indicates that the lower half is not recruiting. Lower back injury and pain, sacroiliac dysfunction, scoliosis, and inflammatory conditions of the digestive and reproductive organs, or surgery in this area, can decrease one’s ability to recruit one or the other part of the TVA. Through utilization of the combinations and adaptations of the exercises listed below, I have been able to facilitate numerous clients in discovering, recruiting, and strengthening their TVA successfully. Always work with these exercises slowly, synching the movements with the breath. Rest when fatigued. Build strength gradually over time.

**Note:** The question often arises as to whether the lumbar should flatten or sustain a natural curve when doing core strengthening. To follow the lead of my colleague Staffan Elgelid, physical therapist, yoga therapist, Feldenkrais practitioner, and the author of *Smart Core*, which is one of the best core-strengthening video series on the market, we want our core muscles strong and flexibly adaptive to real life. With this in mind, you can start these exercises in the position that you feel strongest; perhaps that means maintaining a neutral arch or a more flattened lumbar curve. Some of you may in fact wish to prop your low back with a small hand-towel if you have experienced recent lumbar injury or low back pain. However, as you build more strength and awareness, I encourage you to explore various positions of the pelvis, rather than holding the back rigid in one position.

One significant note is that if your abdominals are pushing out and hardening as you exhale, you are not utilizing the TVA as the corset it was intended to be. Hollow the belly inward, as if making a little cup with your navel area. As you work progressively, moderate the load within a range of effort that allows you to maintain this hollow shape of your belly. This action always coordinates with the exhalation.

In the context of this book, the most important factor is the synching of the abdominals and diaphragm with the breath to act synergistically together. There is no need to push the load or in any way strain or stress your lower back to achieve this. In fact, it is critical that you feel stable and able to maintain a calm relaxed nasal breath as you work. Let the quality of the breath determine your level of challenge. If the breath feels pushed, or becomes audible, back off and adjust the level of effort to create more ease with the movement.

## BLOCK SQUEEZE AND 2-PART EXHALE (KRAMA EXHALE) (**PHOTO 45**)

---

The term “krama” refers to a stepped, segmented, or staged action. This may mean dividing a movement or a breath into fractional parts—for instance halves, thirds, or quarters. Krama acts as a useful concept and technique for linking mind, breath, and body, for cultivating *svādhyāya*, and for breaking habitual patterns of movement and thought. In this particular circumstance, a krama breath combined with the krama movement brings more awareness to the upper and lower parts of the TVA, while simultaneously interrupting the “big breath *saṃskāra*.” With all these exercises keep each

segment of breath small: between 1–3 seconds in length. Overall length of inhale will approximate 4–6 seconds. However, the intention of these practices is not to measure the length of the breath, but rather to practice “sipping” the breath and timing it with the engagement of the core muscles.

- Begin with supine **Core Breathing**, with knees bent, and feet on the floor.
- Insert the block between the mid-thighs, not pressing into the knees.
- Place the hands in the hi–low position (one on lower abs below the navel, one on the diaphragm).
- Pacify the muscles of the chest with the inhale, gently expanding the lower rib cage to ensure more diaphragmatic action.
- Divide the exhalation breath into two “parts,” simultaneously dividing the contraction of the TVA into halves: lower and upper.
- With the first half of the exhale, hug in or zip up the lower belly, engaging the muscles from the pubic bone to the navel—hold for 2 seconds.
- With the second half of the exhale, hug in or zip up, engaging the muscles from the navel to the solar plexus—hold again for 2.
- With the inhale, create a controlled release of the muscles from the top down.
- Repeat 3–5 times or to fatigue, then rest the breath and the TVA.
- As you are able, repeat another 2–3 times, practicing the 2-part krama exhale.

As you become more proficient at this action, practice taking the krama in reverse (with the inhalation), releasing the inner zipper in two parts. This will combine the expansion of the lower rib cage with the release of the abdominals during the inhalation breath. Breath length will vary between four and six seconds, with the exhale slightly longer than the inhale. The breath should not feel pressured or pushed. Be conscious of the tendency to move into “rib-jut” or a slight hyperextension of the back as you do this movement. Can you maintain awareness of your ZOA and keep it neutral as you do this practice?

- With the first half of the inhale, release the abdominals from the diaphragm to the navel.
- Hold for 2 seconds.
- With the second half of the inhale, release the lower abdominals from the navel to the pubis.
- Hold for 2 seconds.
- Combining the 2-part inhale with the 2-part exhale, work to fatigue, then rest, relax, and observe the natural flow of the breath and your awareness.

This TVA practice can also be done from a **Seated Tadāsana/Mountain Pose** or even in **Wall Sits (Utkatāsana/Chair Pose at the Wall;** see below). With the block between the thighs, adductors stay engaged providing more DFL support from the feet and inner legs.



Photo 45

## APANĀSANA/KNEES TO CHEST WITH 2-PART KRAMA EXHALE (PHOTOS 46–49)

---

- Place a folded blanket, towel, or small pillow under the neck and head for light cervical support.
- Insert the block between the mid-thighs (not between or pressing on the knees).
- Pacify the shoulders. Stretch arms out to the sides in a relaxed position. Palms are face up. Shoulder blades are set down, with the wings tipped inward.
- Initiate **Core Breathing**. Neutralize the positioning of the rib cage.
- Draw the chin in towards the throat, creating a gentle JB-like action.
- Squeeze the block with the exhale and engage the TVA; lift both feet off the floor.
- With the feet lifted, bring the knees in (knees bent at right angles), with the thighs perpendicular to the floor and the shins parallel to the floor. (Photo 46) Knees and feet remain hip-width apart; feet are flexed and active.
- Keep the legs firm, parallel to one another, hip-width apart, the feet flexed.
- Using a 2-part krama breath and movement, begin to draw the knees into the chest. Move the knees halfway in, as you zip up from the pubic bone to the navel, and hold for 2 seconds. Then continue to draw the knees into the lower ribs, zipping all the way up. Hold for 2 seconds. (Photos 47 and 48)
- Slowly release the knees back to their starting/right-angle position with the inhale as you relax the TVA. (Do not bring feet back to the floor.)
- Repeat 4–6 times or until fatigued.
- Consistently check in with the neck, shoulders, and jaw for tension. Note if the chin lifts at any point during the process or if you are able to sustain the JB contraction.
- If the upper body is tensing, take a rest and undulate. Place the feet on the floor and try a few **Scapular Swirls** or **Paint the Floor Undulations**, as described in Chapter 6.

**Note:** If the feet touch each other or keep falling together in this position, try placing the block between the calves instead of the thighs. This engages the lower half of the DFL

and often provides new svādhyāya of how the whole kinetic chain works. As you become more proficient with this movement, try doing it in reverse, adding a 2-part krama inhale movement. With this, gradually release first the upper, then the lower TVA on inhalation as you move the knees away from you. Maintain neutrality in the rib cage—ZOA awareness—as you do this movement.

[Photos 46, 47](#) and [48](#) show the correct position; [Photo 49](#) is incorrect, putting strain on the neck. Use a light cervical support under the neck and head.



*Photo 46*



*Photo 47*



*Photo 48*



Photo 49

## BRIDGE WITH BLOCK 2–3-PART KRAMA EXHALE (**PHOTOS 50–52**)

---

- Begin with supine **Core Breathing**.
- Insert the block between the mid-thighs or calves—not pressing on the knees.
- With the inhale, press the feet to the floor and lift the pelvis, opening into the front of the body. (**Photo 50**)
- The heels stay firmly pressed to the floor.
- With the first half of the exhale, draw the lower abs in and curl the spine halfway down. Hold for 2 seconds. (**Photo 51**)
- With the second half of the exhale, curl all the way down. Hold for 2 seconds. (**Photo 52**)
- Repeat 3–5 times.
- Return to **Core Breathing** and notice how you feel, what’s changed or shifted in your experience? In your awareness?

If you wish to work more intensely, try progressively increasing the holds to 3–4–5 seconds; or break the breath and movement into *three* parts, refining the activation of the TVA with a more controlled breath and flexion of the spine. With all of these Bridge variations, maintain a steady squeeze into the block and firm pressure through the soles of the feet and up into the glutes.





*Photo 50*



*Photo 51*



*Photo 52*

## CHAKRAVAKĀSANA OR WHEEL POSE<sup>5</sup> WITH 2-PART EXHALE (**PHOTOS 53–55**)

---

- Position yourself in **Child's Pose** with the hands forward, shoulder width apart, the elbows soft and forearms resting on the floor.
- With the inhalation, move forward into the spinal extension position of **Cat/Cow**. (**Photo 53**)
- Avoid hyperextension of the neck by drawing the chin into a light **jālandhara bandha**, and gaze towards the floor, rather than looking up.



- Avoid hyperextension of the lower back, by drawing the TVA in gently while inhaling—thus creating a safety net of support for the lumbar spine.
- With the first half of the exhalation, lead with a stronger lift inward through the lower TVA and begin to draw the hips halfway back towards **Child's Pose**. Hold for 2 seconds. (**Photo 54**)
- Let the head relax and release. The elbows fold towards the floor so the thoracic kyphosis is not exaggerated; the neck is softly flexed.
- With the second half of the exhalation, continue to zip in the upper TVA and bring the hips further back towards **Child's Pose**. (**Photo 55**)
- The forehead and forearms rest fully to the floor (or on a light support).
- Rest for a breath as needed or repeat the movement 3–5 more times.

If you wish to work more intensely, try progressively increasing the holds to 3–4–5 seconds, sustaining a strong abdominal contraction during suspension after each exhale; or break the breath and movement into three parts (e.g., exhaling back a third of the way, then two-thirds of the way, then fully towards **Child's Pose**), refining the activation of the TVA with a more controlled breath and emphasizing the flexion of the lumbar spine. Maintain the **JB** chin tuck on the exhale.



*Photo 53*



*Photo 54*



*Photo 55*

### **BABY PLANK—HOVER POSITION KNEES DOWN (PHOTO 56)**

In spite of the name, there is nothing “babyish” about this version of Plank. It is my personal favorite, because from the forearms it provides stability through the shoulder girdle and there is absolutely no way to cheat. The TVA has to do the work! I use this adaptation with my therapeutic clients with low back pain and have come to trust it because, while it is intense and hard to hold, it is relatively safe and very effective. Maintain awareness of the **ZOA** throughout the Baby Plank series. Direct the engagement of the abdominals to synch with the exhale and the narrowing of the rib cage for a complete core experience.

- Lie prone on the belly.
- Lift the chest slightly, bend the elbows and interlace the fingers.
- Place forearms on the floor, elbows a few inches forward of the shoulders.
- Interlace the fingers.
- Tuck the chin into a light **JB** and hold it there.
- Keep eye gaze towards the floor, the back of the neck long.
- Keep chest lifted, pecs contracted, shoulder blades protracted (spread apart, not tucked in).

- Curl the toes under, but keep the knees on the ground.
- Engage the TVA and micro-lift the navel area and pelvis off of the floor. Hover and hold the TVA in this localized contraction progressively for 2–6 seconds as able. Keep ribs hugged in throughout construction.
- Rest when fatigued. Then repeat another several reps.

**Note:** If you are experiencing tension in the upper body, wriggle your toes back to create more length between the pelvis and the elbows. The further apart they are, the more effective the work of the abdominals and the less pressure on the upper back and shoulders. This is a *micro*-movement. The feeling is as if a bungee cord were hooking the ASIS (front bones of the pelvis) together and the triangular area between the hips and pubis are intensely lifting in and up away from the floor.

Once you have mastered this, try a stronger contraction of the TVA that initiates a *slight* lift of the upper thighs off the floor (knees are still down). Keep the pelvis low to the ground, maintaining passivity in the hamstrings and glutes. The lift comes from the inside, not the back side.



Photo 56

**Tip for success:** Start the lift from the lower rib cage. This will initiate the action from the upper TVA and diaphragm. Not only does this strengthen this area, but it offers far more support for the entire lumbar spine.

## BABY PLANK—HOVER POSITION WITH ALTERNATE KNEE LIFTS (**PHOTO 57**)

This variation is more intense, so take time developing the TVA with **Baby Plank**—**Hover Position** first. Notice that as physical movement becomes more challenging it is easy to generate bigger breaths. Practice keeping the breath silent and slow, calm and light, even while working the muscles strongly and building endurance.

- Come up into Baby Plank with knees down.
- With the toes curled under, actively extend one leg at a time. Lift the thigh and knee off the floor. Alternately lift the right, then left knee.
- Stay in a low parallel hover with the body.

- Maintain TVA activation and soft nose breathing throughout.
- The key is to maintain horizontal stability through the pelvis as the knee lifts (no wobble in the pelvis).
- Rest down when fatigued.
- Relax the breath.
- Repeat 1–2 more sets as able.



*Photo 57*

**Note:** As strength builds, a slightly more intense version of this posture starts with the knees extended and requires alternately dropping one knee at a time to the floor or holding static for longer periods of time. ([Photo 58](#))



*Photo 58*

## COUNTER POSE AFTER BABY PLANK WITH CHILD'S POSE AND PAINT THE FLOOR UNDULATION (SEE [CHAPTER 6](#))

### **Developing the Pelvic Floor**

I usually begin core work with the activation of the TVA and diaphragm, prior to working with the pelvic floor (PF). Working with the PF is more personal, can be associated with sexual or bladder dysfunction, and can reignite past sexual trauma in some people. As yoga teachers, unlike PF physical therapists who have devices that monitor this specifically, it is impossible to validate correct PF recruitment in our clients. Succinct cuing and a variety of techniques are the primary tools we have to offer. I find working

first with the TVA, **Subtle** and **Core Breathing** builds confidence in students' own interoceptive awareness. This helps significantly when exploring the recruitment of the PF.

That said, there are a few details to note when working with the PF. First of all, some people have hypertonic (tight or tense) PF muscles that chronically spasm. This can translate to pain in the lower back or in the sacrum and/or coccyx and pain during sex, and can lead to incontinence. "Hypertonic" does not mean the muscles are strong, just ultra-tense. Remember the example of a tightly held fist from [Chapter 6](#). It is difficult to build strength in a muscle that is in spasm. Resting tonus must be restored first. I have found that a combination—gentle contract, release, contract, release, explored slowly—is a more effective means to develop strength than contraction alone. This modality seems to "massage" the area into relaxation. It is a bit like getting your car out of a rut: you ease in reverse a little, then rock forward, reverse, then go forward. If you gun the engine unidirectionally, it digs the wheels deeper into the trench.

Kegel exercises, the standard approach to PF strengthening, are often taught in a gun-the-engine manner, meaning hard-fast contraction, hold at 100 percent for ten seconds, then release. This is significantly different than the approach I take to working with the PF. I keep my instructions slow and cue consistently to stay in the mid-range (somewhere between 20% and 85% effort), with as much emphasis given to the controlled release of the muscles as to their activation, all of which is timed with the breath, inducing a parasympathetic response.

## BOLSTER STRADDLE ([PHOTO 59](#))

---

As the yoga teachings emphasize, we can only change what we are aware of. The initial (and oftentimes biggest) challenge with working with the PF is helping people feel their PF. I have found the Bolster Straddle a useful approach to take. Note the wording used to address male and female anatomical differences.

Kneeling from the floor:

- Straddle a firm yoga bolster (if available) in the vertical plane (lengthwise) or use three firm blankets stacked and rolled into a tight mound.
- *For women:* Lean slightly forward so the anal sphincter (and glutes) are less weighted. Firmly place the perineal floor (the area between the genitals and the anus) onto the bolster, positioning yourself so the front end of the vaginal opening has firm contact with the support.
- *For men:* Place yourself on the bolster with care, so that the "boys" (the testes) are comfy and you have contact with the perineal area between the testes and the anus.
- The bolster is a means to create a sensory bio-feedback loop from the muscles of the pelvic floor to your brain—so you can feel more of what's happening "down there."
- *For women:* visualize the sling of the PF (use of an anatomical diagram can be helpful). There are muscles that run front to back; some run side to side; and another set create a drawstring that gathers the threads and lifts them up towards the pubis. Visualize each of these layers and begin to activate them. Notice which

ones you can recruit and which “flicker” into awareness and then are lost. This is all useful information.

- *For men:* Imagine that you just stepped into a cold lake and feel the lift of the testes. Try drawing them in and up in greater or lesser degrees, and visualize the variations of lift options as per the sling description from above.
- Once you have a sense of recruitment of the PF muscles, continue on with the **Anemone Hand Pulses** (see below) to refine your awareness and synch the pelvic floor action with the breath.



Photo 59

### **CHAIR VARIATION WITH BLANKET ROLL (PHOTO 60)**

The same process can be done while seated in a chair with a smaller blanket roll underneath the pelvic floor. This is a useful variation for those who cannot kneel or get down on the floor.



*Photo 60*

## **ANEMONE HAND PULSES (PHOTOS 61 AND 62)**

---

The image of an anemone conjures a soft and flowy undulation that mirrors the style of engagement I encourage when working with the PF. Working with the PF can initially bring up doubt, as in, “Do I really feel the muscles contracting? Am I releasing? Is it or is it not the pelvic floor?” Using your hand as a somatic cue to stimulate PF recruitment can help activate the muscles and synchronize their firing with the breath.

- Turn one palm face up and hold it slightly up off your lap.
- Make a tight fist with your hand and say to yourself, “100 percent contraction.”
- Then, tighten your PF muscles to a similar degree.
- Now make the palm of the hand passively open—free of contraction. Say to yourself, “0 percent contraction.”
- Relax your PF muscles as completely as you can to match your hand position.
- Now that you have the parameters, play the middle ground...

- Take your hand into a 20 percent contraction and follow with your PF, contracting 20 percent.
- Relax your hand and PF by 5 percent (so you're at 15% contraction).
- Then, bump up the contraction to 45.8 percent; the PF follows the hand.
- Relax 12.2 percent.
- Continue to repeat this process with your PF following the cues relayed from the mind and hand—keep exploring the in-between places and spaces for contraction and release.

Synch the breath with the movement so contractions are taken on the exhale, the soft release of the muscles on the inhale. The breath stays low and slow at all times.

In the interest of establishing the recruitment of the PF to synch with the breath, consistently link the exhalation with the action of contraction, and the inhalation with conscious release. Sip the breath, rather than gulp it, keeping the in-breath soft and light. Each movement and the accompanying breath mirror each other.

**Note:** I intentionally use fractional percentages to ward off the tendency for students to get caught up in thinking there is an exact 30 percent or 65 percent that is just “right.” This process, like an undulation, cultivates awareness. Exploring the possibilities between 0 and 100 percent provides infinite opportunities for discovery. I urge you to not get attached to an exact percentage, but rather to explore the range within that middle ground between all or nothing. Emphasizing the idea of play keeps the nervous system settled, and the parasympathetic, vagal response alive and happy.

You can even work in a krama fashion, as in: Exhale partially and contract 7.7 percent. Then exhale a little more and contract another 3 percent. Then exhale a little more and contract 9.3 percent. Then, inhale and release 17.5 percent. Breath rate will vary according to how large or small the “krama.”





*Photo 61*



*Photo 62*

As you become more aware of and proficient at activating the PF muscles, especially the drawstring lift, you'll automatically feel the engagement of the lower TVA recruiting as well. This is a sign of your growing proprioceptive awareness of the fascial connections. Building on this awareness, you can begin to follow the kinetic chain up from the lower to upper TVA, to the diaphragm, and back down again, working in a krama style. I've heard this referred to metaphorically as the "Elevator Technique" (i.e., lift to the first "floor," then the third, drop down to the second, down into the basement...). Work with any metaphors and visualizations that help you connect to the PF muscles and feel comfortable with both their recruitment and release.

### **DYNAMIC BUTTERFLY POSE—SUPTA BADDHAKONĀSANA (CHAIR PHOTO 63, FLOOR PHOTOS 64–66)**

To take the PF action to the next level, try working with Supta Baddhakonāsana (pronounced soop-ta bahd-dah-kone-aw-sah-nah, Dynamic Butterfly Pose), either from a supine position or seated in a chair. Both are extremely valuable and each has a unique impact on the spine and pelvic girdle.

When working on a chair, start with the **Seated Mountain Pose** position for the pelvis. You may need to sit slightly forward on the chair, so the hips can open freely. Chairs with arms will restrict your movement. The outside edge of the feet press firmly on the floor. Feel as if you are lifting your sit-bones slightly off the chair, as if you are about to launch, so the glutes and hamstrings are activated as well. Check in with the rib cage and set it in neutral. Maintain a neutral lumbar curve. This is particularly useful when working with Butterfly in the chair, as it provides more support for the lumbar area.

- Bring the soles of the feet together, opening the hips.
- This position correlates with the PF at 0 percent recruitment. (Knees all the way together reflects 100 percent contraction.)
- Work the PF as described above in the **Anemone Hand Pulses**. Coordinate the adduction (closing) and abduction (opening) of the thighs in time with the PF contraction and release on the exhale and inhale. Inhale, open and relax the PF. Exhale, close and engage the PF.
- Play the middle ground, closing the thighs and zipping up the core a percentage of the way on the exhale, opening another percentage on the inhale.
- Sometimes it is easiest to start with pre-determined amounts, such as: half-way open/closed; two-thirds of the way open/closed, three-quarters of the way open/closed. Then you can begin playing with the in-between places, using micro-movements to finely attune your awareness.
- Rest when fatigued (the thighs may begin to shake). Do some undulations. Then repeat another 2–3 sets.

Movement in this posture creates a wonderful link from the adductor complex, through the PF, and up into the TVA and abdominals. It is particularly useful to continue that DFL kinetic chain up through the spine, to the ribs, mid-back, and into the cervical alignment with a slight **Jālandhara Bandha** set to the chin. Working with tiny micro-movements (a half-inch in, half-inch out) can help you identify areas of low proprioceptive awareness, or places that are weak or tight along the way.

**Note:** For those who are very flexible in hip abduction, I recommend limiting your range to approximately three-quarters of the way open, particularly in the supine position. This will avert the possibility of hanging in the hip joints and over-stretching the ligaments.



*Photo 63*



*Photo 64*



Photo 65



Photo 66

## Developing the Mid-Back Core

To fully integrate diaphragmatic action and increase the **ZOA**, we need to put equal attention to the action above the diaphragm as well as below it. Mobilization, strength, and proper positioning of the mid-back, ribs, and shoulder girdle play a significant role in resolving breathing pattern disorders such as chest and paradoxical breathing. While the **undulations** described in [Chapter 6](#) are very useful for releasing tension and “unhooking” the upper shoulder girdle from the act of breathing, equally as important is learning how to anchor the scapula and stabilize what I call the “mid-back core,” the MBC.

The MBC comprises the serratus anterior, the lower portion of the rhomboids, the rotator cuff muscles, and the lower traps. Together they work synergistically to establish cohesive action of the shoulder blades. This prevents “chest droop” and the tendency to collapse the front of the rib cage down into the belly. That said, “rib-jutters” beware! Working with the MBC can feel like an invitation to slide into the old hyperextension *saṃskāra*. Maintain a gentle “knitting” or drawing inward of the lower rib cage while working the MBC. This will illuminate tight areas in the pecs, the iliopsoas, the lats, or

even the neck that have been bypassed through habituation of the forward displacement of the rib cage.

## WIDE V/NARROW V WITH PF AND TVA ENGAGEMENT FROM SUPINE POSITION (**PHOTOS 67 AND 68**)

---

- Begin supine with **Core Breathing**.
- Set the upper arm bones in external rotation.
- Do some **Scapular Swirls** and **Passing Notes** to wake up the shoulder blades.
- Bend the elbows and angle the arms so the thumb tips touch down to the floor.
- Adjust the angle to make this possible at a degree that keeps the top of the shoulders passive, the breath light, and the rib cage in neutral.
- Feel free to place a small towel or blanket under the neck and head to help pacify the neck, jaw, and upper traps.
- On the exhale, initiate movement from the tips of the wings so that the blades draw in towards the spine (retract) and the angle of space between the upper arms and spine decreases (narrows).

**Note:** The angle of the elbow through the forearms remains the same.

- On the inhale, protract the blades (spread them apart) and increase the angle between the upper arms and the spine.
- Notice that it is possible to move the elbows/arms in and out and *not* mobilize the shoulder blades by simply moving the arms from the ball joint of the humerus. How is it different to keep the movement small and slow, and to initiate from the scapula and have the elbows/arms follow?
- Notice if the ribs “pop up” when the shoulder blades draw in. How would you interpret this action?
- Notice if the lumbar area hyperextends with the narrow Vs. How would you interpret this action?
- Notice if the chin lifts, or the shoulders cup forward or tense when the blades retract. How would you interpret this action? How can you pacify these areas and work the mid-back in isolation?
- Intersperse undulations like **Paint the Floor**, **Doodle**, or **Passing Notes** to release tension in the upper back and neck as you work with the Vs.
- Take another rep of Vs in and out. Remember to always work SLOW, SLOW, SLOW, and time the movement with the breath.
- Return to **Core Breathing** and notice the effect of the process.



*Photo 67*



*Photo 68*

## LINKING IT TOGETHER

To weave together the kinetic chain with the breath, let's start from the base and work through to the top, linking the PF, TVA, and a light **Jālandhara Bandha** action with the recruitment of the mid-back.

- Set up for **Wide V/Narrow V** as above.
- Place a block between the thighs and engage a light DFL awareness with the adductors.
- Inhale and set the chin in JB.
- As you exhale, engage the pelvic floor muscles, zipping up through the TVA.
- On the next inhale, halfway unzip the TVA to the navel, and protract the scapula in a wide V.
- With the exhale, zip the abdominals in to the rib cage and narrow your Vs.

- Repeat another 4–6 rounds of Vs with core engagement, cuing yourself as you breathe in and out.
- As much as possible, isolate the mid-body, focusing on mini-movement of the diaphragm and shoulder blades, and maintaining consistent stabilization through the PF, lower TVA, and neck.
- Notice if the chin lifts or juts forward.
- Notice if the block squeeze lightens.
- Notice if the lumbar arches more or less in response.
- Notice the challenge for *you* in keeping the core movement integrated and flowing with the breath.
- Intersperse any of the **undulations** that help release and relax the neck and shoulders between reps.

Vs with core engagement can be performed in **Butterfly Pose**, **Bridge Pose**, **Standing/Seated Mountain Pose**, **Chair Pose**, or **Warrior I (Photo 69)**, among others. Each position offers a different way of increasing awareness of the kinetic chain and its own unique challenge.





*Photo 69*

### SHALAMBHĀSANA (LOCUST POSE) (PHOTOS 70–72)

This is another position that works well with the Vs. As it requires more strength, I tend to be cautious with people who are more vulnerable in the lower back or cervical areas when working with this particular variation. It may be weeks to months before I introduce it.



*Photo 70*



Photo 71



Photo 72

Working with the core muscles in prone backbends integrates a feeling of **Baby Plank** through the TVA, while maintaining upper-back extension *and* the JB tuck of the chin. This is awesomely strengthening for the whole body. Add **Diaphragmatic Hugs** to the process and it offers a full-on body-breath workout!

- Lie prone (face down) with a block between your calves.
- Bend your elbows into wide Vs and tip the thumbs up in a “hitchhiking” position.
- Tip the elbows low and inward towards the lower ribs, activating the MBC while creating a feeling of neutrality along the upper traps.
- On the exhale, squeeze the block, zip up the PF and TVA, and lift the legs a few inches off the floor (stay low).
- You may also choose to keep the legs on the floor and simply squeeze the block.
- On the inhale, maintain the core engagement below and lift the chest, head, and forearms while keeping your eye gaze down towards the floor, with JB in the neck.
- Stay lifted and on the exhale, retract the scapula, bringing the elbows in closer to the rib cage while maintaining a strong **Diaphragmatic Hug**. Hold 3–4 seconds.
- On the inhale expand the rib cage, protract the scapula and send the elbows out slightly—an inch or two wider.
- On the exhale, relax and rest down.
- Pause for a resting breath or two, then repeat the sequence.
- As strength builds, stay up and work in sets of 2–4 breaths at a time; actively work the diaphragm while working the Vs and maintain good core stabilization through the PF with the set of the chin in JB.

**Note:** In the back extension, angle the arms so the thumbs are higher than the elbows at all times. Notice that if the elbows lift and the thumbs drop towards the floor, the shoulders will cup forward in internal rotation. This disengages the MBC. Instead, prioritize the proper set of the blades over the height of the lift of the chest or limbs. Even lifting the chest, arms, or legs an inch with proper positioning of the arms is beneficial.

## **COUNTER POSE FOR BACK-BENDING: WHEEL POSE, CHILD'S POSE, PAINT THE FLOOR, AND SCAPULAR SWIRLS AS NEEDED**

---

### **Developing the Neck Core**

Headstand and prāṇāyāma share a similar saga in that during the era from which they evolved, the posture, stamina, and quality of life required of the practitioners was a good match for the challenge of these practices. Headstand essentially takes the DFL and puts it in reverse relative to gravity. It is a pose that requires a solid core line, especially the mid-back and neck core. The condition of the neck and shoulder girdle of the average yoga practitioner these days provides a less than adequate foundation for the strength and integration required for a healthy headstand practice. That said, one does not develop a strong neck core without doing strength work. The following are my top favorite and accessible neck strengtheners that I use routinely in my therapeutic practice. Integration of the abdominal core and MBC work from the exercises above is a critical ingredient to ensuring the neck position is well supported.

### **BABY FISH 1–2–3–3–2–1**

---

This position is sequenced in a stepped fashion, when transitioning into and out of the posture to ensure the neck is never left hanging. Position the flat of the tongue up into the roof of the mouth and keep it there throughout the practice. This helps engage some of the neck core muscles, creating a safety net for the neck.

- Begin lying supine as for **Core Breathing**, with knees bent.
- The use of a block at mid-thighs will help maintain engagement of the lower part of the **DFL**.
- Bend the elbows and set them firmly in next to the rib cage (with the backs of the upper arms on the floor), making a strong brace of support with the upper arms. The hands are lightly fisted and raised towards the ceiling, with the forearms parallel to one another. (**Photo 73**)
- Press the elbows down into the floor and lift the chest and upper back. Engage the MBC strongly and draw the scapulae in away from the floor. Lift the sternum more than the ribs to avoid a big forward jut of the lower rib cage. The upper back and scapula will lift off the floor. (**Photo 74**)
- Press the back of the head into the floor and roll the chin up so the contact point of the head to the floor moves more towards the crown. (**Photo 75**)
- Hold for 2–3 breaths. Then reverse the action, starting with the neck.
- Roll the chin in and neutralize the pressure on the neck. (**Photo 74**)
- Relax the upper back, letting it come to rest on the floor again. (**Photo 73**)

- Release the strong downward thrust of the upper arms, relaxing the brace of support.
- Take a resting breath or two and then repeat the process 1–2–3–3–2–1; progressively stay for more breath cycles as able.



*Photo 73*



*Photo 74*



*Photo 75*

**Note:** To avoid compressing the neck, bring as much PF, TVA, and ZOA awareness into this process as possible, so the neck isn't hanging in hyperextension without support. To avoid compressing the back of the neck, visualize a small grapefruit positioned at the base of the skull and imagine draping the head up and over it, rather than jamming the head back as far as possible.

## COUNTER POSE FOR BABY FISH: DO THE UNDULATIONS THAT FEEL THE MOST RELAXING

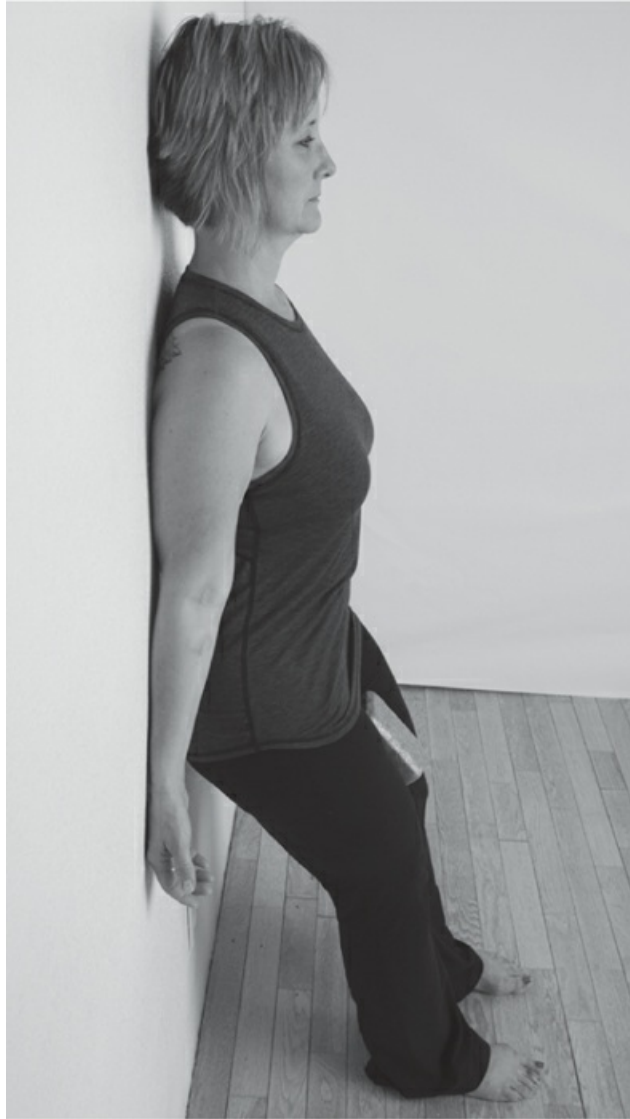
---

### MASTHEAD ([PHOTOS 76–79](#))

---

Masthead is done from a standing position at a wall. For some people it is an easier start point than **Baby Fish**, and for others it works better as a second option. Due to the straight-legged position and diagonal orientation with the wall, it is easier to sag into the lumbar area than with **Baby Fish**. This will droop the chest and leave the neck without proper support. That said, Masthead is a favorite among my therapeutic students as they love the feeling of integration and connection they experience through the back of the body and a sense that the neck is effortlessly set back in proper alignment with the shoulders.

- Stand in **Mountain Pose** at the wall, placing a block between the thighs.
- Place the back of the head on the wall and center it.
- Step the heels about 1.5 feet (45 cm) away from the wall. ([Photo 76](#))
- Exhale—squeeze the block and zip up the abdominals from the bottom to the top.
- Check in with the ribs and be sure they are set in neutral.
- With the inhale lift the buttocks off the wall, opening the arms approximately 30 degrees out from the body, chest and sternum lifted (no “rib-jut”). ([Photo 77](#))
- Keep the chin in neutral, so the neck is neither flexed nor hyperextended.
- Hold for 2–4 breaths.
- To come out of the pose, step one foot back and press yourself forward into **Mountain Pose** away from the wall. ([Photo 78](#))
- Pause and notice how you feel. ([Photo 79](#))
- Repeat 2–3 times as comfortable.



*Photo 76*



*Photo 77*



*Photo 78*





Photo 79

COUNTER POSE FOR MASTHEAD: **UTTANĀSANA** (STANDING FORWARD FOLD) WITH **PASSING NOTES** AND **RAPUNZEL** UNDULATIONS

---

NECK CORE LIFTS (**PHOTOS 80 AND 81 CORRECT, PHOTOS 82 AND 83 INCORRECT**)

---

This exercise is useful for identifying the weak links of the neck core and working isometrically to strengthen it. The key is to vertically lift rather than flex the neck, and to honor the potency of the micro-movement and slow engagement of the muscles. The lift is *tiny*, a hair's breath away from the floor.

- Lay supine as for **Core Breathing**.
- A block between the thighs will help to maintain engagement of the abdominal core.

- Extend the index and middle fingers of both hands, curling the thumb, ring finger, and pinky into the palm.
- Place the tips of the index and middle fingers on either side of the very base of the skull (C1).
- The elbows rest on the floor or on blankets for comfort.
- Exhale and draw the chin in to **JB** and lift the head *slightly*—maybe half an inch (1 cm) off the floor at the exact spot the fingertips are cuing.
- Hold for 1–2 seconds.
- Inhale and relax down. Repeat at that same position 1–2 more times.

**Note:** The hands do not assist in the lift; the neck core is entirely responsible for the action. The neck *does not flex*. This is a straight vertical lift, with JB intact.

- Begin to work your fingertips down from C1 to C2 and repeat the process.

Most people find that as the point of the lift moves further away from the occiput (away from the base of the skull and towards the base of the neck), the action becomes more tiring and difficult to engage. It may take a number of weeks of regular practice before one can move much beyond C2 or C3. Build slowly until you are able to lift and hold comfortably through C7. Always stop and rest (and undulate) when you are fatigued.

Signs of compensation:

- Hyperextension of the neck, inability to sustain the **JB** action with the chin tuck.
- The arms or hands are holding the weight of the head.
- The neck flexes in and the head lifts higher than half an inch (1 cm). This indicates recruitment of other muscles, not just the neck core.



Photo 80



Photo 81



Photo 82



Photo 83

## Integration of Core Alignment at Wall

Once one has a sense of the pieces that configure the **DFL** and the synchronization of the breath, I recommend tying them together with standing work at the wall or in a corner, utilizing **Chair Pose (Utkatāsana)** as a means of integration.

## CHAIR POSE AT THE WALL (**PHOTOS 84 AND 85**)

---

This posture is a wonderful way to integrate all three cores safely and in synchronization with the breath.

- Stand with your back against a wall.
- Step the heels out your thighs' length from the wall, with the feet parallel, knees bent in a soft squat.
- Place a block between the mid-thighs, with no pressure on the knees.
- Set the shoulders so the wing of the blades tip in and the arms are externally rotated, with palms facing forward.
- If it is comfortable to do so, press the back of the head to the wall, ensuring a light **JB** tuck of the chin, then set the head in that position.
- If it strains the neck to press into the wall, take a light **JB** and move the back of the head towards the wall without making contact.
- Bend the elbows and set the arms for **Narrow and Wide Vs.**
- Thumb tips touch the wall, elbows tip away from the wall.

- Exhale and squeeze the block, zip up through the PF, TVA, lower to upper.
- Engage the diaphragm, while narrowing the V by engaging the MBC.
- Keep the chin tucked (head pressed to the wall) and hold 2–4 seconds.
- On the inhale, press the legs up an inch or two, and widen the V of the arms, expanding the diaphragm (without jutting the ribs).
- Repeat the squat and **Narrow** Vs on the exhale 3–5 times or until fatigued.
- Keep the jaw and upper traps relaxed.

Use undulations including the **Forward Bend** and **Rapunzel** in between sets or if tension rises into the neck, jaw, and upper body. Consistently keep the breath light and low in the body. As with all of these exercises, attending to the proper positioning of the tongue on the roof of the mouth (upper palate) will facilitate better diaphragmatic action and engagement of the neck core.



*Photo 84*



*Photo 85*

## CHAPTER SUMMARY

---

- The Deep Front Line is the myofascial meridian that runs from the inner (medial) arches of the feet up through the adductors, pelvic floor, the iliopsoas muscles, respiratory diaphragm, and up through the longus coli. It functions synergistically with the transversus abdominis, meaning as the TVA contracts it assists the diaphragm's upward release into its resting position under the rib cage, and as it expands, it assists the diaphragm's lateral contraction.
- The three primary bandhas—mūla bandha, jālandhara bandha, and uḍḍiyāna bandha—engage muscles that are part of the DFL.
- The bandhas were traditionally engaged as part of all prāṇāyāma practices, specifically during long kumbhākas (breath holds).
- When learning to engage the bandha/core muscles it is important to work slowly in small micro-movements, and to hold the engagement for increasingly longer periods of time.

This trains the core to function for endurance (not speed) and to provide stabilizing support consistently for long, seated breathing practices.

## Chapter 8

---

# THE EMOTIONAL BRAIN AND THE BREATH

What has become apparent to me since my deep exploration of prāṇāyāma began is that the breath affects everything and everything affects the breath. My own **Svādhyāya Breath Journal** from the first six months of practice revealed that eating a big meal or having a glass or two of wine would lower my CO<sub>2</sub> levels, reflected in the next day's **Comfortable Pause (CP)**. If I took a brisk uphill walk or attended a vigorous exercise class, kept my mouth closed, and focused on **Subtle Breathing**, my CP and energy levels would shoot up, indicating higher levels of CO<sub>2</sub>. Strong emotional outbursts like crying or shouting dropped my CP into the basement, and I began to realize how much the chemical shift elicited the inevitable hangover of exhaustion that followed.

The numbers were only one indicator. I actually came to equate my life-long battle with nauseating fatigue, mental dispersion, and emotional brittleness with low CO<sub>2</sub>—or as I have come to think of it, prāṇic depletion. I realize now that without addressing the chemical and biomechanical aspects of my breath, my nervous system was consistently made vulnerable. I wanted to be emotionally resilient, but I couldn't become resilient through thought reform alone. In other words, as long as I addressed the mind separately from the breath, I was engaged in a losing battle. The vṛttis (thoughts and feelings) certainly played a role: Anxious thoughts shifted me unknowingly into chest breathing, which would instigate higher breath rates, which eventually tipped me over into hyperventilation, to which I was prone. From there everything became a trigger: a loud noise, a particular food that would throw off my digestion. My sleep would become disrupted by the need to pee multiple times during the night. All of this, of course, made me less able to meet the everyday challenges of life with udāna, an open and positive attitude.

Throughout the day I now check in, using my breath and my CP as barometers as to whether my "prāṇic tank" is full, or three-quarters and draining. I try to not let it drop lower than that, having learned the consequences of living without a solid reserve of CO<sub>2</sub>. Reducing my breath to retain my "vāyu" (wind) has meant I spend less time tossed in the sea of emotions. This in turn has stabilized me so I have become less reactive, less easily tossed. Fortified with the capacity to rebuild my reservoir in the moment has felt like having my own super-power. Fifteen minutes of practice and I feel rejuvenated, ready to step back into the world calm, alert, and balanced—sattvic. Timmons and Ley, editors of *Behavioral and Psychological Approaches to Breathing Disorders*, explain this phenomenon in this way: "While it is commonly understood that changes in breathing follow changes in emotion,

cognition, and behavior, current research points clearly to the less commonly understood fact that changes in breathing lead to changes in emotion, cognition, and behavior.”<sup>1</sup>

The interweave of the chemical, mechanical, and psycho-emotional factors that play into our everyday breathing saṃskāra creates a psychophysiological gyroscope. When these factors are perfectly calibrated they maintain allostasis—an appropriate and fluctuating balance. However, the rajas–tamas (activity–inertia) pendulum of our lives often throws these components off-kilter. Once that happens, it can become difficult to know how to intervene and return to sattva, equilibrium. This is why it is so important to consider context when addressing the breath with any particular individual. Our thoughts, beliefs, and emotions can all drive our breath rate up. That process can move us into a dysfunctional breathing pattern that, over time, dysregulates our biochemistry. This will result in a further agitation of mind.<sup>2</sup>

Yoga teaches us that our daily habits create the lingering tendencies or saṃskāras that make a particular action (karma) more likely to be repeated. Anything we do repeatedly creates an imprint. Like a trickle of water incessantly dripping down a granite wall, over time, it etches a deep groove. In modern terms, we talk about this as neuroplasticity, and the Hebbian rule that “Neurons that fire together, wire together.”<sup>3</sup> This references how our neurological system can be trained, much like Pavlov’s dogs, to respond or react to anything that is consistently reinforced. In fact, this is happening in every unconscious moment of the day. The question is: How are we etching the structure of our own body, mind, spirit complex—our panchamaya? How can we harness the primary vehicle that disperses, agitates, or conversely contains our prāṇa—the breath—in order to direct our mind in ways that create beneficial neurological feedback loops?

In this chapter, we will explore two main concepts. First, we’ll investigate how the brain processes information and responds to stress. Then, we’ll examine the fear circuitry through the perspective of the polyvagal theory. Understanding these mechanisms will help clarify how breathing can directly alter our feelings, mental function, and emotional resilience—for better or worse.

## **Our Brain on Stress**

Within us we have a primitive, internal interface that scopes out potential threats, and conveys an immediate felt sense of whether our surroundings are safe or not safe. This is known as our reptilian brain, as it is considered to be the older, pre-mammalian part that is wired for survival. The perception of relative safety is mediated through the autonomic nervous system (ANS), and communicated via a variety of visceral and physiological reactions within the body. Some of these we’ve already discussed, such as breath rate and volume, heart rate, and tension or relaxation in the gut (to name a few). Depending on the internal cues we get minute by minute, our musculoskeletal system readies itself to respond. Through years of repetitive training, we’ve learned to “read” our inner landscape, and equate that when we “feel like *a*” it means we can “expect *b*” to happen. Most of this is happening below the radar of our awareness, in the flash of a nano-second. Ultimately, the logic that drives our assessment of any given situation is based on prior assumptions. It is not reviewed by an accuracy committee. We simply react, riding the toboggan run of familiarity, as we have always done in the past.

It is important to recognize that this response system, in evolutionary terms, was largely driven by survival and reproductive needs and not by the quest for enduring happiness. The immediacy of this processing reflects an evolutionary compromise between speed (for



survival) and response flexibility (contemplation, reflection, negotiation). In this limited context, the brain's only agenda is to provoke us to respond with a strong enough defense to keep us alive.

As information is taken in through our senses, it is relayed through the brain's processing center, the thalamus, and then mitigated by the fear center of the brain—the amygdala—for a safety-check. The amygdalae are almond-shaped masses of grey matter situated in the emotional center of the brain, which is known as the limbic system. Input that is deemed threatening fast-tracks to the amygdala. There it gets highlighted and committed to memory in order to avoid future situations that may present similar threats. LeDoux goes on to explain the depth of this imprinting on our psyche and the ultimate cost:

Unconscious fear memories established through the amygdala appear to be indelibly burned into the brain. They are probably with us for life. This is often useful, especially in a stable, unchanging world, since we don't want to have to learn about the same kinds of dangers over and over again. The downside is that sometimes the things that are imprinted in the amygdala's circuits are maladaptive. In these instances, we pay dearly for the incredible efficiencies of the fear system.<sup>4</sup>

Trauma expert Dr. Bessel Van der Kolk calls the amygdala our “smoke-detector.” He says it sounds the alarm when our sensory system communicates anything that it perceives as an imminent threat.<sup>5</sup> Once the amygdala's alarm has been tripped, the sympathetic nervous system (SNS) will move us into action via an army of stress hormones, such as adrenaline and cortisol. These hormones compel us to react defensively. This is considered the “low-road” reaction. It ensures that we will act swiftly (fight or flight) to get us out of danger's way.<sup>6</sup> The vṛttis that accompany this type of SNS response may or may not be appropriate to the situation. The classic Vedic example of this type of reaction is the parable of the villager who reacts to a stick in the road as if it is a snake about to attack.

The path of choice, or the high road, is through the prefrontal cortex. When we're not truly facing danger, the high road allows us to think through our options and negotiate the space between feeling and action. The prefrontal cortex is the seat of much of our unconscious appraisals as to whether it is safe to move towards and approach, or step back and avoid, whatever it is we are confronting. It is often described as the seat of “executive function.” This is a more refined and global interpretation of reality, and it takes milliseconds longer than the low road. Depending on which route we are more accustomed to using, that pathway will be a smoother, slicker slope, and will act as our default setting. In other words, the more we practice fear and avoidance, the more likely we are to respond with fear and avoidance to the next challenge we encounter, whether or not it is appropriate to the current situation.<sup>7</sup> [Figure 8.1](#) illustrates the high road/low road brain pathways.

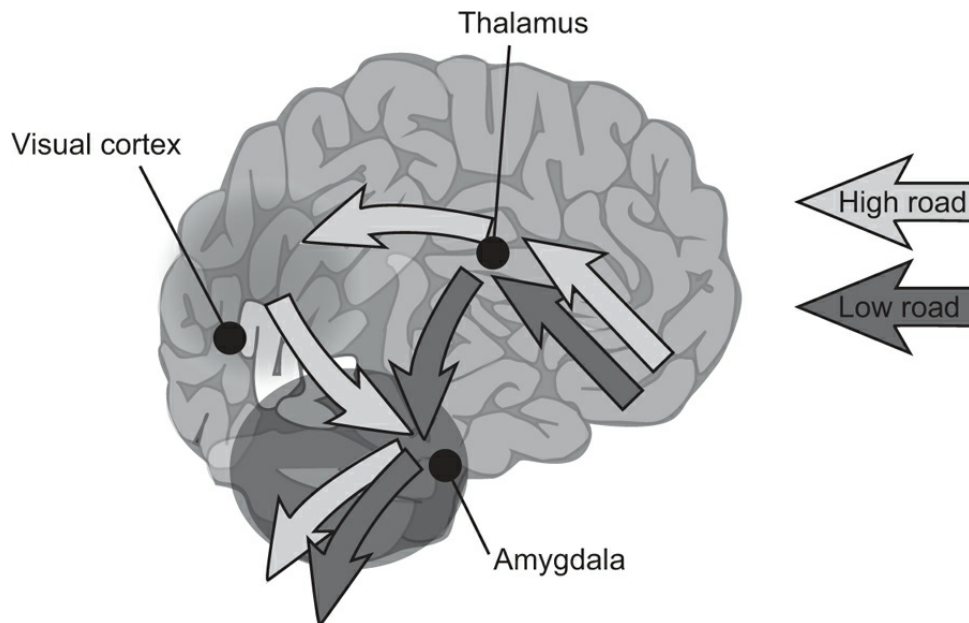


Figure 8.1 High Road/Low Road

A psychology experiment done several years ago illustrates the effect of “approach versus avoid orientation” on our cognitive capacity. A group of college students were asked to complete a paper maze task, helping a mouse to find its way out. One group’s motivation was to get the mouse to the cheese awaiting at the end (approach, positive reinforcement). The other group was to save the mouse from imminent doom, escaping an owl that hovered above, talons ready for capture (avoid, fear, negative reinforcement). All participants completed the maze successfully. However, when each group was tested afterwards on a creativity task, the group that was motivated by avoidance showed a sharp decline: 50 percent lower in their scores, as compared with their approach counterparts.<sup>8</sup>

Neuroscience researcher Richard Davidson showed that meditators demonstrated a distinctive prefrontal shift in brain function, as they self-regulated their emotional response to negative stimuli. Through their practice they trained attention and were able to shift from avoid to approach. This neural flexibility was shown to elicit improvements in immune function. With time and repetition, these kinds of changes have actually been shown to be effective in speeding cortisol recovery following social stress, reducing inflammation, and mitigating genetic factors that are related to aging.<sup>9</sup>

Our capacity to manage fear and anxiety is tied up in our original attachments and are linked to our personality and character. You could think of it as part of our prakṛti, our intrinsic nature. The high road acts as the modulator and adds a sprinkle of cognitive processing. Using the villager and the stick analogy: If the villager perceiving a snake were to take another step forward, or even lean towards the object in the road (approach), he may note that it hasn’t moved, nor does it have a head or tail, so it is likely dead or inanimate. He might then assess that it is perhaps a stick and nothing to fear. We can train ourselves to become high-road processors through mindfulness practices like prāṇāyāma, which is fundamentally a meditative practice where the object of focus is the breath.<sup>10</sup>

## The Multi-Faceted Nervous System

In the past, the nervous system has been viewed as an either–or proposition: sympathetic or parasympathetic dominance. Either we had our foot on the accelerator (SNS) or the brake

(parasympathetic nervous system [PNS]). Psychologist and author Stephen Porges, originator of the polyvagal theory, suggests that in evolutionary terms, the aspect of the PNS which most of us are familiar with—the relaxation response—is a relative newcomer on the scene. This aspect of the PNS governs social engagement through eye contact and verbal communication, and calms our instinctual, reactive tendencies to fight, run, or hide (freeze). It effectively slows down our processing, by “braking” the SNS pacemaker (which runs fast and hard), providing time for us to shift from the low to the high road. This allows for a more thoughtful response. The newer PNS is mitigated through the upper channel of the vagus nerve (above the diaphragm), and can be thought of as equipping us with kind of “vagal brake” on our emotional reactivity.

Porges has also proposed that there are two parasympathetic branches, not one. He describes an older branch of the PNS that activates the freeze or dorsal vagal response (below the diaphragm). When this older PNS gets triggered, rather than engendering a fight or flight reaction, it can cause a complete shut-down, fainting, or dissociation in some people. Porges posits that stress vulnerability—that is, how reactive versus responsive we are to stress—is best assessed by examining the resiliency of the *newer* level of the parasympathetic nervous system, *prior* to a stress-inducing event.<sup>11</sup> In other words, our ability to meet the day-to-day travails of life with a high-road, reflective response (newer PNS) is predictive of how stress-resilient we will be when faced with more challenging adversity (see [Figure 8.2](#)).

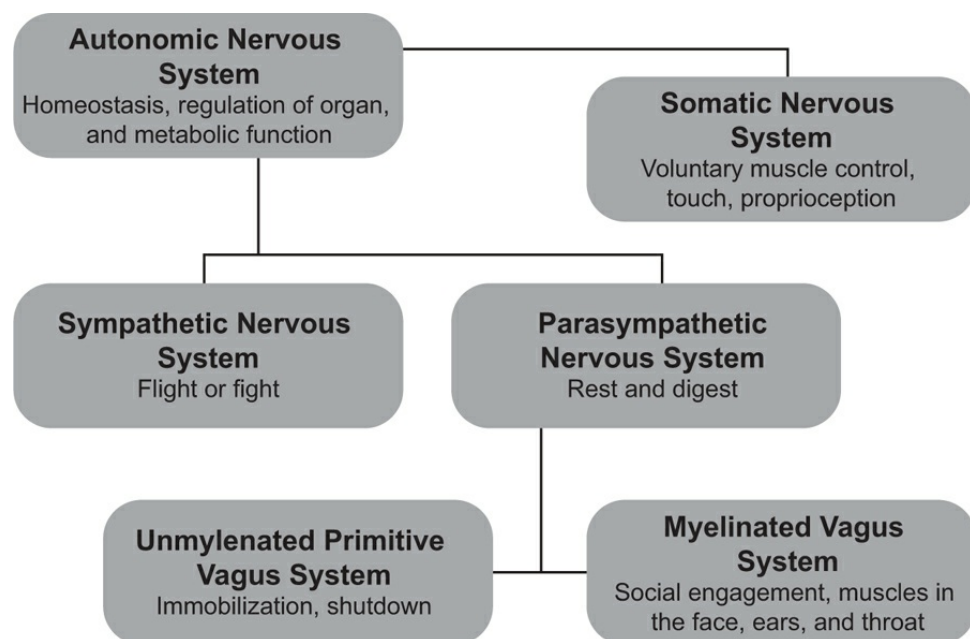


Figure 8.2 Polyvagal Theory Chart

As we noted in [Chapter 3](#), heart rate variability (HRV) is a test for stress resilience, and a strong indicator of “vagal tone,” or the ability to apply the vagal brake and self-moderate. Low variance between the rate of the heart with inhale and exhale reflects a systemic rigidity. The less vagal brake responsiveness, the more likely the accelerator will get pushed to the floor; or in others, low HRV will cause total collapse, paralysis.<sup>12</sup>

According to Porges, from an evolutionary perspective both the freeze response (the older, dorsal vagal system) and the sympathetic, fight/flight response are part of the original reptilian, rhinencephalon brain. This area of the brain doesn’t factor in time for processing fears before taking action, as even a moment of questioning could result in our becoming some critter’s dinner. The chemical and physiological responses that called our ancestors to

act in the face of danger were fierce: One doesn't negotiate with a tiger; one runs, hides/freezes, or kills it. The newer, parasympathetic system allows us to dial our arousal levels up and down as needed. It helps us modulate the reactivity of the older systems.

The science of neuroplasticity (the adaptability of our brain) mirrors the ancient yoga model that says we're never too old to learn new patterns. Self-awareness, resolve, and repetition can in fact change our *vṛttis*, our thought patterns. In so doing, we can change how we react and respond to stress.<sup>13</sup> It has been shown, for example, that mild to moderate stress when trying something new orients our brain to learn, and become more "plastic," less rigid. There's a quality of alert attention that accompanies that slightly jazzed-up feeling, allowing for fresh connections to be made, fostering learning.<sup>14</sup> This reminds me of my grandson's new mantra while learning to ride his two-wheeler. Instead of screaming, "It's too scary!" and refusing to pedal, he now exclaims, "It's a little scary, and kind of exciting," while circling the driveway with a tone of pride.

High levels of stress, however, can inhibit or disrupt the brain's ability to integrate information, resulting in dysregulation.<sup>15</sup> This often leaves one feeling flooded and overwhelmed. Once we're slipping into "freak-out" mode, it is hard to regain our equilibrium and get back to that *sattvic* middle. Our physiology tells a compelling story, and when the body starts cranking out the stress hormones, and our heart and breath rate are elevated, it becomes difficult for our mind to be convinced that the threat is not real.

One of the things that the yogis really seemed to understand was that this circuitry didn't just happen in the brain, it happened globally, with messages going in both directions: TOP DOWN (brain to body) and BOTTOM UP (body to brain). The intrinsic link between *prāṇa* and *citta* accounts for why the yogis insisted on breathing practices as the primary means to pacify the mind. Through the breath, the ANS is directly impacted. Breathing can effectively modulate the reactive loop, and restore us to a more coherent frame of mind.

Attempting to simply talk through high levels of distress has led to disappointing results, according to trauma experts, who now weave a variety of body-based approaches into their work.<sup>16</sup> Cognitive behavioral therapy, for instance, can be effective in changing the *vṛttis*, the thought patterns of mind (TOP-DOWN approach), while exercise can offer a great way to release stress hormones, increase CO<sub>2</sub> levels, and reset the heart and breath rate (BOTTOM-UP approach). Linking mental construct with movement and breath retraining is proving an even more effective means of healing, particularly when working with trauma. With the combination, thoughts are being rewired while the physiological and musculoskeletal systems are likewise being reformatted.<sup>17</sup> This supports good autonomic regulation or neural integration.

You could think of neural integration as the ability to experience life with a minimum of defensiveness or reactivity. It's reflected in the ability to engage the mind in activities that soothe and shift the body's physiology, and to flexibly change the *vṛttis*. This can take us out of a negative avoidance stance by engaging the high road. Cultivating good "neural integration" is an implicit goal of yoga. Mindfulness practices that engage us in an interoceptive process (*svādhyāya*) have been shown to keep the prefrontal cortex online (*manomaya*—the mind), while movement and breath work can help rewire the *annamaya* (physical) and *prāṇamaya* (physiological dimension) to be more resilient.<sup>18</sup>

A good example of this dual-directional approach would be to combine *āsana* (non-habitual, conscious movement that reinforces good biomechanics and postural alignment) with *prāṇāyāma* (conscious and appropriate control of the breath) and *mantra* (mental

recitation that takes us out of our ordinary thought process, and connects us to something less fear-driven, like Light, Love, Peace, or God). In other words: *Yoga!*

### SUMMARY OF PORGES' THEORY

**The unmyelinated branch of the parasympathetic system (PNS) is the oldest.** Think: raw fear and the freeze response; the feeling of being trapped. When this part of our system is activated, we are immobilized and shut down. In the case of trauma, the tendency may be to dissociate. There are many nerve fibers for this system below the diaphragm, reflected in the protective reflex to curl into a ball and not move, like we've been "sucker-punched." Reoccurring trauma may be associated with paradoxical breathing, which literally freezes the diaphragm in its domed position, holding it taut on inhale. This likely began as a self-protective mechanism to avoid harm. In modern times, the result may be an everyday disordered breathing pattern that regenerates the trauma physiology with every breath. This can perpetuate a chronic anxiety loop of hypervigilance.

Next in line is the **sympathetic system (SNS)**, the fight or flight response which connects directly to our cardiac and hormonal systems. This results in the outlay of adrenaline and cortisol through the hypothalamus-pituitary-adrenal (HPA) axis. The HPA axis controls digestion, modulates the immune system, regulates mood and emotions, promotes sexual function, and mediates our reactions to stress (see [Figure 8.3](#)). The SNS is associated with increased metabolic activity, and influences the cardiac pacemaker. If unopposed by the newer myelinated vagal system, the heart would pump at an accelerated and unsustainable rate.

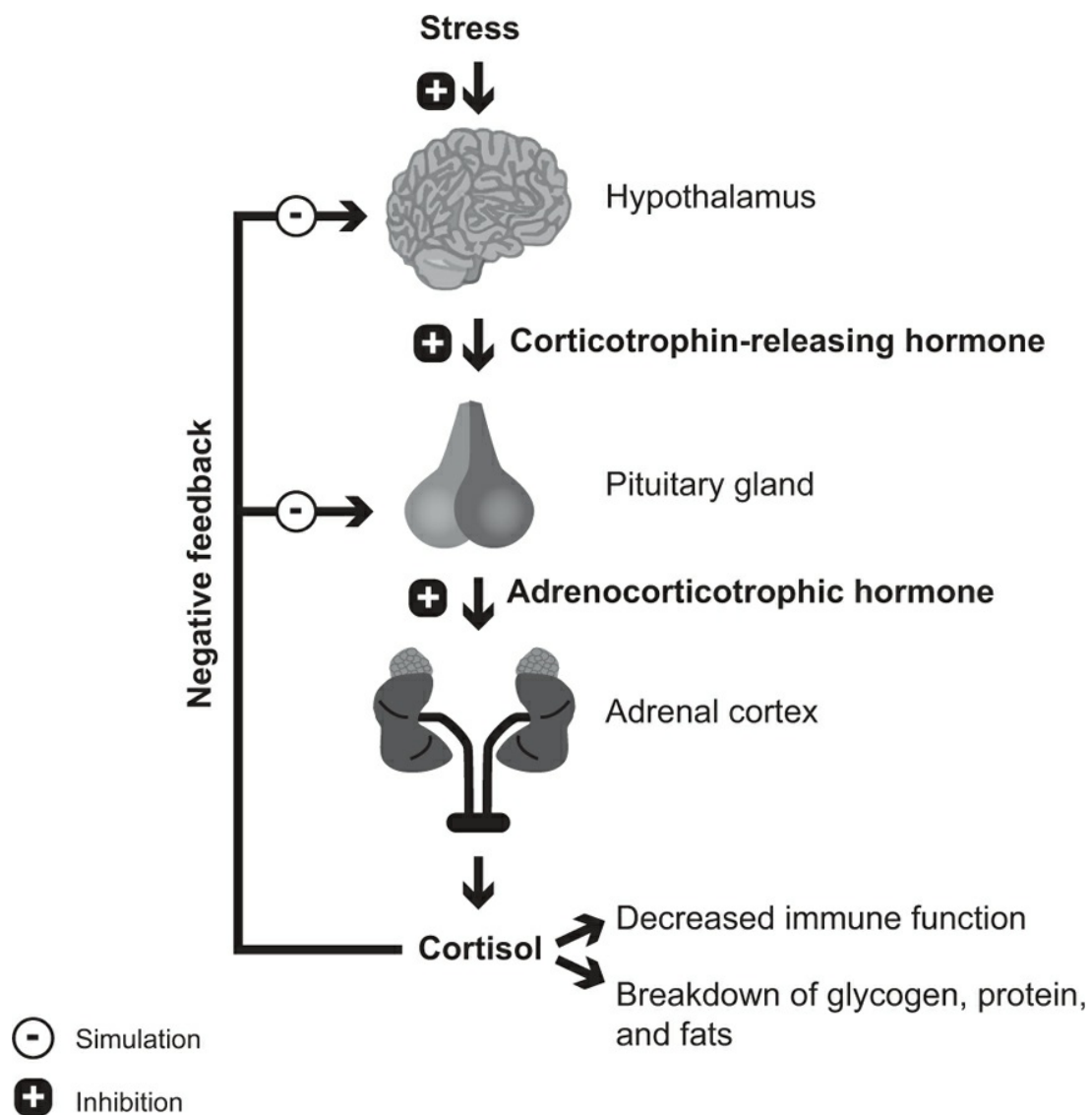


Figure 8.3 HPA Axis Chart



When we experience momentary stress, like the dog barking in the middle of the night, the SNS activates the HPA and sends a jolt of adrenaline through our system. This prepares us to react defensively and get ourselves to safety as is necessary. If our stress resilience is in good working order, as soon as it is clear there is no intruder, just a little doggy neurosis, we easily fall back to sleep. However, if we are perpetually hounded by work, relationships, and financial pressures, a never-ending stream of challenges—our HPA system starts churning out cortisol, the long-term stress hormone. This will negatively affect our sleep cycles, our ability to digest, our heart rate, breath rate, and ultimately, our prāṇa will cause damage and break us down, in whatever areas we are genetically, culturally, and personally vulnerable. Chest breathing and irregular chaotic breath patterns can perpetuate the HPA axis output of cortisol, and with that, feelings of anxiety, chronic tension, inflammation, and pain. This keeps the SNS roller-coaster keyed up with no brake, no means to dial it down.<sup>19</sup> Both the unmyelinated vagus and the long-term SNS reactions exemplify the low-road response to stress, where sensory information coming in goes directly to the amygdala.

The myelinated branch of the parasympathetic nervous system (PNS) is the newest and represents the high road. It employs the prefrontal cortex, which is a more recent evolutionary development and represents our mammalian brain. Myelin is a fatty sheath that insulates the nerves, allowing this circuitry to flow faster and with greater efficiency. The myelinated PNS is modulated primarily through the action of the upper portion of the vagus nerve. The targets for this branch of the PNS are mostly above the diaphragm, and engage the brain–heart–face circuit. The vagus nerve is the longest nerve in our body and releases the neurotransmitter acetylcholine, which among other things controls heart rate and breathing, and affects the inflammatory response.<sup>20</sup>

A robust vagal brake is a critical part of stress resilience. Slow, low, diaphragmatic breathing has been shown to engage the vagus and shift us into the myelinated PNS. In addition, vagal modulation or the “vagal brake” is linked directly to the social engagement system (SES), and has incredible power in deactivating the other two systems when it is brought online. The SES links social behaviors to autonomic regulation. The myelinated vagal system becomes “wired up” in the third trimester of pregnancy. It mitigates social gaze and controls important muscle groups that govern facial expression, the ability to differentiate the human voice from background sounds, sucking, swallowing, exhalation, vocalization, and head position, especially turning and tilting. This system links social behaviors to autonomic regulation. Suckling and mother–child bonding is built around this social engagement system. If it is not set in place in infancy, it becomes more difficult to build it out as we develop. A robust vagal brake is a critical part of stress resilience. Slow, low, diaphragmatic breathing has been shown to engage the vagus and shift us into the myelinated PNS.

## Today versus Yesterday

Negotiating the balance of our internal wiring and development while navigating the bombardment of sensory and information overload coming at us from the outside world makes for a peculiarly modern human dilemma. In times past, we didn’t have that much input to contend with on a day-to-day basis. Today, in a single day we may end up processing more information than a person a hundred years ago did in a lifetime. Our biology hasn’t caught up with the technological marvels that bring us a barrage of news instantaneously. Unlike our fore-mothers, we know in a flash that a mass murder happened three states away *and* that hurricanes have wiped out whole islands *and* that wars in continents on the other side of the globe are escalating, *and* the planet is warming at terrifying rates. We take it in as we sit, immobilized, in our chair, our car, or our desk at work.

One of the ways in which the body prepares for potential or projected crisis, even if it is anxiety about an event that’s happening three months in the future, or frustration over a work decision that happened two weeks ago, is to stimulate the breath via the SNS. This will result in either faster breath rate or an erratic breath pattern of over-breathing, punctuated by unconscious breath holds. Even though the “threat” is a mental exercise only, the body gears up as if it will require the usual full-on defense. If these feelings, or *vṛttis*, become habitual, then the call to arms will also become chronically embedded, taking on a life of its own. In essence, feelings of anxiety may predispose one to hyperventilation, which behavior then reinforces the feelings of anxiety, forming a potentially destructive cycle.<sup>21</sup>

Our physiological system is more than willing to call out the SNS troops when it

perceives there is a threat; however, when we don't *do* anything, we pay with an enduring cascade of internal shifts that compromise our health. Our system's inflexibility hasn't prepared us to handle "anticipatory anxiety" unaccompanied by action, like worrying about the future. This has made us uniquely vulnerable to the kinds of stress-related diseases that arise from stewing in a sympathetically manufactured chemical soup.<sup>22</sup> The good news is that we also have developed the capacity to bring mindfulness to anticipatory anxiety and to work with movement and breath directly, in order to shift those patterns.

## **Breath and Mind, a Symbiotic Relationship**

The correlation between how we feel and how we breathe has been widely researched. Strong emotions such as bereavement, anger, separation, loss, and grief increase breathing and can trigger hyperventilation.<sup>23</sup> If you are angered by something and respond with a vivid expression of emotion, like shouting at the top of your lungs, you'll incite the SNS even more. As your heart and breath rate increase, your eyes dilate, you begin to sweat, your mouth becomes dry. These symptoms will feed your mind's certainty that your reasons for being angry are valid, which will commit you more to your side of the argument. The usefulness of the amped-up SNS response is that it also increases sensitivity to sensory input, tenses our muscles so they are ready to take action, and puts us on high alert. In the case of real physical danger, these mechanisms could save our lives. When fighting with our spouse over whose turn it is to wash the dishes, probably not so much.

When the SNS response becomes habitual, it leads to many problems, including breathing pattern disorders and hyperventilation. If there is already a biochemical imbalance in place, for example low CO<sub>2</sub> and high cortisol levels, the system can be easily tipped by a slight elevation in breath rate. The opposite also holds true. If people are wired to be more sensitive emotionally, they may be more predisposed to respiratory conditions like hay fever, rhinitis, asthma, or heart arrhythmia. Studies show a high correlation between panic attacks and asthma attacks for people with chronic respiratory conditions.<sup>24</sup>

According to Rosenkrantz, "In [the case of] asthma, there is increased activity of the brain's emotional neural circuitry involving structures in the limbic system such as the insula and anterior cingulate gyrus that are part of the brain's fear network."<sup>25</sup> Furthermore, according to neuro-researchers Rosenkrantz and Davidson, it appears that this circuitry is generated, at least in part, by the physiological response in the body, which can then perpetuate the maladaptive, psychological processing of the individual. The incessant loop of these responses can trigger inflammation and hyper-activity in the immune system, making the individual more prone to the next asthma attack.<sup>26</sup> [Figure 8.4](#) highlights the areas of the brain that make up the fear circuitry that can get stuck in a recirculating loop.

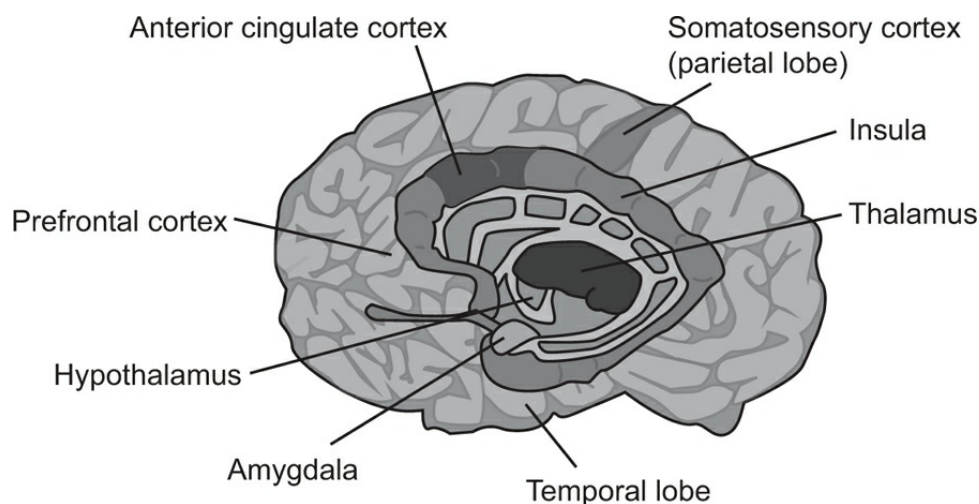


Figure 8.4 The Brain's Fear Network

The practice of slowing breath rate and in particular increasing the length of exhalation has been clinically shown to have a calming effect on the nervous system. Slowing breath rate to six breaths a minute has been clinically proven to increase HRV.<sup>27</sup> Studies confirm that slow breathing increases the ability for people to modulate both physiological and emotional arousal.<sup>28</sup>

Again, here I defer to the intelligence of the yogis who often accompanied prāṇāyāma techniques with either mantra, or *brahmari* (pronounced brah-mar-ee, humming), or even the ocean-like “ham-sa” of a light ujjayi. What all of these techniques have in common is they offer a distraction for the mind, while simultaneously increasing the resistance to the respiratory muscles which will help them function better. This positive resistance increases control of the flow of breath, automatically slowing it down while engaging the diaphragm and abdominal muscles more fully. The addition of sound, particularly in a vibrational manner as with humming, has a soothing effect—activating the vagal brake even more. Vocalization of this type has been compared to the purr of a cat, and apparently has a similar effect as humming or a light ujjayi in prāṇāyāma does in humans:

The purring sound is created by the breath moving past a partial obstruction of the upper airway, creating a vibrational sound. This has several effects that stimulate the soothing part of the cat’s nervous system and induces relaxation.<sup>29</sup>

Unfortunately, the Catch-22 of reliance on the slow, extended exhale as a means to reduce psycho-emotional distress is that it has created a culture of big-breathers who intentionally amplify their breath volume to calm themselves. It is important to understand that while “taking a deep/big breath to relax” can offer short-term relief from the SNS, it can also complicate things in the long run. This is particularly the case if there has been a pattern of dysfunctional breathing set in place, and the biochemistry is already off-kilter.<sup>30</sup>

In our attempt to soothe our mind in the short term, we may actually be perpetuating the physiological imbalance that makes our system so easily triggered by stress. It has been shown that one big breath or sigh an hour is enough to sustain hyperventilation syndrome.<sup>31</sup> You could think of this like using a shot of espresso (or two or three) to get you going in the morning because your sleep is less than restful. The more caffeine you drink during the day, the less likely you’ll be able to rest at night. The more tired you are when you wake up, the more likely you’ll depend on caffeine to keep you going. It’s a vicious cycle. Until you give



up the caffeine and let your system naturally calm down, sleep will likely continue to be elusive.

Big sighs and extended exhales can act in the same way, perpetuating a feeling of breathlessness, when in fact we are breathing too much already. Exhaling with big volume will feel like a relief in the moment, but it sinks us into the CO<sub>2</sub> deficit cycle, which will ensure our brain will continue to call for big breaths and our ANS will be more easily triggered by stressors. If there is no imbalance, then the extended exhales or occasional big breaths will do the job they were intended to do: relieve stress with no ill-effects.

## Changing the Pattern

I have had several students who have suffered with anxiety and panic disorder confess that the big yoga breathing practices from the past never worked for them. It wasn't until I gave them the alternative of breathing light and soft that they realized the big breathing habit was making them more anxious, because they never felt they could get enough. The grasping for more was itself a trigger, leading to chest contraction and initiating feelings of dyspnea (breathlessness).

I have also had clients with anxiety find the journey into reduced breathing and exploration of air hunger absolutely terrifying.

When it comes to breath retraining or prāṇāyāma practice from the psycho-emotional perspective, there are multiple complicating factors to consider. The constancy of breathing makes implementation of a new breath pattern extremely difficult to sustain. When there is already a predisposition towards anxiety, anything that creates a feeling of dyspnea is likely to spiral into a full-blown SNS response, which will then create an inherent resistance to following through with the breathing practice. Finding breathing techniques that can be adapted according to each person's psyche is both challenging and rewarding.

A meditation teacher I worked with once said, "The mind is like a bad neighborhood, you shouldn't go there alone." I appreciated his humor at recognizing that sometimes our own stories can be our worst enemy. It can be a challenge to convince someone who already feels like they aren't getting enough air that the way to help open their airways and calm down is to breathe less. It is especially hard within a culture that worships "taking a deep breath" as the magical answer to stress. This is where practices like yoga nidra, gentle movement practices, mantra, and restorative poses can aid tremendously in helping the nervous system and mind to downshift enough to allow for some new and different information to be received.

According to Rosalba Courtney, ND, DO, PhD, and breath researcher, tools which promote relaxation and self-awareness are important facets to a breath-retraining process. Modalities that reduce anxiety and hyper-arousal can quiet the fear response that arises with feelings of dyspnea. Education around the biochemical and biomechanical loop that triggers the mind can also help clients feel more in control of their symptoms. She concluded that both relaxation and education increase compliance to a new orientation to breathing.<sup>32</sup>

## Svādhyāya: The Way Out of Duḥkha-Ville

Bessel Van der Kolk refers to the mid-brain as the "Mohawk of self-awareness."<sup>33</sup> This area integrates incoming sensory information—bodily sensations, visceral and emotional processing—with thinking. It creates a kind of internal GPS to help us formulate a map of how we are doing at any particular moment in time. While there are a variety of brain

structures involved in this phenomenon, the insula seems to be a key area of integration that either reinforces the fear response or modulates it through the development of interoceptive awareness.

Activation of the insula has been shown to have a direct impact on our perception of pain and emotional distress.<sup>34</sup> The area of the insula and its neighbor, the anterior cingulate, seem to work in tandem to move us from the low road to the high road. Practices that increase proprioceptive awareness (knowing where your body is in space) and interoceptive awareness (the interior felt sense of ourselves) seem to quiet the fear center, and shift us to high-road processing by rewiring the insula to communicate more directly with the prefrontal cortex.<sup>35</sup>

### PROPRIOCEPTION VERSUS INTEROCEPTION: AN EXPERIMENT IN SVADHYAYA

To understand the difference between proprioception and interoception, try this experiment:

Raise both arms overhead and, without looking, gauge which one extends further than the other. This is proprioceptive awareness.

Now, keep the arms extended overhead and compare the felt sense of stretch in the right arm and the left. Which side feels longer, looser, tighter, more open? How would you describe the difference? This is interoceptive awareness.

In āsana practice, we utilize proprioceptive and interoceptive referencing whenever we couple cues that attend to the placement of the feet and hands with reflective inquiry regarding the internal felt experience of the shift in weight, in symmetry, in tension versus relaxation. Cultivation of this type of BOTTOM to TOP (body to brain) circuitry has been linked to increases in gamma aminobutyric acid (GABA), a neurotransmitter that directly supports healthy insula functioning.

We can develop prāṇāyāma practices in a similar way by inquiring into:

- *Depth of breath:* Where in the body are you initiating the movement of the breath?
- *Volume:* How much/how little breath is flowing in and out?
- *Changes in breath pattern:* How does the breath change when we change positions?

Perhaps this information sounds reminiscent of the teaching from [Chapter 1](#) regarding the kleśas, the five afflictions that lead to suffering. The teaching is that fear, attachment, avoidance, and ego (self-preservation) are the seeds that sprout in the soil of avidya (lack of knowing). Yoga teaches that the pathway out of duḥkha (suffering) is through vidya (knowledge). Vidya is the inner awareness that comes through our own direct experience, and our personal svādhyāya process. Western science seems to affirm the yoga teachings that state that avidya (lack of this inner knowing) gives rise to duḥkha, tripping our fear alarm. Through the activation of awareness, we can transmute sensory information consciously, and wire up the high road. This enables us to moderate both emotional and physical suffering. To this end, the yogis valued prāṇāyāma with its direct line into the ANS, as the most salient practice to activate and strengthen the vagal brake, and train our mind and body to integrate, top down and bottom up.

### KEY CONCEPTS

- Our brains are wired for survival—not for happiness.

- Yoga practices can help us to move from a fearful, avoidance reaction—the low road—to resilient, high-road approach responders.
- Stress resilience is best assessed by our ability to apply the vagal brake prior to a stressful event.
- Neural integration happens TOP DOWN (brain to body) and BOTTOM UP (body to brain).
- Breath influences the vagal brake.
- Combining prāṇāyāma with movement, relaxation practices, education, and awareness processes supports good neural integration.
- Breath retraining needs to adapt for the emotional resilience of the student or client, in order to foster compliance and facilitate success.

## — PUTTING IT INTO PRACTICE —————

### **Sensory Svādhyāya Practice**

In the Katha Upanishad, the analogy of a horse and chariot convey the relationship between the senses, the emotional mind, and the higher mind of discernment. The horse represents the senses; the reins, the mind pulled by emotions; and the charioteer represents the conscious Self. The question is: Who has control of the reins—the senses or the Self? This teaching represents how we can be pulled by the force of the senses, and directed to follow their “scent.” The svādhyāya (self-awareness) practice articulated below is intended to help you develop more vidya. It will help you develop more interoceptive awareness of how the senses and the breath interrelate and “pull” you into an emotionally reactive state.

Choose one of the five senses to focus on for a period of time, perhaps over the course of several days or a week. Attend to your response to this sense through your daily activities. If you choose a sound, for instance, observe all sounds: from the birds chirping in the tree, to the crash of the garbage truck. Relay this information through the lens of the breath. In other words, what happens to your breath when you listen and feel the impact of this sound on your nervous system? Reflect on these interoceptive questions and add any others that you think of to the list:

- Does the breath speed up or slow down?
- Does it become more shallow and chest-driven?
- Does it become deeper, more abdominally–diaphragmatically driven?
- Does it stop altogether?
- How does this information help you to understand how this sense affects your emotions and state of mind?
- Are there particular vṛttis (thoughts/feelings/sensations) that accompany your approach-or-avoid response to this sound?
- Can you move beyond the reflex of like/don’t like and become curious as to how sound impacts you?
- If you change your breathing does it change your relationship to the sound?

Once you have completed this for one sense, follow through with each of the others. Record your experience in your **Svādhyāya Breath Journal**. Complete the process by using the mind (informational input) as the sixth sense.

When this process is complete, consider the following reflections:

- Which senses “pull” you the most? For example: I am a very visual person and viscerally respond to color. I literally feel nauseated by certain color combinations, while others feel like they align my whole subtle body into sattvic bliss. The intention at this stage is not to change your reaction but rather notice—witness—it unfolding within you.
- When you complete this process, go back through your **Energy Bank Account** (EBA) reflections from [Chapter 2](#) and re-evaluate the pancha vāyus (five winds), explicitly connecting the senses and the mind to your EBA equation.
- What have you learned?
- How much of your energy is consumed by your senses?
- Has this experience shifted your lifestyle choices? Your behavior?

## Wiring Up the Vagus

The following breathing practices offer effective alternatives to the use of extended exhalation as a means to calm the nervous system. The first few come from the Vedic tradition. The use of **Short Breath Holds** (SBH) is from the Buteyko method. I have found each of these to be useful in varying contexts and, like anything, no single modality will work for everyone. Experiment, explore, and track your experience. ([Photo 86](#))



*Photo 86*

## **BRAHMARI (BRAH-MAR-EE)—THE BEE BREATH OR HUMMING**

Everyone who can make sound can hum. Close your lips and let the vocal cords vibrate. As noted earlier, the use of sound creates positive resistance which supports functional breathing and soothes the nervous system. While all mantra practice is at least in part organized around this idea, brahmari is the only one that allows for sound and also ensures the nasal breathing.

I have recommended brahmari as a “Pocket Practice” for chronic mouth-breathers, meaning they can sprinkle it in throughout their day regardless of where they are. It is extremely beneficial as a way of increasing consciousness of the breath while maintaining a lip seal. Brahmari also provides an opportunity to practice proper tongue placement at the upper palate. It can be easily woven into āsana practice, particularly with dynamic movement. The hum can initiate any movement done on an exhale, such as lowering arms or forward bending.

Here are some ideas for how to “play” with brahmari, linking it to the concepts communicated in this and previous chapters:

- Play with the coordination of the core muscles and brahmari: Does humming activate the abdominals and diaphragm any differently?
- Play with pitch: Can you feel a different resonance in the annamaya (physical body) with higher or lower pitches?

- How does the tongue push against the palate when you hum? Lightly? Forcefully? Equally left and right?
- Play with volume: How is it different to hum loudly, or softly, or softer still?
- Play with brahmari as an emergency intervention to interrupt the vṛttis (thoughts/feelings/sensations) when you find yourself sliding down the low road: What do you notice? Is it an effective intervention for you?
- How does brahmari affect your attention and prāṇa? Do you feel more rajasic (agitated), tamasic (lethargic), or sattvic (light/balanced) during and after practice? (Note: Your energy after the practice may differ from during the practice.)

## SILENT MANTRA

---

“Mantra” means to transcend or protect us from our ordinary mind. The use of a phrase or single word as a mantra is a beautiful practice for transforming the vṛttis. It replaces our negative thoughts with something sattvic and links us to that. Whether we are feeling mentally depressed and need to invoke “Light” (*om jyoti namaha*—om j-yote-ee nah-mah-ha), or we are feeling anxious and need to connect the grounding force of the earth (*om prithivī namaha*—om pri-thi-vee nah-mah-ha), mantra has the power to shift our mind out of its neurotic loops and return us to our center.

*The Vedic teaching on mantra is vast and this brief descriptor is not in any way intended to illuminate that body of work.* What is offered here is more of a simple way to link bhāvana (meaning or intention) with the breath, to offer reprieve from mental duḥkha.

There are four phases to the breath: inhale; retention; exhale; suspension. Each one activates the panchavāyu in its own way. Mantra can be utilized to emphasize just one side of the breath, as in chanting out loud on the exhale to slow it down. With silent mantra, it can be activated on any or all phases. It depends on the desired effect.

Inhalation and hold after inhale (retention) are considered more energizing (a little press on the accelerator). This is useful if the mind is sluggish and tamasic or stuck on one negative loop, as can happen with depression. Exhale and hold after exhale (suspension) have more of a quieting effect. Combining mantra with them can help to still the “pinball” mind associated with anxiety. Suspension affects the CO<sub>2</sub> levels and oxygenation as discussed in previous chapters. When held for short periods it has a parasympathetic effect on the system, and when held longer has a mixed effect on the ANS. This will be explored more fully in the next chapter on kumbhāka, breath holding.

**Note:** The term “holding the breath” can itself be triggering for some people. Suspending the breath has a different feel to it. Other language options like “pausing” or “resting between breaths” may be preferable for some people.

A Buteyko colleague and pulmonary rehabilitation specialist, Lynn Gorton, RRT, RBBE, shared the following way she uses mantra to help her patients in the hospital clinic. She works with people with severe COPD, many of whom are on oxygen tanks. These people often experience a feeling of panic when attempting breath control practices. Lynn believes strongly in the mind-body-spirit connection, and has found that adding the following mantra provides solace to many of her patients, calming fear as it arises. Each word is to be recited silently and timed with the breath.

- *Inhale*: Peace.
- *Retention (hold after inhale)*: Amen.
- *Exhale*: Chaos (releasing the inner turmoil).
- *Suspension (hold after exhale)*: Hallelujah.

Notice that with Lynn's mantra, the shortest side of the breath is the inhale, the longest is suspension. This is in keeping with the desired effect of recalibrating CO<sub>2</sub> levels and avoiding hyperventilation. Lynn's example illustrates that simple one- or two-word mantras can be extremely powerful and need not be in Sanskrit. While om shanti (om peace) is lovely, not everyone is comfortable using a language other than their own. Thich Nhat Han offers many simple mantras of this type in his books on breathing meditations. I use Light, Love, Joy, and Peace individually, or combined together quite often.

**Note:** If there is any concern with hyperventilation or over-breathing as an instigator I would recommend refraining (for a period of time) from chanting out loud, and utilize either brahmari or silent mantra as alternatives for those with a regular chanting practice.

## HALO BREATHING (**PHOTO 87**)

---

This practice was taught to me by a very dear colleague, Matra Majmundar, who is a respiratory occupational therapist and yoga therapist. She is known as "The Breathing Lady" in the cardio-pulmonary community in which she works. Matra uses Halo Breathing, which is created through a circular rotation of the head, with her patients, even those on oxygen tanks. She has found they respond positively to it, and cite its immediate, calming effect on their breathing. It has become my personal favorite way to teach **Subtle Breathing**, as it seems to effortlessly reduce both breath rate and volume. The movement creates an almost trancelike feeling that people describe as meditative and soothing. This practice is particularly helpful if you have attempted to reduce your breath and found the process stressful.

- Prepare yourself as you would for seated **Subtle** or **Core Breathing**.
- Visualize a small "halo" a few inches above your crown center.
- Begin to roll the head gently in a circle to trace the halo.
- The head will oscillate slightly at the occiput.
- Every 5–6 rotations, reverse direction (clockwise/counterclockwise).
- Notice that one direction of rotation may feel more comfortable to you initially.
- Observe what happens naturally to the breath.
- Let the breath minimize until you feel a slight sense of air hunger. Continue rotating.
- Sustain the rotation, changing directions periodically, for 4–5 minutes. Rest. Allow the breath to expand naturally.
- Repeat 2–3 more rounds of Halo Breathing with breath reduction and slight air hunger for 4–5 minutes.

- Notice the felt sense of working with the Halo. How is it different? How does the breath change in rate or volume?
- What's the feeling at the end of the practice?

**Note:** If you find yourself getting dizzy while doing the Halo Breathing, I suggest you try with your eyes open. If that doesn't help, discontinue this practice.



*Photo 87*

## SHORT BREATH HOLDS (SBH) WITH MOVEMENT (**PHOTOS 88 AND 89**)

This practice is an extremely useful technique for multiple conditions. I use it regularly for students with very low **Comfortable Pause (CP)** (below 15), or those with anxiety who are just getting started with breath work. It is the most reliable way for me to stop the tickle in my chest when I feel I'm going to have a coughing bout. Sometimes I use it personally if I've been lecturing a lot and am aware that my CP is low, before I go into my regular prāṇāyāma practice.



One of the beautiful things about the SBH practice is that it tends to be less anxiety-producing than the longer breath holds, and combined with movement can actually be doubly useful in application of the vagal brake. SBH practice can be done multiple times a day as a formal practice, or as an emergency stop-gap measure to quell feelings of anxiety, stress or panic that arise circumstantially.

- Take your **CP** (see [Chapter 3](#)).
- Sit or stand comfortably.
- Gently inhale and exhale through the nose.
- Pinch the nose and hold for no more than half of your CP (e.g., If CP was 10 seconds, start your first SBH at 5). If you don't know your CP, start with a hold of 5 seconds.
- While holding the breath, sway from side to side.
- Between rounds, pause the movement and take 1–2 small, silent resting breaths through the nose.
- With the next round of SBH, bump up the hold by 1–2 seconds as able, without pushing you into a gasp with the subsequent inhalation.
- Continue to build the holds slowly and progressively.
- Play with the movement:
  - If sitting, you can undulate in figure 8s or “chair-dance.”
  - If standing, you can march, jog in place, or dance free-form.
- Remember that as you move you are creating more CO<sub>2</sub>.
- Do 6–8 repetitions of SBH.
- Relax the breath and observe the effect.

**Note:** As you gradually build the breath holds, ensure that you are always able to take a relaxed breath through the nose on the inhalation that follows, without gasping. Also, be sure to take enough resting breaths in between reps to allow the breath to settle. If you jump into the next rep too soon, your breath-hold time will likely be lower. If this happens, just relax the breath, let it completely normalize and then begin again.

**Contraindications:** If you are pregnant, have uncontrolled high blood pressure, have had a heart attack or stroke in the last three months, have an aneurysm of the aorta or in your brain, kidney disease, arrhythmia, or tachycardia, or have very low lung function on a baseline spirometry test *please refrain from this practice*.



*Photo 88*



*Photo 89*

## **COMBINATION PRACTICE**

---

- Try interspersing a round of **SBHs** in between rounds of seated **Subtle** or **Core Breathing**.
- Do 4 minutes of **Subtle** or **Core Breathing**.
- A round of **SBH** (6–8 repetitions).
- Another 4 minutes of **Subtle** or **Core Breathing**.
- Another round of **SBH** (start where you left off at the last round and build for another 6–8 cycles).

- Finish with a round of **Subtle** or **Core Breathing**.
- Observe and feel, letting the breath relax.
- Wait a few minutes until breath normalizes.
- Take your **CP** and notice how it has been affected by the practice.

Once you have a sense of these practices, mix and match them with the practices suggested in previous chapters. For example, add **Brahmari** (humming) or **Silent Mantra** to the core exercises described in [Chapter 7](#); or interweave the diaphragmatic exercises in [Chapter 6](#) with **SBH**. What do you notice? Track your observations in your **Svādhyāya Breath Journal**.

## CHAPTER SUMMARY

---

- The amygdala is the “smoke detector” of our fear system and runs the low road.
- Imprints from previous experiences can drive our present-day reactions.
- The prefrontal cortex activates the high road, the path of choice: response versus reactivity.
- “Approach” as a response to stimulus fosters curiosity, creativity, and positive feeling.
- “Avoid” as a response to stimulus engenders fear, anxiety, and a feeling of *duḥkha* (suffering or feeling stuck). This may be based on past perceptions of danger rather than current reality.
- Meditation practices have been shown to impact our ability to shift from avoid to approach.
- The polyvagal theory offers a way of understanding the multi-faceted way we respond to stress: SNS (fight or flight); unmyelinated PNS (freeze); myelinated vagus (calm, relaxed).
- The ability to apply the “vagal brake” via the myelinated PNS can moderate the SNS (fight or flight) and dorsal vagal response (freeze).
- Body-based practices like yoga are effective ways of wiring up the vagus nerve and activating the myelinated PNS.
- The senses (including the mind) are the way our brain interfaces with the world.
- In modern times, our senses are constantly being bombarded, which affects our nervous system, the way we think, and the way we feel.
- Reactions become habitual. Emotional reactivity can alter chemistry, increasing neural connections in number and strength, which makes us more vulnerable to emotional reactivity in the future. It is also possible to unwind those connections by neutralizing our reaction to the same or similar stimulus.
- Breathing can modulate or exacerbate the emotional tone of the moment.
- For some people the use of mantra or sound combined with breathing practice can be more effective for emotional regulation than breathing practice by itself.
- People with less stress resilience may find breath retraining more challenging.

- Functional breathing can effectively modulate reactivity and support good neural integration.
- Extended exhales as a primary means for ANS regulation can create long-term physiological imbalance; alternatives include humming, mantra, and small breath holds.
- The use of interoceptive and proprioceptive reflections (svādhyāya) during yoga practice can build neural integration and strengthen the vagal brake.

## Chapter 9

---

# THE MIND OF THE SUBTLE BODY

## CITTA, CHAKRAS, AND THE BREATH

Prāṇāyāma techniques that utilized nostril valving, like *nādi shodhāna* (pronounced nah-dee show-dah-nah), were always my favorite to practice. I appreciated the mental attention they required and also the soothing feel of the air moving through one nostril at a time. What I didn't appreciate until I experienced the Buteyko method was that the nostril techniques were all a form of reduced breathing. That first year of learning about Buteyko and breath retraining, I found that within two or three breath cycles of single nostril breathing, I didn't feel the sweet calm I had formerly experienced when practicing prāṇāyāma. Instead, I felt on the edge of air starvation—skipping right past “slight air hunger.” That got my attention. It also made me aware of how much I had been compensating (cheating perhaps?) when practicing before. Instead of breathing half the quantity of air as intended, I had simply increased my volume through the one nostril, entirely bypassing an essential point of the practice.

It took me nearly a year of learning to breathe lightly through two nostrils before I could comfortably breathe lightly and sustainably through one. As I returned to practices like alternate nostril breathing, it was with a new awareness. There was a refinement of my senses, more interiorization of attention. With my fingers held firm to both nostrils, one side sealed, the other side pressed in partial closure, I found a subtle control of the flow that felt as if the breath itself had disappeared, and that all I was moving was prāṇa.

This process led me back to reading the hatha yoga teachings on the *nādi* (pronounced nah-dee, energy circuit) system and the chakras. My study has enabled me to understand more about how these techniques transform the subtle body, and the interplay between mind and senses. As I reintroduced mantra and mūdra (hand gestures) into my prāṇāyāma practice, it was as if I was “sensing” on a different frequency. Each layer of practice continues to reveal another aspect of how and where prāṇa flows—and how the senses convey that information. It's a quiet process. There's no fanfare. I'm just more aware of how my senses hook me, and I now have more tools to gently release the barb.

*By changing the pattern of the breath, one can learn to maneuver the autonomic nervous system and high brain function, or in yogic terms, the iḍā, piṅgalā and*

*suṣumnā nādis. In other words, by changing the breath pattern one can induce a chosen state of mind.*<sup>1</sup>

## Vedic Review

It is clear that the yoga masters had an intuitive understanding of the interconnection between the breath, the mind, and the emotions. Remember the axiom that where prāṇa (energy/breath) goes, citta (mind) will follow; and where citta goes, prāṇa will follow. The interface of the prāṇamaya (energy dimension) with the other four mayas illustrates the lack of divide between the multi-dimensional facets of our being. From the perspective of the guṇas (inherent qualities of nature), the path of practice always directs us towards sattva (harmony/light). However, the starting point, rajas (movement) or tamas (inertia), will govern the particular means to that end, for any individual. This will be determined, in part, by a person's prakṛti (intrinsic nature). It will also be affected by the variables in life that are disrupting their mental and physiological equilibrium, their vikṛti or doshic imbalance. "Doshas that have undergone increase and traverse upwards through the channels of the mind, get localized in the mind and cause its abnormality."<sup>2</sup>

In most cases, reducing vata, the dosha cultivated from the elements of air and ether, is fundamental to balancing vikṛti. This is because vata gives motion to pitta and kapha and can therefore cause them to increase. Regulating the amount (volume and rate) of air that blows through our system is one piece of this process. Prāṇāyāma offers us a means to curtail the leakage, and clear the excess or stagnation of flow, by redirecting the movement of the vāyus (winds) via the breath. This process supports more parasympathetic processing, leading to clearer thinking, as discussed in the previous chapter. Additionally, the yogis drew on the other elements, earth, water, and fire, to achieve doshic harmony, utilizing a number of mechanisms and engaging the senses fully. This chapter explores the interweave of these concepts.

## Citta: Manas, Ahaṁkāra, Buddhi, and the Senses

From the Vedic perspective, citta (mind/heart) has three facets: *manas* (pronounced mah-nahs), *ahaṁkāra* (ah-hahm-kar-ah), and *buddhi* (bood-deeh). Manas is the aspect of citta that takes in information from external and internal sources via the sense organs. It resembles the thalamus in its role as a sensory relay station. The ahaṁkāra, or the I-maker, places the information received through the senses in relationship to the self, as in "I see something in the road. I am afraid it may be a snake." The ahaṁkāra's process of conveying the significance of sensory input to the "I" (or self) may symbolically represent the mid-brain's "Mohawk of Self-Awareness" (see [Chapter 8](#)), engaging the amygdala to insula to prefrontal cortex in an "approach/avoid" negotiation. Buddhi, known as the discriminating aspect of the citta, is the next level of cognition. With buddhi one might ascertain that the immobility of the object, and lack of head or tail, renders it "safe." Then, one can proceed forward knowing that it is a stick, not a snake. Buddhi correlates with the part of our cortex that controls executive function or higher, rational thinking.

According to research done by Dr. Claudia Welch (doctor of Oriental medicine) on the *manovahasrotas* (pronounced mahn-o-va-ha-shro-tas, the channels/nādis that govern the mind), manas is an enclosed circuit in the space between the skull and the hard palate.<sup>3</sup> Manas, she says, "[r]eceives the objects of the senses [sic] and is thus made aware of its surroundings." She goes on to say: "The strength of all *indriyas* [pronounced in-dree-yahs,

senses; my italic] is derived from the manas.”<sup>4</sup> Welch’s statement is founded in many yoga texts, such as the Yoga Sūtra that describe sensory information itself as being relatively neutral.<sup>5</sup> The teachings emphasize that it is our perception of that input—be it a sunset or a garbage dump—that colors it preferentially (pleasant/unpleasant/neutral). This emotional hue feeds and strengthens our beliefs, and the likelihood that we’ll respond with equal or amplified intensity with the next similar encounter. Returning to the example of the villager and the stick: If the villager was from a part of the world where there were no snakes to fear, the stick would likely not have been perceived as a snake. The object in the road was always a stick. It was the mind of the villager that created the perception of a snake about to attack, and reacted accordingly.

The term “buddhi,” according to the Madhava Nidana text, is used interchangeably with *hṛdaya* (pronounced h-rid-ayah). “Hṛdaya” is translated as “heart,” but does not solely represent the physical organ. The Vedas specify that the location of the *hṛdaya* is 12 fingers’ width above the navel and 12 fingers’ width below the neck, and claim it as the center of *prāṇa*.<sup>6</sup> The buddhi, or *hṛdaya*, is characterized as the seat of the mind/heart. It is “often translated as memory, consciousness or attention.”<sup>7</sup> You may note, as you span your hands on your own body, that 12 fingers could easily place *hṛdaya* at the area of the diaphragm or solar plexus. Recalling the contiguous fascial link between the diaphragm and the pericardium, it is interesting to conjecture whether the Vedas differentiated breath from heart in their rendering of *hṛdaya*.

As related in the Upanishads, the *hṛdaya* harbors *ojas* (pronounced oh-jahs), the substance that according to Ayurveda provides us physical immunity and spiritual strength. It is also considered a store-house for sensory perceptions.<sup>8</sup> Manas and buddhi, mind and heart, are therefore separate, yet integrated aspects of *citta*, with the *ahaṁkāra* acting as a conduit in between. Welch concludes that the health of the mind is determined by the health of the heart, and vice versa. Ultimately, “health” is highly dependent on the exchange of *prāṇa* in and out of the *hṛdaya*.<sup>9</sup>

As in the horse and chariot analogy discussed in the previous chapter, the yogis noted wisely that mental and emotional health start with our ability to become our own charioteers, meaning our desires and aversions are no longer driving us. Several of the teachings from Patañjali’s Yoga Sūtra direct us to learn to perceive the world with equanimity. We are encouraged to develop practices that make us less vulnerable to the temptations of the *indriya* (the senses), in order to settle the mind. Sūtra 1:15 states that non-attachment “emerges when the mind changes its underlying motivations from selfish to selfless, from seeking sense satisfaction to seeking an experience of peace that transcends external circumstances.”<sup>10</sup> Carrera, the translator of this version, further explains that it is the freedom from the pull of the senses that allows us to open up to an experience of *puruṣa* (the Divine). In Chapter 2, Sūtra 2:43, *tapas* (disciplined effort to change) is portrayed as the process of destroying the allure of the senses, which in essence feed *avidya* (ignorance). In other words, our practices are to help us unhook from the notion that any transitory satisfaction would somehow free us from *duḥkha* (suffering). *Prāṇāyāma* is listed as one of the primary vehicles to activate this purification process.<sup>11</sup>

Sandwiched between *prāṇāyāma* and *dhāraṇā* (concentration) lies *pratyāhāra*, the fifth limb of Patañjali’s eight-limbed path. *Pratyāhāra* is described as sensory withdrawal. It necessarily shifts attention away from the clamor of the senses in order to achieve the deeper inward focus required for meditative practice. Patañjali recognizes that the senses are very much how we interact in the world, and therefore are necessary for life. At the same time, our



desires and aversions are provoked by them. Our relationship to sensory input therefore creates an obstacle to our ability to direct the flow of prāṇa, and quiet the mind. The more distracted we are by the senses, the less able we are to attend to the breath, or any other object of meditation.

## Hatha Yoga and the Chakra System: A Map into the Subtle, Feeling Body

While the sūtras of Patañjali consider the interrelationship of the mind and senses in a more academic and philosophical way, the hatha yoga tradition explores that relationship experientially through the manipulation of the nādis (the energy circuits of the subtle body) and the chakra system.

Hatha yoga emerged from the Tantric tradition and focuses on gathering and directing prāṇa through the use of specific physical practices such as āsana, prāṇāyāma, bandhas (locks/seals), and kriyas (cleansing processes). Tantra grew strong in the 13th century, following classical yoga, the yoga of Patañjali.<sup>12</sup> It offered an approach that utilized the senses and elements as a means to access and direct prāṇa to reunite with puruṣa (the Divine). Most of the āsana- and prāṇāyāma-based schools of yoga in the West are derived at least in part from the tantra/hatha yoga teachings.

In the word “hatha,” *ha* refers to the sun or masculine energy, and *tha* to the moon or feminine energy. Hatha yoga espouses that there are 72,000 energy channels or circuits called nādis animating us. The word “nādi” literally means “a river, channel, passageway, or pulse.”<sup>13</sup> On the gross level, the nādis (like meridians in acupuncture and marma in Ayurveda) make up the channels of the nervous, circulatory, digestive, lymphatic, and respiratory systems.<sup>14</sup> In some texts, the more subtle nādis are correlated with the acupuncture meridians.<sup>15</sup> According to the Tantric tradition, physical and mental health, as well as spiritual evolution, depend on our capacity to direct prāṇa to flow freely through these gross and subtle nādis. The intention is to merge the “ha–tha” polar or dual energies so they come into balance, directing prāṇa to move us towards a state of unified consciousness, beyond duality.

The thousands of minor nādis culminate in three primary channels: *īḍā* (pronounced ee-dah, the left-flowing channel), *piṅgalā* (pin-ga-lah; the right-flowing channel) and *suṣumnā* (suh-shum-naw, in the center). These three intersect at seven vortexes within the body, known as the chakras (energy centers). The joining of these three primary nādis, at the chakra centers, resembles the DNA double helix, or the caduceus, which is often held up as a symbol of healing. They weave from the coccyx to the nasal cavity through the spinal column.

## The Nādis and the Autonomic Nervous System

The right/left division of the *īḍā* and *piṅgalā* nādis have been correlated by yogis with the autonomic nervous system’s (ANS) sympathetic and parasympathetic branches. The science of prāṇāyāma involves many techniques that manipulate one side or both, to directly shift the dominance from one nostril to the other, theoretically weighting that side of the ANS. Ultimately, in the hatha yoga tradition, the intention with these nostril-specific practices is to establish balance between the two sides of the nervous system, so neither is dominant. When this happens, it is said that prāṇa moves uninhibited through the central channel, *suṣumnā*.<sup>16</sup>

As detailed in [Chapter 5](#), throughout the day and night there is a natural oscillation of nostril dominance that occurs, with only short periods of time when we breathe evenly

through both nostrils.

Iḍā, which is activated by directing the breath through the left nostril, is said to establish a calm, introspective awareness, and have a cooling effect. Piṅgalā, the more stimulating side, is heating and mobilizing, and is activated through right-nostril breathing. Alternating the breath through both nostrils is said to cultivate balance and equanimity. The yogis used nostril techniques to intentionally shift dominance in order to achieve a desired effect (e.g., left-nostril breathing to calm the mind and prepare for meditation).

Actual studies on unilateral breathing have not been shown to be conclusive about this conjecture. Raghurag and Telles, in 2008, observed that right-nostril breathing raised systolic, diastolic, and mean blood pressure, and increased vasoconstriction in normal volunteers who practiced for 40 minutes.<sup>17</sup> This would support the theory that the piṅgalā (the right nostril) activates the sympathetic side of the nervous system. However, a 1997 study by Naveen *et al.* found that right-, left-, and alternate nostril breathing equally showed improved scores for a spatial relations test (right- hemisphere-specific task). There was no statistical difference between the techniques and the results.<sup>18</sup> Clearly, more research needs to be done in this area to substantiate the claim of correlation between unilateral breath and ANS function.

The merging of prāṇa from iḍā and piṅgalā into suṣumnā has been described as *prāṇa vidya* (knowledge of prāṇa), *prāṇa shakti* (mastery of the flow of prāṇa), or *kundalini rising* (the rise of prāṇa through the central channel). These terms reflect the sattvic—balanced—state of calm, and receptive and focused presence associated with samādhi. Samādhi could be considered the capacity to govern from the buddhi (wisdom heart) with discernment and equanimity. Often this process of convergence is symbolically depicted as the shakti (energy) that releases a coiled snake of prāṇa (kundalini) at the base of the spine and allows the energy to flow upwards, through suṣumnā, first towards the heart—and then towards the crown center—leading to enlightenment. (Different texts talk about it in different ways.)

### THE THREE PRIMARY NĀDIS

**Iḍā:** Begins at the left nostril and runs through each of the seven primary chakra centers. It is linked to the myelinated PNS. Qualities: Cooling, quieting, feminine, receptive energies. It is called the *chandra* (pronounced chahn-drah, or moon channel).

**Piṅgalā:** Begins at the right nostril and runs through each of the seven primary chakra centers. It is linked to the SNS. Qualities: Heating, stimulating, masculine, assertive energies. It is called the *sūrya* (pronounced soor-yah) or sun channel.

**Suṣumnā:** The central channel that begins at the base of the spine and runs through each of the seven primary chakras. It is centrally located in the spinal column. When the energy of iḍā and piṅgalā are in balance, it is said that we are functioning from suṣumnā. Described as *prāṇa shakti*, or *prāṇa vidya*, when the flow of energy is moving through suṣumnā, it is thought that the PNS and SNS are balanced. This produces a sense of alert calm, focused presence, and relaxed clarity.

## The Chakra Model

The broad scope and esoteric nature of the teachings regarding the chakras have made it one of the more challenging topics to grasp fully. Every teacher, every text, has offered a somewhat different orientation, description, or explanation of what chakras are and how they function. The overlay of Western psychological interpretations on the Vedic system, charted with rainbow colors and analysis of emotions, has added to the confusion, making it difficult to ascertain the original intent of this model, and how to utilize it authentically. Even various Tantric texts differ in their explanation and description.

The chakra system is based on a rather complex paradigm intended to integrate and calibrate the ANS, manas and buddhi, mind and heart. Prāṇāyāma, in particular nostril techniques, stands as a central mechanism to activate this process. Additionally, visualization, sound, aromatherapy, and other strategies have been implemented to refine the relationship between the mind and the senses, directing our attention inward—a practice of pratyāhāra (sensory withdrawal). In the Tantric system, the elements and senses are used as balancing agents to manage derangement of the doshas. It is thought that the systematic application of these techniques in combination with one another effectively rewires citta (mind) and directs prāṇa to flow through the circuits that feed hṛdaya (heart).<sup>19</sup>

### ***An Interesting Perspective***

Dr. Joseph Loizzo, psychotherapist, researcher, and founder of the Nalanda Institute for Contemplative Science, posits that the chakra system of the subtle body provides a compelling model of neural integration, and one of the most complete of its kind. With its top-to-bottom (brain-to-body), and bottom-to-top (body-to-brain) multi-dimensional components, he states that the chakra system serves as an “embodied interoceptive neurofeedback aid” that is as applicable today as when it was originally conceived.<sup>20</sup>

Loizzo proposes that the interplay of idā, piṅgalā, and suṣumnā are actually more representative of Porges’ polyvagal model than the traditional binary, SNS/PNS perspective. He suggests that while piṅgalā still represents the sympathetic pathway, idā is more akin to the dorsal or more primitive aspect of the parasympathetic’s lower vagal system. Suṣumnā corresponds to what Loizzo calls the “smart” vagus, referring to the myelinated, upper vagal system that is capable of higher thinking, discernment, and empathy. According to Loizzo, the “heart hub” is the point of culmination, the dividing point between the upper and lower vagal processes and the center of the chakra matrix.<sup>21</sup> This matches the description from the Vedic texts of the hṛdaya or buddhi, located at the heart/diaphragm, with the various nādis like petals of a lotus flower fanning out from its center.

This perspective organizes the interactive chakra model as a means to cultivate psychophysiological balance, utilizing not just the neurological system, but the sensory and endocrine system as well. By braiding together these mechanisms that drive the vṛttis (thoughts/feeling/sensations), the chakras do indeed offer a sophisticated, interoceptive mind-map that can provide us with useful tools to direct the flow of prāṇa. In order to understand how we can use the senses and the elements as change agents to modulate our reactivity and bring us into a sattvic (harmonious) state, we need to put them in context. Doing so will also support our ability to work more effectively with the nostril prāṇāyāmas, in combination with these other components, to fine-tune our breathing practices (see [Figure 9.1](#)).

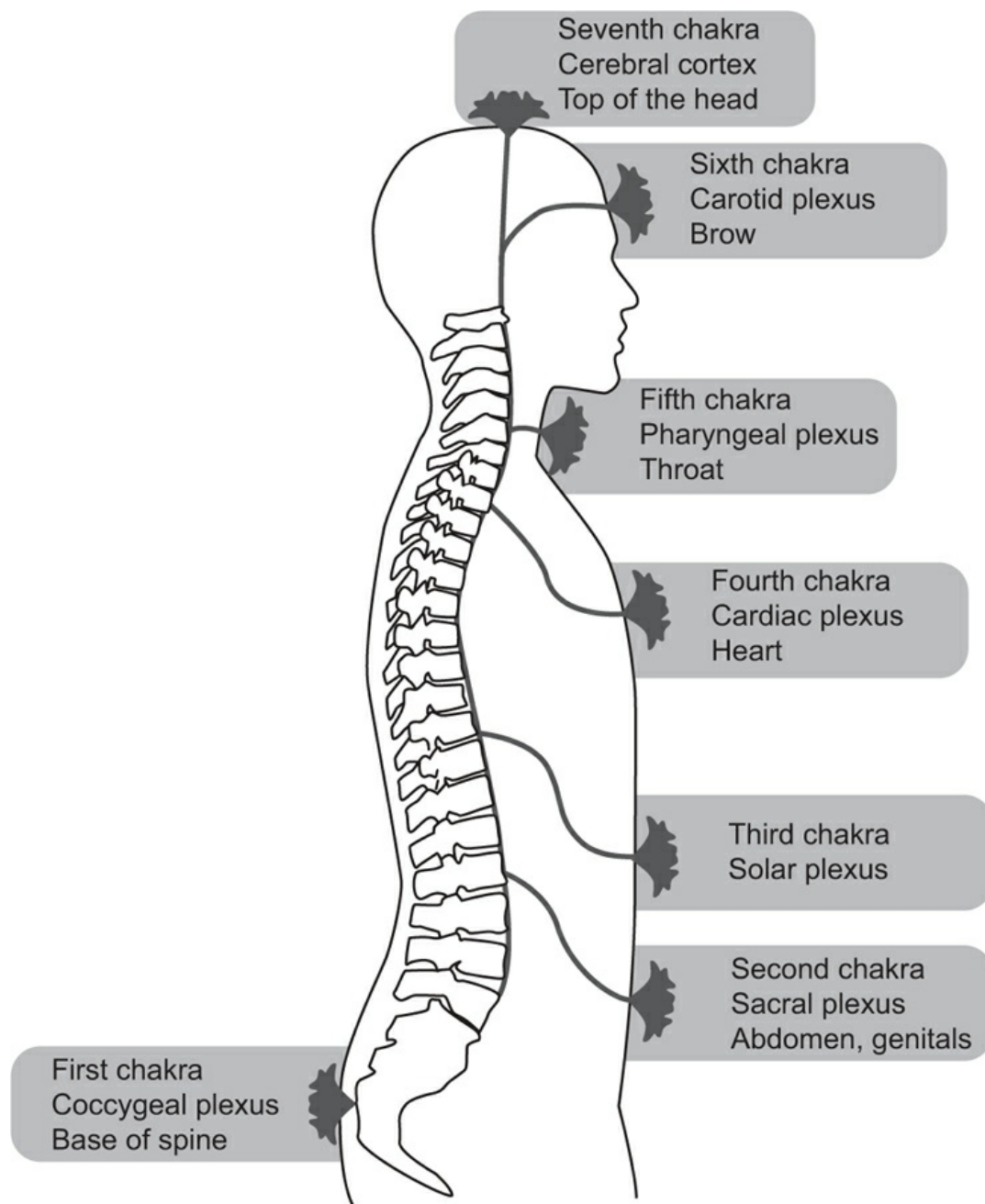


Figure 9.1 Chakras and Nerve Plexuses

## Chakras and Nerve Plexuses

We've already briefly discussed the relationship between the primary nādis and the ANS's main circuits. Additionally, the chakras are situated at the five major nerve plexuses in the body: coccygeal, sacral, lumbar, brachial, cervical. These nerve plexuses govern both sensory and motor functions including muscle control, coordination, and reaction to sensations such as heat, cold, pain, and pressure.

The second (sacral plexus) and third (lumbar/solar plexus) chakras lie in the enteric nervous system, which is informally known as the “belly brain.” This “second brain” can function somewhat independently of the sympathetic and parasympathetic nervous systems. The enteric system has more nerves in it than the spinal cord, and is responsible for 90 percent of the serotonin production in our body and 50 percent of the dopamine.<sup>22</sup> Serotonin

is a neurotransmitter involved in sleep, depression, memory, and other neurological functions. In the gut, it is primarily involved in maintaining peristalsis, which is separate from its central nervous system functions. Dopamine, another neurotransmitter, helps to regulate movement and emotion, and is the primary chemical released as part of the brain's reward system. It is interesting to note that second and third chakra symbolism such as desires and aversions, our ability to form and sustain relationship with others, as well as self-confidence and personal will, are located within the realm of the enteric brain.

### ***Chakras and Hormones***

The seven major chakras have been coupled with the vital organs or sites of hormone production. The endocrine or hormonal system is part of the body's main control mechanism. It comprises a number of ductless glands that produce hormones, which act as chemical messengers that are secreted into the bloodstream to stimulate or inhibit physical processes. By adjusting hormone levels, the endocrine system works to maintain the body in a state of allostasis. We all know what happens when our hormonal system, or that of a loved one, is out of whack. The chaos of puberty is a direct reflection of the havoc created by an endocrine system in an unstable transitional state, and the challenging impact on the brain's executive function. As the hormonal system is a major manipulator of prāṇa, the relationship between the endocrine system and the chakra system cannot be overlooked.

### ***Chakras and the Senses***

Each of the first five chakras (starting from the bottom) is associated with one of the five senses. The sixth chakra corresponds with the mind, and the seventh to the astral realm beyond prakṛti. As previously discussed, the senses are considered our interface with the world. By bringing awareness to how the senses, hormones, and the nervous system interact within us, we can begin to develop svādhyāya about the nature of our mind. Developing practices that promote this attunement aids us in learning to harness and direct attention at will. In the Tantric system, the process of pratyāhāra utilizes controlled sensory input to orient attention in a more introspective way, and keep it localized in time and space. For example, the use of yantra (a symbolic geometric form used as a visual reflection), or incense (to sublimate attention through the sense of smell). Crystal bowls or gong baths for sound healing are very popular nowadays, and their use can be traced back to the Tantric system. Sound and vibrational therapy were traditionally used as a means to balance the nādis. Mantras and mūdras, likewise, are transformative tools that are intended to contain and direct the flow of prāṇa by directing the mind through specific sensory input. When chosen consciously, these techniques create a loop of intention, which is then reinforced through repetition and ritual.

Modern-day interpretations of the chakra system have imbued the rainbow color spectrum on the chakra centers. Starting with red or black at the first chakra, this model works its way up to violet or white at the crown center. More traditional texts do not follow this specific color wheel. As color can be quite evocative, I encourage students to explore the resonance of color free of expectation. In this way, they tend to have a more authentic experience of the relationship between color, the visual sense, and their own chakra centers.

<p><b>THE OLFATORY BULB, THE SENSE OF SMELL, AND THE FEAR CENTER</b></p>
--

We receive sensory information via our eyes, ears, nose, tongue, skin, and the mind itself. Interestingly, the thalamus relays the sensory information from all the sense organs, with the exception of the olfactory sense, or the sense of smell. The olfactory bulb is a separate structure located directly above the hard palate. Olfaction, or smelling, begins in the nasal cavity as we breathe in, or in the mouth while eating. A number of scientific studies have focused on the relationship between odor and emotion. Physiologically, smell is processed according to emotional content, even without any specific emotional context. This accounts for our immediate, visceral response of disgust to the science project in the refrigerator, without being personally upset prior to opening the door.<sup>23</sup>

Not surprisingly, odors are assessed according to intensity, which then in turn activate the amygdala, the insula, and the hippocampus (the memory center). More than any other sense, olfaction or smells are divided into positive (approach) or negative (avoid) responses. Before refrigeration, the smell of rot or fermentation could save our life. Pheromones are a potent way in which we choose a mate, or unconsciously read people in a crowd. Odors have been shown to induce emotional states, offering validation for the use of aromatherapy to settle the mind, and calm emotional agitation. Psychiatric disorders such as depression and schizophrenia have often been linked with olfactory disruption.<sup>24</sup> The bond between the sense of smell and the survival imperative is clearly embedded in our infrastructure. It is interesting that the science of *prāṇāyāma*, particularly the utilization of nostril techniques, centers around slowing and even minimizing the intake of breath—and with it, the taking in of smells. This could perhaps be another factor that helps temper the low-road reactivity, reducing olfactory input which could easily trigger desire or fear.

## ***Chakras and the Elements***

Each of the five elements—earth, water, fire, air, and ether/space—correspond with the first five chakras. They allude to the elemental construct of our *prāṇic* system. The elements, like the senses, are used as balancing forces within a practice. This can be done in multiple ways. For instance, *mūdras* (hand gestures that evoke intention) or *mantras* may reinforce a specific element (e.g., *prithivī* [pronounced prih-tih-vee, earth] *mūdra* or “om *prithivī namaha*” as a mantra, used to ground or stabilize). These types of practices can strengthen our connection to the elements and harmonize our *prāṇic* system. It is traditional to place objects like crystals or stones, a bowl of water, or a candle on an altar before practice, as a representation of the elemental energies we wish to invoke. For some students this can be another powerful way to bring the elements into view (connecting to the visual sense), and support the intention to ground, contain, or ignite *prāṇa* within.

## ***Chakras and Emotions***

The chakras in the traditional teachings were considered areas of emotional fixation, stations where *prāṇa* collected and could be effectively manipulated through the various techniques described above. The centers were marked by the tendency to be either *rajasic* or *tamasic* (excessive or deficient) in nature.<sup>25</sup> When we attune to the subtle messages coming from the body, each chakra holds the key to free us from the powerful pull of desire (approach) or fear (avoid). This could also be framed as freeing us from the grip of the *kleśas* (afflictions): *raga*/attachment, *dveṣa*/avoidance. As we finesse our practices in the direction of *sattva* (harmony), it emancipates us from the sway of the *guṇas*, the *kleśas*, the senses, and our habitual patterns of thought. This clears the chakra centers of their emotional residue, so that *prāṇa* can freely flow through the *suṣumnā* (the central channel). Loizzo, mentioned above, claims that these kinds of practices help us to function from our “smart” *vagus*, so we can choose from a place of conscious discernment.

It is not necessary to study the Vedas or enroll in a college course in psychology in order to understand the emotional nucleus lodged in each of the chakra centers. Our everyday vernacular utilizes “chakra talk” to describe embodied emotion and the impact of strong



feelings on our whole system. Consider these common clichés, and where you feel them in your body:

- having the rug pulled out from underneath me
- feeling butterflies in my belly
- being punched in the gut
- feeling broken or open-hearted
- being all choked up
- only seeing black or white.

All of these have a universal resonance and a specific felt sense in particular locations in the body: the chakra centers! If we break down each of these embodied feelings (which correlate to the first six centers) we can understand the emotional challenge that we are being called to address in a mature and evolving way.

### ***Emotional Fixations for the Chakras***

- *First chakra:* Stability and trust versus fear and panic.
- *Second chakra:* Emotional connection with healthy boundaries versus isolation or excessive neediness.
- *Third chakra:* Self-confidence/empowerment versus self-doubt or need to control others.
- *Fourth chakra:* Compassion and acceptance versus anger and intolerance.
- *Fifth chakra:* Healthy, truthful self-expression versus repression or verbosity.
- *Sixth chakra:* Seeing between the lines, intuition informs intelligence versus dogmatic thinking or denial of facts or feelings.
- *Seventh chakra:* Īśvarapraṇidhāna recognition of that which is greater than ourselves versus a lack of belief in anything beyond what can be seen/proven.

The field of psycho-neuro-immunology has effectively demonstrated that negative attitudes and emotions create unremitting suppression of the immune system and health, cell death, and memory impairment.<sup>26</sup>

As we work to bring our prāṇic house in order, we need to clear the emotional “ama” (dross) so there is more space in the system for prāṇa to enter and circulate. The more toxicity we house in our mind and body, the more our **Energy Bank Account** gets thrown off-balance. Emotional dysregulation leaks more prāṇa than perhaps anything else. In order to staunch the leaks, and retain our prāṇa, we need to learn more about ourselves and create practices that support us in cultivating sattva (harmony). Quieting our nervous system overall, through the practices of prāṇāyāma in combination with the other tools of yoga, offers a means to create greater equilibrium between idā (moon channel) and piṅgalā (sun channel) and to function more from the state of balance represented by suṣumnā (central channel).

### ***The Chakra Centers***

Traditional colors are utilized here only for representational purposes.

*Mūladhāra* (pronounced moo-lah-dah-rah)

- 1st chakra: root center
- Governs: security, basic survival, and trust
- Endocrine system: sex hormones and adrenals
- Nerve plexus: coccygeal
- Vāyu: apāna (eliminary)
- Sense: smell
- Element: earth
- Bija mantra: lam
- Designated color: red/black

*Svādhiṣṭhāna* (pronounced s-vah-dih-staw-nah)

- 2nd chakra: procreative center
- Governs: sexuality, creativity, boundaries, duality as in pleasure and pain
- Endocrine system: reproductive hormones, adrenals, serotonin
- Nerve plexus: sacral
- Vāyu: vyāna (assimilation)
- Sense: taste
- Element: water
- Bija mantra: vam
- Designated color: orange

*Maṇipūra* (pronounced mah-nee-poor-ah)

- 3rd chakra: center of self
- Governs: self-empowerment and differentiation
- Endocrine system: insulin, dopamine, serotonin
- Nerve plexus: celiac/enteric
- Vāyu: samāna (digestion)
- Sense: sight
- Element: fire
- Bija mantra: ram
- Designated color: yellow

*Anahata* (pronounced ahn-aw-hah-tah)

- 4th chakra: center of hrdaya



- Governs: higher emotions such as courage, compassion, empathy
- Endocrine system: thymus gland
- Nerve plexus: brachial
- Vāyu: prāṇa (ingestion)
- Sense: touch
- Element: air
- Bija mantra: yam
- Designated color: green/pink

#### *Viśuddhi* (pronounced vi-shood-dhee)

- 5th chakra: throat center
- Governs: self-expression, truth, communication (including listening)
- Endocrine system: thyroid
- Nerve plexus: cervical
- Vāyu: udāna
- Sense: hearing
- Element: space
- Bija mantra: ham
- Designated color: turquoise

#### *Ajña* (pronounced ahj-ñah)

- 6th chakra: center of svādhyāya
- Governs: the balance between intellect and intuition, development of higher levels of consciousness, meditative focus and introspection
- Endocrine system: pituitary gland
- Bija mantra: ām (ahm)
- Designated color: indigo/violet

#### *Sahasrāra* (pronounced sah-haws-ra-rah)

- 7th chakra: spiritual center
- Governs: connection to God or spirit; center of divine communion
- Endocrine system: pineal gland
- Bija mantra: om
- Designated color: gold/white

## KEY CONCEPTS

---

- Citta (mind) houses the manas (sensory relay system), ahaṃkāra (awareness of self), and buddhi (wisdom mind/mind of discernment) and regulates the flow of sensory input.
- Our relationship to the senses and sensory input greatly determines our level of reactivity.
- Pratyāhāra (refinement/withdrawal of the senses) helps us to direct our attention away from sensory gratification and settles the mind—prāṇāyāma helps us develop pratyāhāra.
- The chakra model provides us a way of integrating the nervous, endocrine, and sensory systems with the mind and the elements to achieve psychophysiological balance.
- The combination of prāṇāyāma nostril techniques with the bhāvana (intention) of connecting to the chakras (combining mantra and mūdra) can be a very powerful means to direct prāṇa and transform the mind.

## — PUTTING IT INTO PRACTICE —————

### **Svādhyāya (Self-Awareness) Chakra Practice**

Return to the practices from [Chapters 6](#) and [7](#). This time, practice them while drawing your attention to the specific chakras that are associated with them. Notice how prāṇa is moving through them. For example, with **Core Breathing** notice the first and second chakras in particular; when working with **Diaphragmatic Hugs**, the third. While doing **Scapular Swirls** contemplate the effect on the fourth chakra, and with **Paint the Floor**, the fifth and perhaps sixth (especially Paint the Floor with your forehead). Consider these reflective questions as you move and explore:

- How does your prāṇa feel in these areas? Is it rajasic (activated)? Tamasic (lethargic)? Sattvic (balanced)?
- Does bringing attention to the chakra change your movement or your breath?
- How is it to consider the subtle body and flow of prāṇa rather than thinking of just engaging muscles?
- What is the felt sense after your practice?
- Does practicing this way have a different effect on the mind?
- How does practicing with this awareness affect your svādhyāya of the subtle body off the mat?

**Note:** If this type of practice inspires you, try bringing in a little **Brahmari** (humming), or a mantra or mūdra specifically oriented around the chakras (suggestions listed below) and observe the effect. Make notes in your **Svādhyāya Breath Journal** on your experience.

### **Color Play**

In the last chapter, I suggested you play with the senses and notice your relationship to them. In this practice I invite you to focus specifically on color and observe how you relate to colors in your environment. Notice what combinations are inviting, and which are more neutral or offensive. Do you have any visceral (embodied) responses to color?

I also encourage you to explore bringing color as a visualization aid into your chakra practice. Without a preconceived idea of what specific colors “mean” symbolically, allow

yourself to feel where and how your body responds to various tones. For example: Imagine being painted marine blue or fire-engine red. What is your felt experience? Then attune to the chakra centers specifically and notice if you have a different felt sense/relationship to the centers as you “color” them. For example, Does painting your third chakra marine blue feel different than painting it fire-engine red? What feels more sattvic to you? What is the prāṇic effect?

## Mantra Practice

According to the Upanishads, mantra can be a single word or a string of words. Mantra can be used for many different purposes; for instance to develop concentration, to improve memory, prepare us for meditation, or connect us to the Divine. Here, we are using mantra to activate more awareness of the chakra centers, and the impact of the resonance of sound itself on the breath.

The traditional bija or seed mantras for the chakras are as follows, from the bottom up:

- 1st: lam
- 2nd: vam
- 3rd: ram
- 4th: yam
- 5th: ham
- 6th: am
- 7th: om

These can be recited silently or out loud on exhale (keep the volume of the breath low and controlled via the diaphragm). You can bring these mantras into your āsana and prāṇāyāma practice, focusing on just one at a time or on the full range. How do the vibrations of the sounds resonate inside of you? Are some more powerful than others? How does this chakra focus affect your practice, specifically your mind and your breath? What is the prāṇic effect?

Some mantras are considered more soothing, some more energizing, and some are best for balancing. Notice how you may feel called to utilize not just a different mantra, but a higher or lower pitch, pace, or volume to intentionally manipulate your felt sense of prāṇa within your body.

In your experimentation, consistently note the after-effect on the mind and the breath. Consider the impact on the nervous system with the intention to quiet both prāṇa and citta. To that end, what do you find most useful?

## Mūdras

“Words and thought are closely connected, as are sound and gesture. Gesture expresses visually the activity of the body and the mystery of the word.”<sup>27</sup> For centuries, mudras have been used as a way to harness and direct the natural expression of the mind, heart, and spirit. These symbolic gestures made with the hands or other parts of the body activate intention and can be used to amplify the effect of our practice. Chakra practices

often incorporate the use of mudra as a means to connect to the nadis and direct the flow of prāṇa. There is evidence that utilization of mudras affects the nervous system and alters psychophysiological processes within the body and mind.<sup>28</sup> When working with mūdras, each person must discern through direct experience what is true and useful for him or herself.

There are many wonderful books out now that offer illustrations and many details for working with mūdras. My two personal favorites are Joseph and Lilian Le Page's book *Mudras for Healing and Transformation*, and Indu Arora's *Mudra: The Sacred Secret*.<sup>29</sup> I would suggest starting your exploration of mūdra by equipping yourself with one of these texts. Choose a specific bhāvana. Use the mūdra within your prāṇāyāma practice and observe the effect. I encourage you to stay with one mūdra for a period of time (perhaps a few weeks to a month) so you have time to observe the effect of its use on your nervous system, your level of reactivity, the breath, and the mind. Here are a few suggestions to get you started:

- Choose an elemental mūdra to work with, e.g., prithivī mūdra (earth element).
- Choose a vāyu mūdra to work with, e.g., pran mūdra, or apāna mūdra ([Photo 90](#) prān mūdra; [Photo 91](#) apāna mūdra).
- Choose a particular mūdra that correlates with a chakra center, e.g., svādhīsthāna mūdra.
- Choose a mūdra for balancing the nādis, e.g., iḍā mūdra.

**Note:** Combining mantra and mūdra with breath is a powerful combination. For example:

- *āsana*: seated meditation posture with engagement of the core muscles
- *prāṇāyāma*: **Core Breathing**
- *mantra*: “om prithivī namaha” recited silently on the hold after exhale
- *mūdra*: prithivī mūdra.

This could be particularly useful for someone who is interested in cultivating the qualities of grounding and stabilization, with an awareness of their first and second chakras.



*Photo 90*



Photo 91

## Nostril Techniques

Once functional breathing is established at a low-volume level, adding manipulation of the airflow at the nostrils reduces the breath further and works more subtlety on the nādis. These techniques are very useful, provided that volume and flow rate aren't increased when the seal is applied. *This takes considerable time to master!*

Nostril techniques funnel energy through the two primary nādis:

- **piṅgalā:** sūrya/sun, heating, SNS, stimulating
- **iḍā:** chandra/moon, cooling, PNS, calming.

The intention of these prāṇāyāma practices is to bring the polarity of iḍā and piṅgalā into balance. The process can be addressed in one of two ways: the first is to activate the channel that is deficient (tamasic) by working on that side as you inhale, which will be more stimulating. Or conversely to sedate the channel that's too rajasic by working with it on the exhalation. It is important to observe not just the right-to-left balance but also the

apānavayu (below the diaphragm) to prāṇavayu (above the diaphragm) effect, which also impacts the chakras and the ANS.

For instance:

- **Chandra bhedana** (pronounced chahn-drah bayd-ah-nah) emphasizes idā nādi, stimulating the left side with the inhale.
- **Anuloma ujjayi** (pronounced ahn-u-low-mah oo-jai-yee) emphasizes the calming effect of the exhale, which is done through both nostrils on the exhale. It emphasizes apānavayu, reducing stress and tension.

To discern the discrete differences between these two requires introspective focus and repetition of practice.

Classically, these kinds of prāṇāyāmas were utilized in concert with mantras and mūdras to further regulate prāṇa through the chakra centers. However, I would suggest starting out slow to ensure that the breath doesn't become hard or feel pushed. The process of training yourself to breathe in this highly reduced manner requires svādhyāya and patience. Remember, the use of ujjayi is also intended to be subtle. Limit yourself to a light contraction of the glottis that increases awareness and positive airway resistance, *without creating any outward sound*.

## **Mūdra for Nostril Techniques (Photos 92 and 93)**

There are many variations from different traditions for this. The way I learned from the Krishnamacharya tradition involves a seal on one side and a valve on the other. This means the hand is touching on both nostrils at all times, ensuring a higher level of regulation. I suggest, even if you haven't utilized this method before, to attempt it. Observe for yourself if it enables you to be a more precise conductor of prāṇa.



*Photo 92*





Photo 93

**Note:** Neck and shoulder tension can make nostril techniques stressful on the annamaya kosha (physical body). See [Chapter 2](#) for propping suggestions.

**Nādi shodhāna:** Alternate nostril breathing. The pattern runs: inhale left; exhale right; inhale right; exhale left. Balancing for both iḍā and piṅgalā with equal emphasis on inhale and exhale, this breath can be beneficial for almost all practitioners.

**Viloma ujjayi** (pronounced vi-lo-mah oo-jai-yee): Alternate nostril inhale; ujjayi exhale. *Viloma ujjayi* stimulates the inhalation side of the breath equally on both sides, and as such is an energizing technique. It is beneficial for waking up in the morning, reducing kapha (dull) mind, or for a midday pick-me-up. Antara kumbhāka (pronounced ahn-tara koom-bah-kah, hold after inhale) will amplify the effect. Contraindications: Antara kumbhāka should not be used for anyone who has heart issues or vulnerability to stroke, who is pregnant, or who has high blood pressure.

**Anuloma ujjayi:** Alternate nostril exhale; ujjayi inhale. Anuloma ujjayi stimulates the exhalation side of the breath equally on both sides and is considered a calming, soothing technique. It is beneficial for quieting the mind when anxious or racy, as it reduces vata

(air/ether) and pitta (fire). It is a nice before-bed practice, or done in combination with shīṭali (the tongue breath), for an added cooling effect. A short bāhya kumbhāka (suspension after exhale) for 4–6 seconds can amplify the quieting effect.

**Pratiloma ujjayi** (pronounced prah-tee-lo-mah): Complex breath. Combines anuloma and viloma ujjayi. The pattern is: inhale ujjayi; exhale left; inhale left; exhale ujjayi; inhale ujjayi; exhale right; inhale right; exhale ujjayi. Four breaths complete one cycle. *Pratiloma ujjayi* is excellent for ordering the mind and bringing it into focus. It requires great concentration. It is useful for preparing for a mental project, or exam, or when you have to juggle many mental “balls.” It is not useful for quieting the mind to sleep or rest as it has a highly focusing effect.

**Chandra bhedana**: Moon breath. Inhale through idā (left), exhale through piṅgalā (right), or exhale through idā. The focus is specifically on stimulating idā nādi. It has an overall calming, cooling effect, and is useful for times of over-stimulation, insomnia, hot flashes and emotional overload; think of it as nourishing and soothing, internalizing attention. Keep the breath flow slow and subtle, maintaining the exhale slightly longer than the inhale (e.g., inhale 4 seconds, exhale 6).

**Note:** The subject of prāṇāyāma ratios will be addressed in [Chapter 10](#). The above is not a prescribed ratio, but rather a suggestion to keep the exhalation slightly longer than inhalation to maintain a calming, more PNS effect.

**Sūrya bhedana**: Sun breath. Inhale through piṅgalā (right), exhale through idā (left). The focus is specifically on stimulating piṅgalā nādi. It has an overall heating, stimulating effect. This breath may be useful for some kapha conditions, but for the most part, other practices may be more effective to move prāṇa when it is very sluggish, like going for a brisk walk. *Sūrya bhedana* (pronounced soor-yah bayd-ah-nah) can aggravate pitta, which is related to all inflammatory conditions, so it is not one that I recommend on a general basis.

As you explore the nādis and the chakras in these ways, track your experience in your **Svādhyāya Breath Journal**. Note the effect on your mind, your emotional resilience, and your reactivity to stressors. Observe the prāṇic effects. Experiment with one technique for a long enough period of time that you get a real sense of its effect on your system. Monitor your **Comfortable Pause** and **heart rate** for additional information as to how each technique is impacting you. Once you find one or two techniques that seem to have a sattvic effect on your psycho-emotional body, stay consistent with practice. Observe the therapeutic benefit of these types of practices over the long term.

## CHAPTER SUMMARY

---

- Prāṇa (breath) and citta (mind) follow one another; prāṇāyāma facilitates settling both.
- Manas is the sensory relay center.
- Ahaṃkāra makes sensory input relevant to the self.
- Buddhi discerns what to do with the information—it is the “decider.”
- Buddhi is also considered the seat of the heart: hṛdaya.

- The senses are strengthened by our reaction to input.
- The health of the mind is dependent on the health of the heart, and vice versa.
- The flow of prāṇa in and around the hṛdaya facilitates heart–mind communication.
- The more distracted the mind, the less able we are to attend to the breath and meditate.
- Hatha yoga practices seek to balance the polar energies of the “sun” and “moon.”
- When this balance occurs, it is referred to as prāṇa vidya, prāṇa shakti, or kundalini rising.
- The three major nādis or energy channels through which prāṇa flows are idā (left), piṅgalā (right), and suṣumnā (the central channel).
- These three nādis intersect at the major chakra centers.
- Idā and piṅgalā have been correlated with the PNS and SNS aspects of the nervous system.
- Nostril techniques regulate the flow of breath through one side or the other, or both.
- Prāṇāyāma nostril techniques are one of the primary tools used to balance the chakras.
- The use of sound (mantra), gazing techniques (yantra), mūdra (hand gestures), and aromatherapy are traditional ways of engaging the senses with the intention to direct prāṇa and attention.
- Invoking the qualities of the elements in conjunction with the chakras (e.g., through mantra or mūdra) can support balancing the doshas.
- Combining any of these techniques with prāṇāyāma can amplify the effect of the prāṇāyāma by reinforcing the intention to transform the mind and attachment to the senses.

## Chapter 10

# PRĀṆĀYĀMA AS KUMBHĀKA

*Mind ruffles prāṇa and prāṇa ruffles mind. The greatest effect is reached when we enter stillness from both sides simultaneously. However, prāṇāyāma must be learned first, as it is much easier to still the breath than still the mind.*<sup>1</sup>

Maehle, Cox & Watson

Throughout my initial training in the Buteyko method, I was both practicing diligently and questioning constantly. It was confusing to experience many of the touted benefits of prāṇāyāma from a practice that was distinctly not “yoga.” In fact, this more contemporary breath retraining made my previous experiences with prāṇāyāma pale in comparison. In addition to learning to curtail my inhale and exhale to the point of “tolerable air hunger,” I also had to acclimate to progressively longer breath suspensions after the exhale. These were challenging both mentally and physically. Never in my prāṇāyāma classes did a teacher suggest I breathe in a way that created discomfort. It didn’t feel dangerous. It actually felt like being inducted into a club to which I was formerly denied access.

In my Viniyoga training I had worked with bāhya kumbhāka, holding after the exhale, or “breath suspension” as some refer to it. I was comfortable holding for four, six, or even eight seconds both in āsana and in seated prāṇāyāma. There were times my prāṇāyāma practice required holding 10 or 12 seconds, and I considered these intense, yet doable.

When Pippa introduced the **Controlled** or **Comfortable Pause** (CP) to assess my level of health, I felt proud that even though I’d been terribly ill, I could still hold very comfortably for 11 seconds. Imagine my shock as I soon learned from her lecture that maxing out at 11 seconds is a sign of very real malaise within the body. She informed me that my “breath goal” was to be able to sustain a comfortable bāhya kumbhāka for 40 seconds! That sounded preposterous to me.

However, never being one to shirk from a challenge (good pitta that I am!), I worked it. Over weeks, then months, I was able to nudge my kumbhāka gradually from 11 to 15 to 20... then 30, 35, and on a good day, even 40. As promised by Pippa and my other Buteyko teachers, my health increased in accordance with my bāhya kumbhāka, or in their language, my **CP**.

While the practice clearly produced measurable results, cognitive dissonance raged inside me. It didn’t seem possible that the yoga masters had so misunderstood prāṇāyāma, prioritizing the “full, complete yoga breath” rather than breath suspension. Driven mostly by a sense of bewilderment, I pulled out all my Vedic texts and began to research what the

original teachers actually wrote about prāṇāyāma. There it was, in treatise after treatise: *prāṇāyāma was kumbhāka*. The Hatha Yoga Pradipika, for example, mentions eight types of prāṇāyāma; each is named as a type of kumbhāka. Techniques that do not contain breath retention are not even considered prāṇāyāma. The masters were very clear: *The miraculous benefits of prāṇāyāma lay in mastering our volitional power to NOT breathe*, nothing more or less than that.

*The cessation of movement of inspiration and expiration of breath is called regulation of breath (prāṇāyāma).<sup>2</sup>*

It is difficult to convey the deep internal calm that results from extended breath holding to someone who has not had first-hand experience with the process. Logic would dictate that an extended state of “not-breathing” would induce panic and feel suffocating and terrible. The truth is, without significant preparation—it does! Only through the long-term process of changing the ventilatory response (the urge to breathe) and raising CO<sub>2</sub> levels do extended breath holds of 30–40 seconds become possible. Intensive practice is required for extended breath holds to become comfortable and sustainable. As long as minute volume (rate × volume) stays rapid and heavy, our capacity to abstain from breathing is limited.

Once I experienced the potency of extended breath suspension, the whole practice of prāṇāyāma as kumbhāka crystalized. The devolution into subtlety made sense. It became clear that the various techniques, such as manipulating inhale and exhale, bandhas, visualizations, mantras, and mūdras, were all designed to promote greater capacity to suspend the breath.

In this chapter, I’ll address the use of breath holding from the Vedic tradition, and also share new research on the use of intermittent hypoxia (lower than normal levels of oxygen in the arterial blood) as treatment for chronic inflammatory conditions, to support mental and cognitive health, and to increase sports performance.

## **Kumbhāka—Contextual Confusion**

Attempting to draw a linear equation between teachings that were codified thousands of years ago in a different culture and our Westernized, modern world can often result in creating more confusion than clarity. While India rightly claims to be the birthplace of yoga, the territory it covers is immense. A myriad of lineages have led to various interpretations of the Vedas and Upanishads. These have further splintered into factions of disciples following a particular guru’s extrapolation. Prāṇāyāma, like many other yoga practices, has been impacted by this diversity in orientation. Within the various texts, for every name of a prāṇāyāma there could be 3–5 different descriptions: one emphasizing inhalation, one the retention of breath, another the placement of the mind (e.g., attention on a chakra or on the tip of the nose), another focusing on connection to the Divine.

According to Dr. M.L. Gharote Parimal Devnath’s *Science of Prāṇāyāma*, based on the Kumbhāka Paddhati of Raghuvira, there are 70 types of kumbhāka. He explains that, in part, the confusion results from an evolutionary process that separates prāṇāyāma into stages or eras, in time, as it were. For instance, Patañjali’s Yoga Sūtra takes place in what he references as the “Fourth Stage,” while the Hatha Yoga period represents the “Fifth Stage.”<sup>3</sup> Yet, some of the teachings I’ve received appear (by description at least) to be partially informed by the earlier Second and Third Stages, even though my teachers identify with lineages derived from Patañjali or the hatha yoga tradition.

The exploration of all of these variations on the theme of breathing is beyond the scope of my experience, or the intention of this text. However, it is useful to keep in mind, especially as explanations of practices offered here may diverge, in name or description, from what you personally have received from your teachers. My intent is to keep the information accessible, centering on practices that are beneficial and safe for most individuals. Cautionary notes will be made as needed. [Chapter 11](#) will address therapeutic applications utilizing case studies.

## The Phases of the Breath

As mentioned earlier, there are four manipulable phases of the breath: (1) inhale; (2) retention after inhale; (3) exhale; (4) suspension after exhale. In Sanskrit, there are interchangeable names used for each phase, depending on which text you are reading or which lineage you are studying. This, of course, adds to the confusion many people experience when studying prāṇāyāma. The Sanskrit terms most frequently used are:

- *Inhale*: pūraka, abhyantara, or antara.
- *Exhale*: recaka, bāhya (also written bahia).
- *Hold*: kumbhāka, stambha.
- *Retention after inhale*: could be either pūraka kumbhāka or antara kumbhāka.
- *Suspension after exhale*: could be either recaka kumbhāka or bāhya kumbhāka.

Kumbhāka can also be used by itself, without an indication of whether it is referencing retention or suspension. It is valuable to remember that yoga was originally an oral tradition, taught by one teacher to a specific student. The guru would choose the appropriate practice according to the need, capacity, and dedication of the student. The ambiguity of the texts may have been a nod towards the guru, to use his power of discernment to determine the appropriate “formula” for practice as needed. I utilize the terms “antara kumbhāka” (retention after inhale) and “bāhya kumbhāka” (suspension after exhale) in this text to reference the breath holds, respectively.

Prāṇāyāma is executed through the manipulation of one, two, three, or all four phases of the breath. By extending or shortening any of these, the blood gases shift, which impacts cellular respiration and metabolism. To briefly review (see [Chapters 3](#) and [4](#) for more detailed discussion), the ventilatory response is controlled by the medulla and driven by our habitual pattern of breathing. This determines the level of CO<sub>2</sub> in the blood. In order to suspend the breath comfortably for a lengthy period of time, the urge to breathe must be curtailed. This can only occur with higher levels of PaCO<sub>2</sub> (high as in normal: 40–45 mmHg or above). It also requires lowering the breath rate, which involves a recalibration of the chemoreceptors that fire the phrenic nerves. In order to achieve this, one must consistently breathe “low and slow” on a daily (and nightly) basis. As I said at the beginning of this text, getting ourselves and our students to become functional breathers is a great service and will go far to promote individual health and a healthier planet overall. (The assumption I’m making here is this: The more consciously we breathe, the better we feel, the better choices we make, the healthier we eat, live, relate to others...)

For those who would like to investigate prāṇāyāma beyond this level (which requires elevating CO<sub>2</sub> tolerance above 40 mmHg), I suggest you utilize the resources listed in the endnotes to this chapter to find an experienced teacher who can guide you in the process safely. That said, the chemical, muscular, and psycho-emotional mechanisms that impact the

breath are the same, regardless of whether you are intending to extend kumbhāka to 20 seconds, 80 seconds, or 120. If you’ve been working with the exercises in this text so far, you are well on your way to entraining your body for longer breath holds.

## Matras: Measuring the Breath

Traditionally, the length of the breath was measured in *matras* (pronounced mah-tras). Matra means “measurement.” Here again, there are many descriptions of what constitutes a matra: twinkling of the eyes; pronouncing a short vowel; going around the knee joint with hand neither too slow nor too fast; snapping together three fingers; or ringing of the bell when feeding the calf at the time of milking a cow.<sup>4</sup> Today, we can standardize a “matra” as approximately one second in time. As long as the unit of measurement remains constant, you will be able to track your progress.

Another form of matra measured the distance from the body that each exhalation reached. This was measured in finger widths. According to the Gheranda Samhita, “In the natural state, when air goes out of the body it travels twelve fingers.”<sup>5</sup> The next stanza continues with these descriptions: “When one sings, it travels sixteen fingers and when one eats, twenty. When one walks, it travels twenty-four fingers; in sleep, thirty fingers. During sex it is said to travel thirty-six fingers and during exercise it goes further still.”<sup>6</sup> This reminds me of a humorous story I heard from a fellow yoga therapist from Indonesia who attended a presentation I gave on prāṇāyāma. He shared that in his country, the breath is consistently taught to be silent and subtle. According to him, the only time people routinely breathe audibly is during sex. He explained that this creates a problem when Western-taught yogis come for individual sessions at their clinic. He has to coach them quickly to make their breath quiet, lest the people on the other side of the wall misinterpret the kind of “therapy” the practitioner is providing.

The Gheranda Samhita confirms what has been written in other texts: when the natural range of the breath (daily breathing) decreases (i.e., is less than 12 fingers), “then life is lengthened...and death cannot occur.”<sup>7</sup> The Hatha Yoga Pradipika states:

In prāṇāyāma, it is the duration of breath retention which has to be increased. The longer the breath is held, the greater the gap between nervous impulses and their responses in the brain. When retention is held for a prolonged period, mental agitation is curtailed.<sup>8</sup>

This demonstrates an understanding on the part of the yogis that through kumbhāka the “natural breath” is altered (e.g., ventilatory response and volume), and it is this that increases vīrya (vitality), concentration, and peace of mind.<sup>9</sup>

## Matras and Ratio

The use of counting, or a mantra (chant), to “measure” the length of the inhale, exhale, or kumbhāka is traditional, and can be useful as a guide for progress. In the previous two chapters, we explored mantra specifically as an aid for the mind, to ease tension or to increase concentration and focus. Mantra as matra is used more as an internal metronome, marking the proportionate relationship between the phases of the breath. For example: a 1:1:1:1 ratio, where all four phases are equal, (which is known as *sama vṛtti* [pronounced sahm-ah v-rit-tee] or square breath), could be counted as 1 = 4 seconds, or 1 = 6 seconds. It could similarly be measured as 1 = om or 1 = om shanti. With each side of the breath, one would silently



recite the mantra in approximately the same intonation and measure. The “threshold” or total count for one breath cycle totals the sum of the four phases put together. Where 1 = 4, this would indicate a threshold of approximately 16 seconds. This translates to about four breaths a minute.

In the case of an unequal ratio or *viṣama vṛtti* (pronounced vi-shah-mah v-rit-tee), such as the ratio 1:2:2:4, then if 1 = 4, a person would inhale for 4 seconds, retain for 8, exhale for 8, and suspend for 16. The mantra would need to reflect these differences in meter, as delineated below:

- inhale = om
- retention = om shanti (shahn-tee)
- exhale = om shanti, shanti
- suspension = om shanti, shanti, *shantiḥ* (pronounced shahn-tee, peace).

The threshold for this ratio would be 36 seconds, or slightly less than two breaths a minute.

The choice to use numbers or mantra (and which kind of mantra) matters in the sense that it needs to support the mind and preferences of the individual. You may recall the mantra utilized by my Buteyko colleague who works in hospital with her COPD patients: inhale = peace; retention = amen; exhale = chaos; suspension = hallelujah. This is a *viṣama vṛtti* mantra, emphasizing suspension. Keeping the mind calm during breath retraining helps support successful change, particularly with individuals who are more prone to anxiety. The use of mantra may make the difference in assisting them to sustain the practice long enough, to positively alter their chemistry, and calm the ventilatory response.

However, there are a few challenges that arise when using ratio or even mantra to measure the length of the breath. While slowing breath rate is valuable, it doesn’t address volume. The narrow focus on lengthening inhale or exhale to reach a particular number can inadvertently increase the quantity of air taken in or expressed. Slowing the rate without mastering volume can impede change. In Buteyko, counting the breath is strongly discouraged for just this reason. Instead, the practitioner is guided to concentrate solely on volume reduction while maintaining a calm and steady breath rhythm. This develops a unique kind of interoceptive awareness, refining one’s ability to adjust minute volume, not just rate, breath by breath.

The other problem that arises with the use of measurement is that it can send us right into the quagmire of ambition, especially if we are habituated to strive, perfect, and achieve. This can actually take us out of the internal attunement to *prāṇa* that is intended with the practice. Instead, we try to “beat the clock,” or out-best yesterday’s numbers. In the process, we lose connection with the interoceptive signals and subtlety that mark *prāṇāyāma*. This can result in jacking up our nervous system, which in turn can increase heart and breath rate post-practice, defeating the intended purpose. Gregor Maehle, author of *Prāṇāyāma, The Breath of Yoga*, says it beautifully: “When the subject is our soul, strain, discomfort and ambition will get us nowhere.”<sup>10</sup>

I can speak directly to this “striving” from my own experience. All I needed to hear was the number 40 as the “goal” for suspension, and I was like a greyhound after the rabbit. I was determined to get there quicker than anyone before me. In the process of pushing, I experienced many of the “detox” reactions or negative side-effects, both those noted by my Buteyko teachers, and those laid out in the yoga texts: headaches, nausea, energy drop, and exacerbation of symptoms. The Hatha Yoga Pradipika cautions, “Just as lions, elephants and



tigers are gradually controlled, so the prāṇa is controlled through practice. Otherwise the practitioner is destroyed.”<sup>11</sup> Even after I grew wiser and slowed myself down, my attachment to achievement loomed as a pervasive obstacle that needed constant modulation. That, in and of itself, provided me with a wonderful svādhyāya, a reflective window into the patterns of my mind and ways I unnecessarily leak my prāṇa. This practice has uniquely managed to tame my impatience, as there was simply no way for me to force change before my body was ready.

Throughout my years of teaching prāṇāyāma ratios, I have noticed that certain students were also inclined to push the breath, even when their body clearly was signaling to back off. At times, I have found that the use of the **CP** as a form of measurement with Buteyko, has highlighted this grasping tendency as well. I now use great caution as to when and with whom I discuss “goal” numbers, so as to not trigger a sympathetically driven chain reaction. I rarely use ratio in the traditional sense, as in specifically counting seconds for each phase of the breath to achieve a particular threshold. In a group class situation, I may work with a minimal threshold, such as the example I gave above, of square breathing with 1 = 3–4 seconds. Even for this, I prefer the use of mantra, knowing its power to link us to a higher intention, and evade the trap of the ego. Suspension is the only part of the breath I encourage my students to routinely track. This is usually in the context of monitoring their CP for therapeutic reasons or for athletic advancement.

As a guideline for teachers and practitioners interested in attaining the benefits of prāṇāyāma by increasing kumbhāka, reducing, not extending, the breath is the means. For instance, I suggest practicing **Subtle** or **Core Breathing** with an inhale of no more than 3–4 seconds and exhale of 5–6 seconds at an almost imperceptibly light volume (i.e., fewer finger-widths from the body). Sustain a slight air hunger. This will accelerate progress far more efficiently than lengthening inhalation and exhalation to 12–20 seconds a piece. Maehle states, “If advanced āsana practitioners were to reduce their breath count by half, and practice daily, they would suddenly find themselves able to perform kumbhākas.”<sup>12</sup>

## The Diving Reflex: Insight into the Magic of Kumbhākas

Mammals that routinely dive underwater for long periods of time, like seals, dolphins, and whales, have a highly developed diving reflex. The diving reflex initiates a vagal response which immediately lowers heart rate and respiration rate, and instigates peripheral vasoconstriction, shunting blood flow to the limbs.<sup>13</sup> This is what enables these mammals to sustain long bouts immersed, without the need to come up for air. Humans have a less developed diving reflex (mostly through lack of use), though it can be stimulated when the face is splashed or immersed in cold water.<sup>14</sup> The colder the water the quicker the response. If you’ve ever experienced the feeling of a splash of cold water “taking your breath away,” that’s a hint of the reflex in action.

The contact of cold on the face triggers the trigeminal nerve, the fifth cranial nerve. This nerve is responsible for sensations in the mouth, teeth, face, and nasal cavity. When triggered by cold water, it transmits a message to the vagus nerve, which immediately slows the heart rate in response. If the face is actually immersed in water, the demand for oxygen in the arms, legs, and sensory organs lowers, while sustaining a high concentration of oxygen in the circuit between the lungs, heart, and brain. This ensures survival. When submerged for longer periods of time, the spleen is stimulated, acting as a kind of “turbo” that releases more red blood cells, increasing the overall capacity for the body to transport oxygen.

With training, the diving reflex can be activated out of water, through extended breath holding, and amplified through the employment of the bandhas (locks/seals). This mechanism likely allowed the yogis to sustain longer kumbhakās, sometimes up to several minutes at a time, and may provide valuable insight into the power of kumbhāka practices in impacting oxygenation and health.<sup>15</sup> Free divers who go deep within the ocean without the support of oxygen tanks know how to actualize the diving reflex. They describe their underwater experience as “holistic, of being at one with the ocean, and a great feeling of well-being, euphoria.”<sup>16</sup> Sounds like a description of samādhi to me.

## **Kumbhāka: Retention or Suspension? Which to Practice?**

The results of my inquiry into any hard and fast rules as to when to employ retention or suspension, according to the Vedic texts, has resulted in ambiguity. While the Yoga Sūtra speaks exclusively about bāhya kumbhāka (suspension), the Hatha Yoga Pradipika and Gheranda Samhita emphasize antara kumbhāka (retention). Both forms of kumbhāka are discussed as having an impact on the ANS, although without consistent corroboration. Some claim retention creates a sympathetic response, while other texts counter that by stating it induces a parasympathetic response. A similar disparity can be noted with suspension. Retention consistently is said to be easier for the beginner to practice, although it has more complications associated with it. In particular, it can increase pressure on the heart, negatively affecting both heart rate and blood pressure.<sup>17</sup> Suspension is therefore considered to be more challenging to enact, but safer to practice. The Yoga Sūtra explicitly calls out bāhya kumbhāka as having a profound, quieting effect on the mind, and therefore functioning as preparatory practice for meditation and samādhi.

The utilization of bandhas (locks/seals) in conjunction with kumbhāka seems to induce the distinct physiological shifts associated with the diving reflex. The application of jālandhara bandha (chin lock) with antara kumbhāka (retention) helps moderate heart rate. When mastered, it controls blood flow in the carotid arteries, mitigating a rise in blood pressure, by blocking the chemoreceptors in the neck via regulation of the phrenic and vagus nerves.<sup>18</sup> The classic position of lotus (*padmāsana* [pronounced pahd-mah-sah-nah]), traditionally used in prāṇāyāma, presses on the femoral artery, shunting blood flow to the legs. This systematically reduces heart rate and seems to support the activation of the spleen, increasing oxygenation of the blood. Mūla bandha and uḍḍiyāna bandha also work on the chemoreceptors, effectively inducing a parasympathetic response by stilling the diaphragm and quieting the nerve plexuses in the lower parts of the spine.<sup>19</sup> Uḍḍiyāna bandha is primarily taken during suspension, while jālandhara bandha and mūla bandha can be activated during retention as well. The utilization of the bandhas with breath holding enables the practitioner to maintain longer kumbhākas without increasing blood pressure.<sup>20</sup> This accentuates the other physiological changes that occur naturally when the breath is suspended, such as elevated levels of CO<sub>2</sub> in the bloodstream, increase in the dilation of the arteries and smooth muscles, and altering pH. That said, the implementation of the bandhas is not necessary to receive the benefits of prāṇāyāma, nor is padmāsana required. One can sit in a chair and entrain the breath to become functional, while employing kumbhākas by utilizing the methods described throughout this text.

The Buteyko method is much clearer on the subject of breath holding, as it only utilizes suspension. The Buteyko practice could really be broken down into two fundamental

variables. Both are intended to elevate CO<sub>2</sub> to normal levels by lowering the ventilatory response:

1. Reducing breath rate and volume, with particular focus on reduction of volume.
2. Progressively increasing the length of suspension.

The primary difference in the orientation to breath retraining between the yoga masters and Dr. Buteyko's work lies in the *bhāvana* (intention). The yogis were interested in achieving higher states of consciousness, subduing the claws of the ego, the clamor of the senses, and the tether of the material world, in order to join with *puruṣa* (the Divine). They worked intensively with the breath to achieve *kevala kumbhāka*—the state where *prāṇa* is contained in stillness, effortlessly. Dr. Buteyko on the other hand focused exclusively on utilization of the breath as a tool for healing patients suffering from severe, at times life-threatening, chronic illness. He accumulated his research and explored his methodology in the context of a relatively modern lifestyle. For these reasons, and with the information I've resourced from physiology and Vedic texts, I concur that in working with the typical yoga student, and certainly with yoga therapy clients, it is most conducive to follow Buteyko's lead. For that reason, I advocate working with the breath in ways that reduce minute volume and increase suspension, gently and consistently.

## The Magic of Intermittent Hypoxia

Most of us have a negative association with the concept of oxygen deprivation, or hypoxia, which is defined as less than normal levels of oxygen in the blood. Studies done on obstructive sleep apnea (OSA) have established that frequent, extended periods of non-breathing result in significant health risks due to hypoxia. These include increased systemic inflammation, metabolic dysregulation, hypertension, sympathetic activation, and increased risk of heart attack, stroke, and even death.<sup>21</sup> That said, there is also promising new research indicating that titrated doses of mild, intermittent hypoxia (IH) can be beneficial and even therapeutic.

Mountain living has long been associated with longevity and health, and has been an area of interest for health researchers for decades. For instance, people living at high altitude demonstrate significantly lower levels of obesity and incidence of heart attack when compared to people living at sea level.<sup>22</sup> A 2011 report released by the Robert Wood Johnson Foundation (a nonprofit group that focuses on health issues) found that Colorado had the lowest obesity rate (19.8%) in the US. It has the lowest death rate due to heart disease, and lower rates of some cancers and diabetes than most. Colorado also has an average altitude of 6800 feet. Researchers have concluded that living "high," where oxygen levels are low, positively affects cardiovascular health and metabolic function, after adjusting for other factors.<sup>23</sup>

Professional and amateur athletes have increasingly been using IH as a strategy to increase performance times, endurance, and aerobic fitness.<sup>24</sup> Current methods have included high-altitude training or apparatuses that simulate high altitude by creating mild hypoxia. It appears that training under these conditions promotes production of red blood cells and muscular adaptation. These kinds of titrated doses appear to avoid the detrimental impact observed under conditions of chronic, severe hypoxic exposure as with OSA. Postmenopausal women who have combined exercise with mild hypoxic exposure

demonstrate significant reduction of arterial stiffness compared with counterparts exercising at the same level of intensity and normal oxygen levels.<sup>25</sup>

Additional clinical studies have noted a “potential protective effect of IH exposure” on patients at high risk for strokes and heart attack, and an increase in respiratory responsiveness, useful in combating OSA.<sup>26</sup> This type of therapy is known as “pre-conditioning,” and seems to prepare the body to respond with resilience to potentially more intense hypoxic episodes in the future.<sup>27</sup> IH therapies have been used in this way to combat a variety of conditions, including shock, infection, intoxication of poison, and cancer.<sup>28</sup> According to a study done by Bailey *et al.*, exposure to mild hypoxia while performing exercise caused appetite suppression in participants, supporting metabolic health. IH has been used with positive results for a range of cardiovascular conditions, spinal cord injuries, respiratory diseases, and mental health.<sup>29</sup> While further research is required in order to substantiate these results, there are indications that IH stimulates neurogenesis (the formation of nervous tissue), and may be applicable as both a treatment and prevention of mental disorders.<sup>30</sup> To date IH has been used specifically in the treatment of depression, anxiety, and stress, and there are some indications that it may be useful in treating schizophrenia and bipolar disorder.<sup>31</sup> Furthermore, there are interesting results from animal studies demonstrating the possibility that IH can increase mental acuity, specifically enhancing spatial learning and memory.<sup>32</sup>

Over the past 30 years, IH has been used with approximately two million patients. It appears to curb free-radical production, acting as a protectant to the mitochondria and supporting ATP production.<sup>33</sup> This translates into a stronger immune system, a decrease in systemic inflammation, and greater energy—in yoga terms: *vīrya*! It seems that IH is being put forward as a means to improve the general resistance and resilience of an organism, with potential to positively impact every level of the *panchamaya* (five dimensions). Our capacity to utilize oxygen more efficiently, and require less of it, seem to be equated with better health outcomes. Of course, this lies at the heart of *prāṇāyāma* practice. You may recall that the yogis referred to *prāṇāyāma* as *ṛkshana* (protection for our body and mind), which in the light of current research renders a very *apropos* description.

## Approaching Practice Safely

Clearly, how intensely one practices *kumbhākha* is of critical importance. As depicted by the research above, the right amount of hypoxic exposure can be extremely beneficial, while too much can compromise health. Here, the yoga texts do not provide much insight into “dosage”—at least not at levels that are realistic for those of us living in the 21st century. According to the *Hatha Yoga Pradipika*, approximately five hours of practice a day is recommended, spread out at four distinct intervals during the day and night (including midnight), at a rate of one breath per minute.<sup>34</sup> The *matras* given for breath holds are difficult to follow, but it is stated that one should gradually build up to a retention of 80 counts in one sitting.<sup>35</sup>

With regard to the question of intensity of practice, The *Hatha Yoga Pradipika* outlines three distinct stages that a practitioner moves through when developing their *kumbhākas*: “At first there is perspiration, in the middle stage trembling, in the highest stage complete steadiness, and therefore the breath should be withheld.”<sup>36</sup>

Prior to my exposure to the Buteyko method, I would not have had any concept of how to utilize this information and create a healthy *prāṇāyāma* practice for myself, or my students.

Eighty-second breath holds were as realistic as unicorns, and breathing until I sweated and trembled seemed contrary to the idea that *prāṇāyāma* was intended to soothe and alleviate stress. I had been happy to relegate 20 minutes of my practice time to breathing, but could not imagine instituting more than that, let alone five hours of my day.

The reality is that it will be the rare householder who has the time or inclination to practice at this level. Even the engagement of the full bandhas is beyond the scope of most yoga students. Just connecting with the bandha muscles, as outlined in [Chapter 7](#), requires a lot of work and intensive focus and practice. Lifestyle preferences and responsibilities often derail even the most well-intended practitioner, as you may have noted through the keeping of your own **Svādhyāya Breath Journal**. So, the question remains: How much practice is necessary to restore our *prāṇa* and get us back to health?

My Buteyko teachers enforced the idea of a minimum of 60 minutes of daily practice, broken down into 10-, 15-, or 20-minute periods throughout the day. I was shocked to find that this was actually quite doable: 20 minutes upon waking and before sleep, and at least 1–2 shorter practices in the middle of the day. They emphasized consistency, with lots of reminders regarding the science related to the medulla, and the need to build CO<sub>2</sub> tolerance, in order to change the set point. For me, results were apparent relatively quickly, and over time I have been able to sustain a new-found level of health and *vīrya* (vitality). This continues to motivate me each and every day. In fact, an hour of practice seems minimal to me now. On days when I feel run down or tired, I practice more frequently in little 5–10-minute spurts. I find these breath infusions give me a boost. They seem to help ward off impending pathogens and fortify my system.

With regard to the reference to sweating, increasing suspensions raises CO<sub>2</sub> levels in the bloodstream, which accelerates oxygenation. This can make one very warm—even sweat. When I began practicing, I did indeed sweat quite a bit. I learned to dress accordingly, knowing that within the first round of reduced breathing with suspension, I would be throwing off my cardigan, even in the winter. As my CO<sub>2</sub> tolerance increased, and I was able to suspend the breath for longer periods, I would jerk at times (kind of like being on a bucking bronco determined to stay seated) as I challenged myself to reach a new level of *kumbhāka* and retrain the phrenic nerve impulses. Now, after several years of consistent and careful practice, my breath holds frequently exceed 40 seconds, and the experience is one of sublime stillness.

In many ways this is not really much different than any other kind of fitness training, including *āsana* practice. Initially, the effort it takes to go through a series of postures feels exorbitant, with lots of sweating and shaking in the process of learning how much effort and how much ease to exude. Beginners often feel exhausted after practice, collapsing happily into *Shavāsana* (pronounced shah-vah-sah-nah, Corpse Pose), while intermediate students feel more energized and revved up. Advanced practitioners, for the most part, describe the effect of practice as steady, calm, alert presence.

*Prāṇāyāma* works our bodies aerobically, so it is not surprising that the felt sense is similar to the exertion of taking a brisk walk uphill. Heart rate may elevate slightly during breath holds; but if practice is well monitored, it will drop at the end of the session. Our ability to spawn this effect while sitting motionless in a chair or on a cushion creates a dissonance that can only be reconciled through repeated practice and acclimatization. Once you become accustomed to the sensations and know what to expect, there is more ability to self-monitor and know when to stop, rest, and settle the breath. I have found the work with

kumbhāka to be the ultimate practice in svādhyāya (self-awareness). Only we can know when we're pushing our system, or choosing to appropriately challenge it.

The safety net in working with suspension rather than retention is twofold. One is that with suspension, pressure on the heart is minimized. The other is that your own CO<sub>2</sub> radar will prevent you from holding longer than you are able to handle. When you reach your max, *your body will breathe you*. Also, while CO<sub>2</sub> levels do increase with breath holding and lowered volume breathing (such as described throughout this book), it takes a significant and steady drop of arterial levels of O<sub>2</sub> (close to 50%) before it becomes dangerous. During the IH training studies, oxygen saturation rates rarely dropped below 85 percent in most of the studies, and for short periods of time. When I've used a pulse oximeter to measure my SpO<sub>2</sub> (oxygen saturation) with breath holding during exercise, I was only able to drop it down to 87 percent. A drop in SpO<sub>2</sub> in this context is indicative of mild hypoxia and is necessary in order to trigger the chemical shifts that ultimately support health. This is the marker that elite athletes attempt to achieve in their high-altitude training sessions. Hopefully, this puts the idea of breath suspension up to 40 seconds as a potential danger for the average person into perspective.

That said, there are definitely contraindications to extended breath holding. They've been previously articulated, but are worth repeating here: If you are pregnant, have uncontrolled high blood pressure, have had a heart attack or stroke, have an aneurysm of the aorta or in your brain, arrhythmia or tachycardia, cancer, kidney disease, or very low lung function on a baseline spirometry test, please refrain from these practices.

Prāṇāyāma in general, and kumbhāka specifically, needs to be practiced on an empty stomach. Always arrange your midday sessions prior to meals.

While there are many breathing practices offered in this text, I would suggest focusing on just one or two methods from those presented previously, and from there, build your breath-hold times. Once you are breathing functionally throughout your day, and can maintain a consistent 35–40-second **CP**, then I encourage you to explore further. I am an advocate for keeping the practice very simple. The less the mind is distracted by technique, the more fully you'll be able to understand the process and regulate the flow of breath. Remember, it took me nearly a year of daily practice to reinstitute nādi shodhāna, and be able to sustain my low rate, volume, and bāhya kumbhāka.

## THE KRIYAS: CLEANSING PRACTICES

### Caution Required!

There are a few breath practices which are unique in that they defy the description of dīrgha and sūkṣma. In the texts they are often listed as "kriyas" or "*shatkarmas*" (pronounced shaht-kar-mahs). They are considered cleansing practices, used to reduce phlegm and congestion, and to aid digestion and elimination. These practices require the capacity to engage the muscles of the core with authority. Attempting any of these practices without core awareness and the ability to activate the diaphragm properly with breathing will circumvent any potential benefit to the practice. I address them here as they are related to both the muscular recruitment needed for bandhas and the ability to sustain kumbhāka. That said, these techniques are not appropriate for most therapeutic students (unless used under the advisement of a trained yoga therapist). While many of them are commonly taught in the yoga community, I encourage you to consider the impact they may have on breathing pattern disorders and common inflammatory conditions before opting to introduce them in group classes.

- **Kapālabhāti** (Skull-Shining Breath): Activates the abdominals and diaphragm on the exhale in a forceful, pumping action, "like a black-smith bellows." Inhalation is a quick diaphragmatic reflex taken in response.<sup>37</sup> Kapālabhāti, often also referred to as "Breath of Fire," creates a great deal of internal heat, particularly as one becomes more practiced and is able to perform more repetitions in rapid succession. After approximately 50 fast breaths of this type, the breath is held as long as possible. This constitutes one cycle. The instruction is to repeat this cycle until fatigued and then to



stop. Traditionally, kapālabhāti is utilized to remove “ama” (toxicity) in the system and to prepare the body for the other prāṇāyāma practices.

- **Bastrika** (Bellow’s Breath): There are many variations offered of bastrika, depending on the tradition one follows. Within the Hatha Yoga Pradipika there are at least five options given.<sup>38</sup> Similar to kapālabhāti, bastrika is also said to move the breath rapidly like the blacksmith’s bellows. The active movement is taken on the exhale with forceful contraction of the abdominals; however, the inhale requires full expansion of the abdomen. The inhale and exhale are of equal lengths, making it a necessarily bigger breath than kapālabhāti.<sup>39</sup> One of the adaptations of bastrika offered in the Hatha Yoga Pradipika utilizes nostril valving (20 breaths through each nostril) in an alternate fashion. Bastrika moves a larger volume of breath due to the exaggerated inhalation, almost guaranteeing hyperventilation. Each round of rapid breaths is followed by a strong kumbhāka with jālandhara and mūla bandha set in place. Cycles are repeated to the point of fatigue.

It is likely these techniques were used by the ancient yogis to off-gas large amounts of CO<sub>2</sub> quickly (short term) in order to increase their kumbhākas and achieve a more acute state of hypoxia. To understand how this works, put it in the context of someone who has a full reservoir of prāṇa, with normal levels of CO<sub>2</sub>. In this scenario, their CO<sub>2</sub> tolerance is high. Short-term hyperventilation with a practice such as bastrika will drop CO<sub>2</sub> levels quickly and dramatically. This will allow the practitioner to “marinate” in a kumbhāka for a significantly longer period of time before reaching their threshold. This type of technique is often used among free divers, and in other contemporary breathing practices like the Wim Hof method.<sup>40</sup>

The kriyas are meant to be used for a specific reason, not simply done as a daily regimen, unless titrated therapeutically. They can be useful for clearing the sinuses (good prep for prāṇāyāma), prompting peristalsis to alleviate constipation, and to activate and strengthen the diaphragm and abdominal core.

However, they can also induce hyperventilation. It has been postulated that if done correctly, kapālabhāti does not actually cause hyperventilation, as it circulates small amounts of air primarily in the dead air space, and does not actually disturb blood-gas ratios.<sup>41</sup> The problem is, if one already tends to over-breathe/hyperventilate, the diaphragm is likely to be weak and it will be difficult for the person to create the pumping action properly without engaging the accessory muscles and increasing ventilation. Among untrained Westerners, these practices pose a risk of exacerbating pre-existing breathing disorders. This is why therapeutically, I prefer to work as described in [Chapter 6](#), as with Diaphragmatic and Silent Hugs. This supports the conditioning of the diaphragm and visceral motility, without risking the loss of precious amounts of CO<sub>2</sub>.

Contraindications for kapālabhāti and bastrika are many: high blood pressure, heart disease, brain tumors, stroke, vertigo, stomach or intestinal ulcers, GERD, gastritis, glaucoma, diarrhea, systemic inflammation, and hyperventilation.

## KEY CONCEPTS

- Prāṇāyāma is, in its essence, kumbhāka—the practice of breath retention and suspension.
- The capacity to suspend the breath for longer periods of time on a regular basis is developed through progressive reduction of the ventilatory response (the urge to breathe), by consistent lowering of minute volume (rate and quantity of airflow over one minute).
- Practice of prāṇāyāma approximately one hour a day, spread throughout the day, is the recommended “dose” to experience consistent beneficial health effects.
- There are contraindications to breath holding that must be respected: in particular the effect on the circulatory system.

## — PUTTING IT INTO PRACTICE — BĀHYA KUMBHĀKA: DEVELOPING SUSPENSION

- Begin by taking your **CP** and heart rate (**HR**).

- Do 4–5 minutes of seated **Core Breathing**. (**Subtle** or **Halo Breathing** may also be used as an alternative.)
- Do a round of **Short Breath Holds**; 6–8 rounds, building to 20 seconds.
- Rest for approximately 30 seconds, or until your breath settles.
- Repeat another 4–5-minute round of seated **Core Breathing**.
- Take an extended breath hold: Inhale, exhale, pinch your nose, and hold for 5 seconds beyond your **CP**.
- Rest for approximately 30 seconds, or until your breath settles.
- Repeat a third round of **Core Breathing** for 4–5 minutes.
- Take an extended breath hold. If possible, hold 10 seconds beyond your **CP**.
- Rest for approximately 30 seconds, or until your breath settles.
- Repeat a fourth round of seated **Core Breathing**.
- Rest for 1–2 minutes and let the breath settle completely.
- Take your **CP** and **HR**.
- Track your progress in your **Svādhyāya Breath Journal**.

**Note:** This practice will take you approximately 25–30 minutes from start to finish. This makes for a nice morning and afternoon/evening practice. For midday practices, consider reducing the number of rounds of **Core Breathing** to 2–3, with variations of breath holding sandwiched between. If shorter sessions are best for you, work in 10–15-minute increments. *Always* end your formal prāṇāyāma sessions with a round of **Core** or **Subtle Breathing**. Be sure to leave time to settle the breath completely before taking your **CP** and **HR**, otherwise the measurements will likely be eclipsed by the practice.

If **HR** goes up and/or **CP** drops down at the end of practice, it is likely that you pushed beyond your limits. Try reducing your suspension times.

If you find “clocking” your suspension via a stopwatch distracting, agitating, or stressful, I suggest you find a soothing mantra that you can repeat that approximates your **CP**. This will help to keep your attention interiorized and your mind calm.

To increase your **CP** and your suspensions, try to incorporate **Subtle**, **Halo**, or **Core Breathing** into your day, working with your breath informally. You could, for example, use these breathing techniques when reading, driving, watching TV, or working on the computer. The more you consistently downshift the breath throughout the day, the more comfortable you will find the formal sessions of prāṇāyāma, and the utilization of bāhya kumbhāka (suspension).

I encourage you to track your experience and your growing awareness in your **Svādhyāya Breath Journal**. Notice the impact of these more intense practices on your digestion, sleep, appetite, energy levels, mental clarity, and emotional regulation. Always consider the whole panchamaya (five dimensions) in your note-taking, contemplating your prāṇic reservoir, your **Energy Bank Account**, and the holistic effect of altering your breath in this way.



## Bāhya Kumbhāka in Exercise: Breathe Less, Move More!

Practicing suspension during exercise is a very productive way to raise your **CP**. These types of practice are appropriate for those who do not have any of the aforementioned contraindications for breath holding. It simulates the action of high-altitude training, or IH therapy, in the sense that you are both raising CO<sub>2</sub> levels through movement, and creating a hypoxic effect.

I recommend you try these in small doses while walking within your house, or around your property, on a flat surface. Once you feel the effects and are confident that it is useful for you, you can take it into your regular exercise regime, and into your āsana practice, to add a little more challenge to your workout. If you feel inclined to check your SpO<sub>2</sub>, use a pulse oximeter while you practice.

### WALKING PRACTICE ([PHOTO 94](#))

---

- Begin with 4–5 minutes of seated **Core Breathing**. (**Subtle** or **Halo Breathing** may be used as an alternative.)
- Begin to walk, breathing lightly through your nose for 5 minutes.
- Continue walking and take a **Short Breath Hold (SBH)**, starting with 10 seconds.
- Always seal both nostrils with your fingers during breath holds.
- Release the seal, continue walking, and breathe lightly through your nose.
- Wait until your breath settles before taking the next round.
- Continue to walk, and when ready take another **SBH**, holding for 12 seconds.
- Between rounds of **SBH**, keep walking at a slow pace, waiting until the breath settles before your next breath hold.
- Do 6–8 rounds of **SBH** in this way, building gradually to your comfortable point of challenge.
- Continue to walk for a bit after your last **SBH**, breathing naturally.
- After practice, sit and observe the breath for 5 minutes. Notice the effect of the practice.

**Note:** If at any point in time you feel like you need to rest, please do! Stop walking. Pause. Let the breath settle. It is always better to stop and rest, rather than to push yourself into a large gasp or into a state of agitation. Think of this as walking meditation. You can use a mantra as you walk—after all it’s about being present and observing the breath, not about “getting somewhere.”



*Photo 94*

If you like this process, you can experiment with either of the variations below.

### SINGLE NOSTRIL BREATHING WITH WALKING

- Close one nostril and continue to walk for 5 minutes, maintaining a lighter volume.
- Take a few relaxed breaths, letting your system settle.
- Change nostrils and walk for another 5 minutes.

### EXTENDED BREATH HOLDS WITH WALKING

This exercise is best done after you have warmed up with some of the above variations and explored extended breath holds in the seated practice. With this technique, known in the Buteyko method as “**Steps**,” you only walk while holding the breath. After each breath hold you pause in stillness. Allow the breath to settle completely between cycles.

- Stand still (after warming the body with a brisk 10-minute walk or similar activity).
- Settle the breath.
- Inhale/exhale, seal both nostrils and walk, counting your steps. Start with 10–15 steps.
- Stop moving and release the seal on your nose. Breathe in through the nose.
- Let the breath settle.
- Do another round, holding again for the same number of steps or building by 1–2 steps.
- Always stop, rest, and settle the breath between rounds.
- Continue for 6–8 cycles, building gradually and finding your comfortable maximum point of challenge, e.g., 20...25 steps, etc.

As time allows, complete the moving practice with a seated prāṇāyāma practice of your choosing. Allow 5–10 minutes for the breath to completely settle before taking your CP and HR again.

**Note:** These practices quickly elevate CO<sub>2</sub> levels, which can have a laxative effect on the intestines. This is great news for those with sluggish digestion. However, for those who have inflammatory bowel conditions which tend towards diarrhea, I suggest you use these practices judiciously, and decide if they are appropriate for you.

Once you have a sense of how the regulation of the breath and breath holds work for you with movement, you can institute them in your āsana practice or other exercise regimes. In [Appendix I](#), I've created a few āsana–prāṇāyāma practices oriented towards functional breathing. These incorporate core breathing, core strengthening, breath holding, mantra, and mūdra in a variety of ways. [Appendix II](#) serves as training tips for teachers, therapists and healthcare practitioners. [Appendix III](#), reviews the Key Concepts and practices from each of the first ten chapters, sequentially.

## CHAPTER SUMMARY

---

- The breath has four phases—prāṇāyāma practices manipulate these in relation to one another for varying effects.
- Antara kumbhāka means breath retention; holding after inhale.
- Bāhya kumbhāka means breath suspension; holding after exhale.
- The phases of the breath can be monitored in seconds.
- Using mantra in place of counting can be more calming for some people.
- Slowing breath rate alone without lowering volume won't transform minute volume—both have to be addressed.
- This transformation process can create side-effects if attempted too aggressively—remember, changing our chemistry will impact all of our vital functions!

- Monitoring practice via heart rate and **CP** can give immediate feedback to the practitioner as to whether prāṇāyāma is taking them towards sattva, or pushing them into a rajasic state.
- Retention—antara kumbhāka—has more health precautions associated with it, because of the pressure it can put on the heart.
- Suspension (bāhya kumbhāka) is associated with deep states of mental calm, and is safer to practice.
- The bandhas were traditionally utilized in prāṇāyāma because they have a direct impact on the ANS and circulatory system, and enable the practitioner to suspend the breath for extended periods of time.
- The ancient yogis utilized prāṇāyāma to achieve deep states of meditative consciousness (samādhi) as part of their spiritual actualization.
- Buteyko breathing emphasizes reducing breath volume, and progressively increasing suspension time of the breath.
- Dr. Buteyko formulated his practices to facilitate healing in critically ill patients in the West.
- Intermittent hypoxia (IH) therapy has been used for the past 30 years, with very positive results ranging from reduction in inflammation, treatment for anxiety, and other mental health issues, to increased aerobic fitness and weight loss.
- Kriyas—cleansing practices such as kapālabhāti and bastrika—have many potential health risks, including exacerbating inflammatory conditions and hyperventilation. These practices are best reserved for specific individuals under the care of a certified yoga therapist.

## Chapter 11

---

# THERAPEUTIC APPLICATIONS

## HEALING THROUGH THE BREATH

*Due to the disturbance of Prāṇa, all [the Indriyas] get agitated and are indeed engaged, along with the mind, in external objects, which are poisonous. Therefore the Prāṇa has to be restrained through Recaka, Pūraka and Kumbhaka.*<sup>1</sup>

Desikachar, Desikachar & Jaganathan

As I began to introduce the concept of reduced breathing into my work with therapeutic clients, there were some expected responses, and many surprising and intriguing results. New clients readily accepted my explanations and instructions regarding the breath, just as my previous clients had. The difference was that, in the past, I was significantly less educated in the information I was sharing. This reflection reminded me of how vulnerable people are when consulting with a therapist of any kind. They are entrusting us with their physical and emotional well-being and will readily “buy in” to anything they perceive may offer relief. Therefore, as caregivers, we have an obligation to be as skillful and knowledgeable as possible.

I also had to learn to curtail my enthusiasm. What’s the saying? “If all you have is a hammer—everything looks like a nail.” Only a small percentage of the people who walk through my door are interested in developing an intensive breath practice of an hour a day, even if I surmise it would be more vital to their health than stretching their back. My responsibility as a yoga therapist is to follow their lead, and not impose my agenda upon them. At the same time, my new perspective has enabled me to recognize breathing pattern disorders more readily, and weave that awareness into the direction I take while addressing the client’s concerns.

With certain clients, I discuss respiratory physiology directly. We create a breathing practice centered around increasing their **Comfortable Pause (CP)**, because it is fundamental to our work together. This is the case with someone seeing me for asthma, chronic cough, or perhaps anxiety. Any client who clearly is a mouth-, chest-, or paradoxical breather receives a full explanation of functional breathing in their initial visit. Using the hi-low hand position, I will take them through the **Subtle Breathing to Core Breathing** process, helping them to feel the shift in their breath pattern. I will often assign Core Breathing as part of their personal practice. In addition, I may suggest that they observe their tendencies to mouth

breathe, chest breath, or to sigh frequently during the day. I encourage them to notice how they feel when they remember to shift to diaphragmatic breathing, or to breathe lighter, and close their mouth. Sprinkling this awareness throughout the day offers the client an opportunity for svādhyāya, as outlined in the practices in the first two chapters of this book. In this way, I leave the door open for each client to become curious about the impact of breathing on their health, knowing that even a small shift in awareness can bring potent results.

One example of this occurred with a client who came in for post-surgical back pain. He was also a chronic mouth-breather. While in session, we primarily focused on his residual structural discomfort and ways of addressing it. I casually suggested he attempt to shift from mouth to nose breathing, and notice how it felt. The first thing he reported in our follow-up session was that he “got his money’s worth!” after our initial consult (he paid for a package). He referenced his years-long battle with excessive belching, pronouncing that since our session, he’d actively kept his mouth closed and hadn’t had “eructation” (burping) all week long.

In this chapter, I will share the experiences of several of my clients who have worked with the various techniques suggested in this book, including **Subtle Breathing**, **Core Breathing**, **kumbhākas** (short and long), and the use of the **CP** as tools to assist them in healing. They have each given me permission (names have been changed) to relay their story and to share pertinent aspects of their yoga therapy protocol. None of these case studies are prescriptive for any particular condition. They are simply examples of how these techniques can be utilized in a therapeutic yoga context. I have incorporated salient facts based on current research that pertain to the physiological effect of breathing on these types of conditions. My hope is that by bringing the physiology and Vedic teachings forward contextually, it will help you foster connections for applying this information to yourself, your yoga teaching, yoga therapy practice, or healthcare practice.

In accordance with the ethical boundaries and scope of practice designations of a yoga therapist, I refrain from ever suggesting that a client stop their prescribed medication or change other aspects of their healthcare regime as suggested by medical professionals. Each client needs to be individually assessed according to their own prakṛti, vikṛti, lifestyle, and interest.

## Subtle versus Core Breathing

These two breathing practices form the center point of my work with prāṇāyāma. While very much related (**Core Breathing** builds on the **Subtle Breath**), it is helpful to examine the specific application of each in the context of yoga therapy.

**Subtle Breathing** is a wonderful starting point for introducing the breath reduction process. Using hands placed in the hi-low position (chest and lower rib cage), it allows people to begin to tune in to the rate and volume of their breath through both an internal and external felt sense. The **Subtle Breath** keeps the focus on the actual experience of inspiration and expiration, and the threshold of air hunger. Secondarily, one attends to the disengagement of the thoracic musculature. For part-time chest-breathers, this may be enough to increase awareness of the up-down movement of the chest, and to shift gears to a more abdominal-diaphragmatic breathing pattern. When I work with people with respiratory issues like asthma, hay fever, COPD, or heart issues, I primarily use the **Subtle Breath**.

That said, for those who are more habituated to chest breathing, **Subtle Breathing** may become a zero-sum process. The suggestion to pacify or neutralize the movement in the chest

may incite frustration. When addressing a deep-seated saṃskāra, it is often easier to “do something” active, as opposed to passively “refrain from doing.” Offering an alternative means to activate abdominal-diaphragmatic breathing (e.g., recruitment of the abdominal muscles via **Core Breathing**) will often lead to a relaxation of the neck and shoulders. Focusing the effort on the engagement of abdominals and narrowing of the rib cage during exhalation tends to keep the mind occupied. Shifting the hands from the upper chest to the lower belly, or to the sides of the ribs, also supports greater proprioceptive awareness of the core muscle recruitment. Once the abdominal-diaphragmatic breath pattern is ingrained, I may return to the **Subtle Breath** and focus their attention back to rate and volume.

For those with structural issues, like lower back pain or chronic neck and shoulder problems, **Core Breathing** may be the entry point. I’ll work very specifically with the core muscles: transversus abdominis, pelvic floor, iliopsoas, mid-back, and neck core. Then, I’ll incorporate this awareness into various āsanās, as described in [Chapters 6 and 7](#). For these clients, I may use cues like “Breathe slow and low,” or “Observe if the breath becomes audible—and make it silent.” My overall intention will be to use functional breathing to support functional movement—rather than functional breathing in and of itself.

Anxiety tends to pose a bit of a conundrum with regard to these techniques, as so much of the condition is driven by the vṛttis. I find for some, the **Subtle Breath**—as long as it doesn’t push intensely into the zone of air hunger—will bring an immediate felt sense of relief and relaxation. **Core Breathing**, with the additional focus on the engagement of the abdominals in rhythm with the breath, can sometimes flip these folks into overwhelm. Then again, for some of my anxiety/chronic chest-breathers, it is the effortful recruitment of the abdominals with **Core Breathing** that actually allows them to let go and drop into the lesser, lighter breath. As with all aspects of yoga therapy, the choice of technique will greatly depend on the response from the client. If either of these seems to be inadequately addressing the dysfunctional pattern, try the other. **Halo Breathing** is my go-to if either **Subtle** or **Core Breathing** is still creating some tension in the mind or body of the client. It seems to instantly dissipate the stress, and induce a feeling of calm, which will take the breath low in the body and out of the chest, and effectively slow it down.

## DEE (AGE 64)

Dee came to see me on the suggestion of a mutual acquaintance to address her severe asthma. She was specifically interested in the Buteyko breathing that had helped her friend. Dee had been diagnosed with asthma at the age of 26. She had also been diagnosed with multiple sclerosis (MS), lupus, Sjogrens syndrome, and common variable immune deficiency (CVID).

At the time we began working together, Dee was using her rescue inhalers 6–8 times a day (far above the recommended dose). She said she’d never be caught without them, even though she recognized they really weren’t working. She also used a preventer inhaler and nebulizer (2–3 times a day). Even with all of these, she was still experiencing intensive, uncontrollable coughing fits. Even as she felt her health deteriorating, her dependency on medication was increasing. The financial load of her prescriptions added more stress to her already taxed system.

Dee experienced a limited capacity to move, and was concerned because even navigating the three steps down from her trailer to take her dog out was becoming a laborious task. Prior to coming to see me, she committed to a low-carb, no-sugar diet, recognizing that the extra weight she was carrying was contributing to her health issues.

Dee stated that before we started working together she hadn’t worried about how she breathed. She didn’t realize she had always been a mouth-breather. Her voice was deeply raspy—in fact, she sounded like a three-pack-a-day smoker when we met. She said she couldn’t talk or walk without coughing.

Dee exhibited all the signs of a chronic over-breather: mouth breathing, audible breathing at rest, chest breathing, and lack of core engagement. By profession, she is an energy healer who works on animals. I couldn’t imagine that she breathed heavily when working on animals, so I asked her to demonstrate how she breathes when she’s in a healing session. Immediately, her breath became functional: silent, slow, low in her body. Her mouth was closed and her whole being quieted down. I

asked her how she felt when she breathed that way—and she admitted it felt relaxed and much easier. Her informal practice assignment from me was to train herself to breathe like that 24/7.

Formally, her practice involved Subtle Breathing for five minutes; eight rounds of Short Breath Holds (SBH), and another five minutes of Subtle Breathing, to be done six times a day. I asked her to refrain (as possible) from sighing, yawning, and coughing and to tape her mouth at night. When walking, I suggested she keep her mouth closed, even if she had to slow way down. I asked her to track her CP during the week, which was a mere three seconds at our initial session.

At our second meeting, Dee proclaimed she had only used her nebulizer three times the whole week. She had stopped coughing up gobs of mucus. She said the focus on how she breathed made her aware of her mouth-breathing habit, especially when talking. She said she felt calmer, less reactive overall, and even more connected when she's in session with the animals. We switched her to Halo Breathing, which she found extremely calming. After two weeks, she noticed she was no longer gasping when walking up steps. She was taping at night, sleeping much better, and feeling rested in the morning. The habitual evening chest irritation she experienced was reduced by 50 percent. At the end of our third session, her CP was up to 26 seconds.

When I interviewed Dee for this book, it had been approximately nine months since we worked together. She had lost 55 lbs. Her voice sounded melodious. One of the first things she commented on was that she had lost the rasp, along with the feeling of irritation in her throat. She walks a mile with regularity, and goes up and down the stairs with ease. She is extremely mindful to keep her mouth closed and credits the longer breath holds with helping to increase her lung capacity and help her lungs to heal.

Some days she doesn't use her inhaler at all, though she keeps it handy. She doesn't wake up in the middle of the night gasping and having to use it. She says she doesn't take big gulps of breath anymore. Dee still practices reduced breathing, mostly when driving, taking a few rounds of SBH at stop-lights. Lately, the air quality has been a problem due to summer fires. She said that without the breathing practice, she thinks she would've been in the hospital due to the smoke. She's surprised at how well she's doing in spite of it. Dee told me, "I'm loving my life! Feeling very darn healthy!"

### **Breaking It Down**

Dr. Buteyko claimed that the symptoms of asthma are principally a reaction to the loss of CO<sub>2</sub>. A study by Bowler, Green, and Mitchell (1998) demonstrates the effectiveness of Buteyko breathing with 19 long-term asthmatics in a double blind controlled clinical trial. The test group was able to reduce their bronchodilator usage by 96 percent and steroids by 49 percent in 12 weeks.<sup>2</sup>

Studies have shown that just replacing mouth breathing with nasal breathing reduces asthma exacerbations.<sup>3</sup> The regular use of breath holds, produces a mild intermittent hypoxia IH, which acts as an upper airway dilator, increases vagal tone, reduces inflammation and hyperinflation of the lungs, while improving oxygen metabolism and stress adaptation.<sup>4</sup> Lum (1996) noted that a high-protein, low-carbohydrate diet is best for people with a tendency to hyperventilate, like asthmatics, due to the effect of glucose on the respiratory system.<sup>5</sup> Dee's choices to change her diet along with her breathing pattern were well suited, each supporting the success of the other.

## **BRANDON (AGE 18)**

Brandon's original interest in working with the breath was to help him with anxiety and sleeping. His mom, a yoga teacher and student of mine, suggested he try it. Two years ago (at the age of 16), he attended a Buteyko course for teens taught by Patrick McKeown at my studio. Brandon said he immediately experienced a feeling of calm and felt "more open to the world" after class. The breathing, he said, gave him a chance to relax. Before bed, he did the exercises as suggested by Patrick, and taped his mouth. That first night he fell right to sleep and slept through the night. Usually, his worried mind would keep him awake for 1–2 hours, and he'd wake throughout the night. Instead, he woke up rested. In just one day, he could feel the difference with doing the exercises and taping.

Brandon says his anxiety is down almost 100 percent. A few times, it flares with school pressures—and he uses breath to calm himself. He wakes up in the morning refreshed and feels more awake during the day. In addition, the breathing helped resolve a long-standing issue with chronic constipation. Since the first week of practice, he hasn't had any problems with elimination. "It's changed my life," he states.

Brandon is a track and field athlete. Over the time he's been working with the breath, he's experienced a significant leap in his endurance and performance times. He moved from twelfth on a team of 20, to a competitive position of fourth. He nose breathes in all of his practices, and his running time has dropped from an average of 6.28 minutes per mile to 5.13. This last year he placed seventh district wide. He credits the breathing, and notes that it has boosted his confidence. He finds it frustrating that neither his teammates nor his coach will listen when he tries to talk to them about the breath. It doesn't dissuade him though. On a recent ten-mile relay, he experienced a side-cramp—the kind that



usually plagues him throughout the course. He switched to nose breathing, and the cramp dissipated. He was able to run at a faster, sustained rate for the rest of the race.

Brandon practices Steps twice a day (walking or running while breath holding). He averages 50 steps, and recently hit a personal best of 80. He uses Patrick's Buteyko app in the morning and at night, and continues to tape his mouth. Brandon says, "The rewards, even without reaching my full potential, are mind-blowing! It's been a great experience. There's no downside to it!"

### Breaking It Down

Brandon exhibited many of the symptoms of chronic hyperventilation. Whether or not his CO<sub>2</sub> levels were verifiably low, the combination of anxiety, constipation, and sleep disorder signal sympathetic activation and a lack of vagal tone. Fear, anxiety, and IBS are listed as common symptoms of chronic over-breathing.<sup>6</sup> Clearly, Brandon's young mind was receptive to the experience of the reduced breathing. In my work with him over the past two years, he has demonstrated high levels of interoceptive awareness and dedication to change.

Research studies on athletes have shown that breath holding to maximum capacity during training increases production of "endogenous antioxidants and higher anaerobic threshold."<sup>7</sup> Maximal breath holds also stimulate hemoglobin production and splenic activity, increasing hematocrit.<sup>8</sup> Furthermore, higher levels of bicarbonate in the system, with the increase in CO<sub>2</sub>, appear to offset the muscles aches, cramps, and soreness associated with lactic acid.<sup>9</sup> For more details on athletic performance, please see *The Oxygen Advantage* by Patrick McKeown.<sup>10</sup>

## STACIA (AGE 58)

Stacia and I began to work together in 2012, after she had experienced two surgeries that resulted in her ending up on disability with major destabilization of her structure. The first was a hysterectomy, which resulted in sciatica. The second, a cervical spine operation, left her right arm incapacitated, due to nerve damage. In addition, Stacia had a history of childhood trauma, exacerbated by marriage to an abusive man, and a daughter who went through addiction issues in her teens. Highly proactive in her self-care, Stacia sought help. This included extensive counseling, medication for anxiety and depression, and physical therapy. When I met Stacia, her right arm was nearly blue in color and she had very little ability to move her fingers. She was in constant pain, but was hoping to avoid using a fentanyl patch. Our work together combined healing on all levels of the panchamaya. She was drawn to yoga, and within two years was enrolled in my teacher training program, with an eye to becoming a yoga therapist.

Stacia was a committed student and enthusiast for all things yoga. No one was more surprised than I when, after introducing Subtle Breathing to the class, Stacia confessed how much better she liked it than the full yoga breath. She said, "It felt like a relief." Although she had never expressed discomfort with the breath, she said that before it felt like she could never get enough—and that she should be doing it "longer and better." Until she experienced Subtle Breathing, Stacia stated that she never had that "wonderful experience" with prāṇāyāma that others seemed to be having. Attempting to increase her threshold (overall length of inhale and exhale) made her anxious. When she tried to lengthen the breath (even the exhale!), and combine that with the contraction of the abdominals, her body would tighten, and the tension made the pain worse. Now, with the Subtle Breath, she says she feels like she can relax. Breathing is meditative—she feels comforted by it and her anxiety is greatly reduced.

Stacia studied the Buteyko protocol with me and for a while charted her CP regularly. Now, she does a session of Subtle Breathing upon waking in the morning. She uses it throughout her āsana practice. Two or three times a day she does a practice of Subtle Breathing while resting in Shavāsana. She also works with Steps and Walking with Breath Holds.

In 2015, Stacia ended up having a third surgery—a rib resection to address the nerve damage from the previous surgery. This surgery affected her heart, mimicking a heart attack, although she didn't actually experience one. It seems to have restricted her body's ability to activate the PNS by reducing vagal input. This resulted in an elevated pulse rate of 100, and higher than normal blood pressure. However, a regular combination of Subtle and Core Breathing has enabled her to bring up her vagal tone. She rarely experiences dizziness and fainting now. During exercise she watches her heart rate drop on her Fitbit as she employs breath holds and Subtle Breathing. When tested, both her pulse and blood pressure are consistently low now—even with the anxiety that she feels when going to the doctor.

For Stacia, the shift in breathing felt "dramatic." It was an "aha moment" she describes as discovering what had been missing in her yoga practice. She uses the breath as a preventative to stave off anxiety and finds it helps to monitor her speech (listening for gasping). She has trained herself to take small nose breaths in between phrases. She also has found reduced breathing useful for pain relief. Sometimes, a hard, cardio workout would cause a flare in pain. Maintaining the Subtle Breath ensures that she never pushes too hard—and as a result, she doesn't experience the aftermath of increase in

pain. She has also found the information regarding the ZOA and placement of the rib cage helpful to understand how to bring herself into structural alignment.

As a yoga teacher, Stacia has expressed that her students have been highly responsive to Subtle Breathing—especially those who experience anxiety. One in particular speaks of it as “soothing like a balm.” Stacia echoes her student, and refers to *prāṇāyāma* now as “Peaceful Breathing.”

### Breaking It Down

Higher levels of CO<sub>2</sub> result in dilation of smooth muscle, which is embedded throughout the arterial system. There are studies that show that even six hours of breath retraining can lower the incidence of heart trouble in heart attack survivors. Those who received training in a simple relaxation breathing technique, in addition to regular aerobic exercise, fared better five years out than the exercise-only group. Breath and heart rate were reduced and respiratory sinus arrhythmia was stronger.<sup>11</sup> Bernardi *et al.* (1998) also found that study participants with chronic heart failure responded to training in slow breathing (6 breaths per minute) with increased cardio-exercise tolerance and peak oxygen consumption, while lowering the perception of breathlessness.<sup>12</sup>

## BARBARA (AGE 58)

Barbara began attending my therapeutic yoga class in 2011. She has Type 1 diabetes, asthma, and sleep apnea, and was diagnosed with an inflammatory condition similar to rheumatoid arthritis (RA). She had been a physical therapist, but had to stop working when she felt she was putting herself and her patients at risk due to the stiffness in her body and inability to maneuver them effectively. At that time, Barbara could not bend over to tie her shoes or get herself off the toilet. She needed to use a grab bar to pick things up. Therapeutic yoga has been highly beneficial for Barbara, and she has attained a level of physical ease in her body that has allowed her to enjoy kayaking and to move through the daily tasks of her life with more freedom.

Barbara shared that the switch from the full yoga breath to the Subtle/Core Breathing “felt like coming home.” She said the yoga breathing always felt counter-intuitive to her. She found the subtle quality of the breath more meditative and that it allowed her to be less distracted by others, more internalized with her attention.

Barbara was intrigued by this style of breathing, enough to take it home and practice it in her daily life. Later, she took the full Buteyko practitioner's training. Since she's been working with it, she has not had an exacerbation of her asthma. Usually she'd go to the hospital once or twice a year for a nebulizer. She rarely uses her rescue inhaler. Recently, while cleaning out her parents' musty, dusty basement she found herself using SBH to calm her breath and her mind. She was able to get through the cleaning process without using her inhaler.

Overall, she has found her strength and energy have improved significantly since she's been practicing this way with the breath. With nose breathing now, she is able to walk up stairs, and haul her kayak on and off the car with significantly less effort.

Barbara has even seen her basal rate (her background blood sugar levels) decrease. This means that her body requires less insulin in general. She's also dropped down the pressure on her automatic positive airway pressure (APAP) machine for sleep. Once she shifted her internal breath volume, the force of the air from the machine felt like too much. In the 2.5 years Barbara has been practicing Buteyko-style breathing, she has not had a cold, in spite of a great deal of family stress involved with aging parents. She says, “I used to blow things off, and thought I was pretty good about letting things go. Now I know what it feels like to be in the parasympathetic mode. I like it!”

### Breaking It Down

Related to diabetes, Dr. Bernardi is continuing to investigate, with promising findings, the effect of slow breathing and IH therapy with Type 1 diabetics. The use of IH in this context seems to provide a “protective effect,” helping the body to be more resilient to lower levels of oxygen, which is a common occurrence in Type 1 diabetes, and contributes to some of the more serious symptoms associated with it.<sup>13</sup>

At night, CO<sub>2</sub> levels rise as the body relaxes and the breath naturally slows. If a person chronically over-breathes during the day, there will be a low tolerance to CO<sub>2</sub>. This is the mechanism that drives central sleep apnea. The continuous positive airway pressure (CPAP) and APAP machines are designed to keep the airways open, so the flow of oxygen is constant. With higher CO<sub>2</sub> tolerance, there is less need for the external force of air to be as high. Although some people are able to stop using their machines at night, some—like Barbara—need to use them, but can reduce the volume, which is healthier for the system overall.

According to Professor Buteyko, inflammation and allergic hyper-responsiveness are caused primarily by lower immune response dampened by deficient levels of CO<sub>2</sub>. This may contribute to why chronic stress can make an individual more vulnerable to health issues like colds and flu.<sup>14</sup>

Additionally, CO<sub>2</sub> helps regulate production of all hormones, including cortisol. With chronically low CO<sub>2</sub>, normal production of cortisol may be impeded. This would contribute to hypersensitivity and responsiveness of the airways and lungs to inflammation, contributing to coughing, asthma, and respiratory irritation.<sup>15</sup>

## **LIANE (AGE 48)**

Liane had been teaching yoga for 17 years when we met. She had been diagnosed with uterine fibroids, extreme anemia, hypothyroidism, and mononucleosis two years prior. Her system was still significantly depleted and she was interested in pursuing yoga therapy both personally and professionally. She was a regular practitioner of prāṇāyāma, in the classic, chest-inflated manner. Initially, she found the shift to slow, low, reduced breathing difficult—especially the feeling of air hunger. However, once she was able to settle into it, she experienced sustained energy, a more positive attitude and a sense of grounding.

Liane reflects that her previous prāṇāyāma practice left her feeling agitated—kind of like a “sugar high” that would charge her up, but dissipate quickly. She describes the movement of vata with this type of prāṇāyāma as being “More like a windstorm.” In contrast, she says, “Subtle Breathing, feels like a cocoon. It’s very calm and peaceful.”

Her health has benefited significantly from the breathing practice. She has more sustained vitality and confidence. She states that the suspension after exhale has dampened her tendency to worry and spin into anxiety, providing her with more of a sense of acceptance of things unfolding as they happen.

Uterine fibroids continue to be Liane’s principal health concern. She’s researched alternative healing modalities and is intrigued by the potential link between tumor growth and acidosis. She wonders whether balancing her pH may have a possible impact on her fibroids. Regardless, she says the breathing gives her a sense of empowerment around her health. Breath reduction and breath holds have enabled her to sustain the bandhas and kumbhākas with a sense of ease.

Prior to training with me, Liane hadn’t realized that she was primarily a mouth-breather. Shifting to nose breathing has made her more methodical about her thoughts, speech patterns, and reactions. She describes her communication as a reflection of ahimsā (non-violence) and satya (truth) as a result. She also feels that her mouth, nose, and throat are more hydrated. She experiences far less fatigue after teaching than in the past. “What I’m doing now is feeding me in good ways all the way around,” she explains. “I know how to replenish myself when I put a lot out. It has helped me to manage my health over the past 2.5 years—to keep my attitude up and persevere.”

### **Breaking It Down**

Despite Liane’s avidya (lack of awareness) around her over-breathing pattern, it was quite significant. Given that she teaches full time, is a mom, and lives in a highly social, small community, she was unaware of how extensively her constant talking was impacting her health. Reducing her overall breath volume and learning restraint with her communication have likely had a considerable impact on balancing her system, helping her to rebuild her vīrya (vitality).

With regard to hormonal imbalances, note that progesterone stimulates respiration. It does this through increasing the sensitivity of CO<sub>2</sub> receptors, which accelerates the ventilatory response (the urge to breathe). During the second half of the menstrual cycle, progesterone levels rise, peaking a week or so after ovulation. This is the usual time when many women experience bouts of premenstrual syndrome (PMS). Symptoms associated with hyperventilation often are significant during this period of time, including headaches, irritability, mood swings, memory lapses, sleep disruption, and decreased emotional regulation.<sup>16</sup> Menstrual cramps could also be related to increased contraction of smooth muscle embedded in the uterus as CO<sub>2</sub> levels drop.

While there are no conclusive studies with regard to the effect of breathing and cancer, there are some intriguing ideas around the balance of pH, oxygenation, and tumor growth. This is an area that merits more investigative research.

## **TRACY (AGE 54)**

Tracy is a certified yoga therapist and yoga studio owner. She was diagnosed with exercise-induced asthma as a child. As an adult, her condition worsened, to the point where any amount of exercise would trigger it. Tracy also has recently recognized that she has a number of food allergies that have contributed to her immune system’s reactivity. The combination has made her highly susceptible to seasonal hay fever and a consistent feeling of congestion. She said she resisted using her asthma meds because they made her shake, preferring to suffer through an attack or live with a deep heaviness in her chest. However, at least once a week the symptoms were so pervasive that she’d dose herself, just so she could participate in the activities in life she loves.

From the first time Tracy practiced the Subtle Breathing, she says, “There was a sense of lightness—like a fog lifted up.” She hasn’t used any inhaler since she started practicing with the reduced breathing and kumbhākas, two and half years ago. She says she’s very aware of her breath now. If she feels at all symptomatic, she does about ten rounds of SBH, and the symptoms disappear. Tracy says she truly practices all day long. “It’s made me aware of everything that’s going on in my body,” she comments. After many months of tracking her CP, she now can sense when it drops. The first thing she does is check in with herself, asking, “Is it something new in my system, or is it something stressful happening in my mind?” She uses her breath to reflect on how well she’s responding to her life, and then works with the Subtle Breathing practice to relax her mind and meditate. Tracy says, “I’d never been able to feel the sensations in my body the way I do now. I’m so much more aware of the fluctuations of mind and body. I can’t imagine breathing any other way.”

### **Breaking It Down**

There is a direct correlation between histamine levels and breathing. Histamine is secreted by mast cells during exposure to allergens. The level of histamine rises during prolonged hyperventilation.<sup>17</sup> Local inflammation and edema (swelling) results, as well as bronchiole constriction. While this is especially relevant to asthmatics, it can affect anyone to some degree, and lead to breathing difficulties.<sup>18</sup> In addition, research is underway to examine the effects of nasal CO<sub>2</sub> and nitric oxide in the treatment of seasonal allergies.<sup>19</sup>

## **LYDIA (AGE 30)**

At age 27, Lydia—an independently minded freelance writer—fell asleep at the wheel while driving home from the yoga ashram where she worked part time, crashed her car, and knocked herself unconscious. Gradually, over the next month she emerged from a coma. In the accident, she had shattered her left femur and humerus, broken her pelvis in two places, and sustained a severe traumatic brain injury on the left side. When Lydia and I began working together seven months after her accident, she needed to be supported by a transfer belt when she walked, as her balance was compromised. She had limited capacity to engage in practice—only 15 minutes—before extreme cognitive fatigue set in.

Over the past four years, Lydia’s recovery has been remarkable. She now lives on her own and walks everywhere. She has re-engaged with friends socially, and is working through the neurological impairment in her right hand to retrain herself to write. Her passion for yoga drives her to stay committed to regular practice and private sessions twice a week. She is able to perform almost all of the common āsanās. Balance is still a challenge, but she is gradually weaning herself off the wall as she works with Tree Pose and Warrior 3.

Two years ago, I introduced the Subtle Breath and SBH to Lydia. This was a significant switch from the yoga breathing she was familiar with. Lydia is an enthusiastic speaker and often gushes with emotion—gasping—as she goes. She tended to mouth breathe, and is prone to frequent sighing. I have consistently encouraged her to work with breath reduction—reminding her of the benefits to her brain—namely the increase in oxygen. Over this past year, her memory has improved significantly—and with that, so has her consistency of practice. Her practice begins with a combination of Core Breathing (for 3–4 minutes) and seated SBH (6–8 rounds each) with swaying, repeated several times. During her āsana practice she maintains the Subtle Breath, and we will often intersperse SBH during the practice, particularly if her mind is foggy or more distracted. She uses breath holds to support her in challenging postures that require more balance, particularly on her right side.

Lydia says the reduced breathing and breath holds help her when she feels overwhelmed, or needs to focus. “It isolates the thoughts, so that my emotions won’t muddy the waters.” She expresses feeling very present as she breathes this way, as if it “brings the volume down.” She feels it helps her brain by quieting the internal disruption and confusion she often felt before. She also has noticed a significant downshift with the neurological impulses that agitate her right hand. She’s experienced less tremor (it’s virtually gone now), and has more control over holding a fork, or typing on the computer. Lydia says she feels like the communication between her brain and body are easier—“like the roadway has been cleared of boulders.” This has increased her coordination and stability in movement overall. Timing the slow, low breath with movement—and combining that with mantra—has also helped her limbs and torso to synch together.

### **Breaking It Down**

There is not much in the literature that I’ve been able to find with regard to using breath control therapeutically to work with neurological or movement impairment. However, I have consistently found that among my client population, many of whom have movement disorders like MS and Parkinson’s disease, tremors calm significantly with breath holding. There are definite links between respiratory alkalosis, low CO<sub>2</sub> levels, and seizures.<sup>20</sup>

It may be that CO<sub>2</sub> and nitric oxide levels affect acetylcholine levels, and this may be behind the quieting effect on the neurological system. Acetylcholine is a neurotransmitter in the autonomic nervous system, impacting both sympathetic and parasympathetic responses. It also plays a critical role in alertness, sustaining attention, learning, and memory.<sup>21</sup>

### **DONNA (AGE 60)**

Donna, one of my regular clients who has MS, uses the SBH regularly to help her navigate “brain fog and cognitive impairment.” She finds it as useful, if not more so, than medication she was given for this purpose. As a result, she’s cut back her medication use by half. Along with mitigating the cognitive decline she often experiences mid-day, the SBH also provides her relief from fatigue. She’s able to hold up to 20 seconds at a time and finds it rejuvenating.

### **RICK (AGE 59)**

Rick, another client, who has tardive dyskinesia, a rare form of full-body spasticity (a side-effect of the psychoactive drug Haldol), has found extended breath holds “life changing.” Rick and I have been working on his practice together for over 25 years, and for the past ten years, prāṇāyāma has been a significant portion of his yoga regime. A year ago, I introduced him to the breath holds and Subtle Breath. He works with it daily and has noticed a significant drop in his spasms. I’ve noticed his facial tics are greatly reduced and he is able to sit and talk with me without his body lurching or twitching. He has a nightly routine of breath holding and is regularly able to sustain a 25-second breath hold. He says that he’s sleeping better, feels calmer, and his energy is vastly improved. He finds he now is able to experience stillness and quietude in his body—a great refuge for him mentally as well as physically.<sup>22</sup>

More studies in this area are needed to illuminate the underlying mechanisms for these types of anecdotal responses.

# BREATHING PATTERN DISORDERS SCREENING

There are some standardized methods that respiratory experts use to assess breathing pattern disorders (BPD) with the recognition that there are both objective (respiratory rate and tidal volume) and subjective (feelings of dyspnea) criteria to account for in the process. The hi-low hand position—with one hand resting on the chest and one on the diaphragm—is actually considered a fairly accurate means to determine efficiency of breathing mechanics, both to the practitioner and the observer. The Nijmegen Questionnaire is the primary tool used to address the more subjective experience of breathing. Questions assess the frequency of experience for sensations such as chest pain, shortness of breath, dizziness, and tight feelings in the chest. There is a particular scoring system that clarifies functional versus dysfunctional patterns.

The Nijmegen Questionnaire gives a broad view of symptoms associated with dysfunctional breathing patterns. It was introduced as a screening tool over 30 years ago in order to detect patients with hyperventilation complaints. It has a very high validity rate and is easy to administer. For more information regarding the Nijmegen Questionnaire, please go to [www.breathingretrainingcenter.com/nijmegen-questionnaire.php](http://www.breathingretrainingcenter.com/nijmegen-questionnaire.php).

Another frequently used manual test is the Marm, although this requires a licensed practitioner to place hands on the client and then record findings.

## IN CONCLUSION

Clearly, there are many ways to fine-tune the concepts and techniques in this book and customize them to address a variety of symptoms. While the regulation of the breath is important, I have found linking the breath to lifestyle and consciousness—making it relevant—is the determining piece with regard to client compliance with practice. The **Energy Bank Account (EBA)** offers an easily accessible mirror for clients to use. It helps them understand how their daily choices, including their breath habit, affect the sum total of how they feel. Centering discussions around the management of prāṇa keeps our work as yoga therapists in alignment with Ayurvedic principles and our scope of practice. It also offers people a clear, holistic means for understanding cause and effect, placing the reins of empowerment in their hands. By working actively with their **EBA**, and connecting the dots, clients are often able to establish a more sattvic lifestyle. This helps their whole panchamaya to heal. My job then becomes one of offering gentle reminders to, for example, press the pause button, do some **Small Breath Holds**, or just reduce the amount of prāṇa they are taking in or putting out. This process enables the client to learn how to refill their own prāṇic reservoir, to regain their sense of vīrya, and restore their mental and physical health.

*tadā draṣṭuḥ svarūpe-avasthānam*

*Then, when the mind has become still like a crystal lake,  
one can see into the depths.*

*There, the diamond essence of the soul shines through.*



## Appendix I

# ĀSANA PRACTICES TO RESTORE PRĀṆA

*Prāṇāyāma provides the vital link that connects āsana and meditation. Āsana prepares the ground on which prāṇāyāma can be practiced. Prāṇāyāma prepares the ground on which meditation will become successful. Meditation, when done properly, can lead to realization of the Divine.<sup>1</sup>*

Maehle, Cox & Watson

It may feel overwhelming to learn how to employ some of the breathing and core exercises suggested in this book, and weave them into a practice or group class. My recommendation is to always err on the side of simple. Learning these new techniques requires a great deal of interoception. In order to be able to focus on the specific action, it's best if the poses themselves are known quantities to the student(s) and not a challenge to navigate. In this way, the āsana is really in service of the breath—or you could think of it as the annamaya acting as a means to more fully experience the prāṇamaya. Below are a few simple sequences that are intended to provide a template for jump-starting this new orientation to breathing. The key is to observe when the movement agitates the breath and to stop to allow the breath to completely settle. As movements become stronger (i.e., Sequence C), it becomes more challenging to move strongly and keep the breath silent and light.

## Sequence A

1. **Supine Subtle Breathing with Block.** Hands on chest and mid-belly, lower rib cage. Observe; direct the breath low and slow; cue for gentle transversus abdominis (TVA) engagement with the exhale. **(Photo 95)**
2. **Scapular Swirls** and **Paint the Floor** with back of head undulations. **(Photos 96–98)**
3. **Butterfly** with **Anemone Hand Pulses** with focus on pelvic floor to TVA engagement. Progressively extend the pause after exhale (all core engaged and held for 3–4–5 seconds). **(Photos 99–101)**

Repeat 6–8 times.

4. **Wheel Pose** with 2-part exhale krama. Progressively suspend breath 5–6–7 seconds. Engage the pelvic floor (PF) and TVA with each exhale. Repeat 4–6 times. **(Photos 102–104)**



5. **Child's Pose. Paint the Floor** with forehead. (**Photo 105**)
6. **Seated Subtle Breathing** for 5 minutes with hi-low hand position. (**Photo 106**)
7. **Short Breath Holds (SBH)**. Six rounds. Inhale/exhale/pinch nose, sway side to side while counting to 10. Gradually build suspension to 11–12–13 seconds. Stay in the range of soft challenge where you are still able to maintain natural relaxed nose breathing between rounds. (**Photo 107**)
8. **Utkatāsana/Chair Pose at Wall with Block**. Build stay with core engaged. Mid-back core and neck set. Cue for rib cage and **Subtle Breath**. Adjust arms to comfort. Fold forward in **Uttanāsana** (pronounced oot-tah-nah-sah-nah) to rest between reps. Repeat **Chair Pose** 3 more times. (**Photo 108**)
9. **Masthead** working with neck core at wall. Keep abdominals engaged and ribs set. (**Photos 109 and 110**)
10. **Mountain Pose** with **Subtle Breathing**. Hands in hi-low position, 2–3 minutes. Settle breath. (**Photo 111**)
11. **Short Breath Holds (SHB)**. Six rounds. Inhale/exhale/pinch nose, sway side to side while counting to 10. Gradually build to 13–14–15 seconds. Stay in the range of soft challenge where you are still able to maintain natural relaxed nose breathing between rounds. (**Photo 112**)
12. **Uttanāsana (Standing Forward Bend)**. Relax breath and body. Do **Scapular Swirls** and **Rapunzel** to release neck and shoulders. (**Photo 113–115**)
13. **Seated Mountain Pose**. Pause and let breath settle, hands in hi-low position. (**Photo 116**)
14. **Bridge Pose** with **Diaphragmatic Hugs (Silent Hugs)** with hands overhead or on rib cage. Pump diaphragm to fatigue with breath suspension. Three rounds. (**Photos: 117 starting position; 118 inhale; 119 exhale with pumping action**)
15. **Apanāsana (Knees to Chest)**. No hands; use block; 2-part krama exhale and suspend breath for 6–7–8 seconds after exhale—cue for all core muscles to be engaged, including neck core. (**Photos 120–122**)
16. **Apanāsana (Knees to Chest)**. Hands on knees, rock gently to release back, breath relaxed.
17. **Shavāsana**. Focus on maintaining a light, **Subtle Breath**. (**Photo 123**)
18. **Seated Mountain Pose** (chair or floor). **Subtle Breathing** 5 minutes (stay in the range of slight air hunger); **SBH** start with 12–15 seconds and build, as able; **Subtle Breathing** 5 minutes. If time, repeat another round each of **SBH** and **Subtle Breathing**. (**Photos 124 and 125**)
19. Sit for meditation and observe.



*Photo 95*



*Photo 96*



*Photo 97*



*Photo 98*



*Photo 99*



*Photo 100*



*Photo 101*



*Photo 102*



*Photo 103*



*Photo 104*



*Photo 105*



*Photo 106*



*Photo 107*





*Photo 108*





*Photo 109*



*Photo 110*



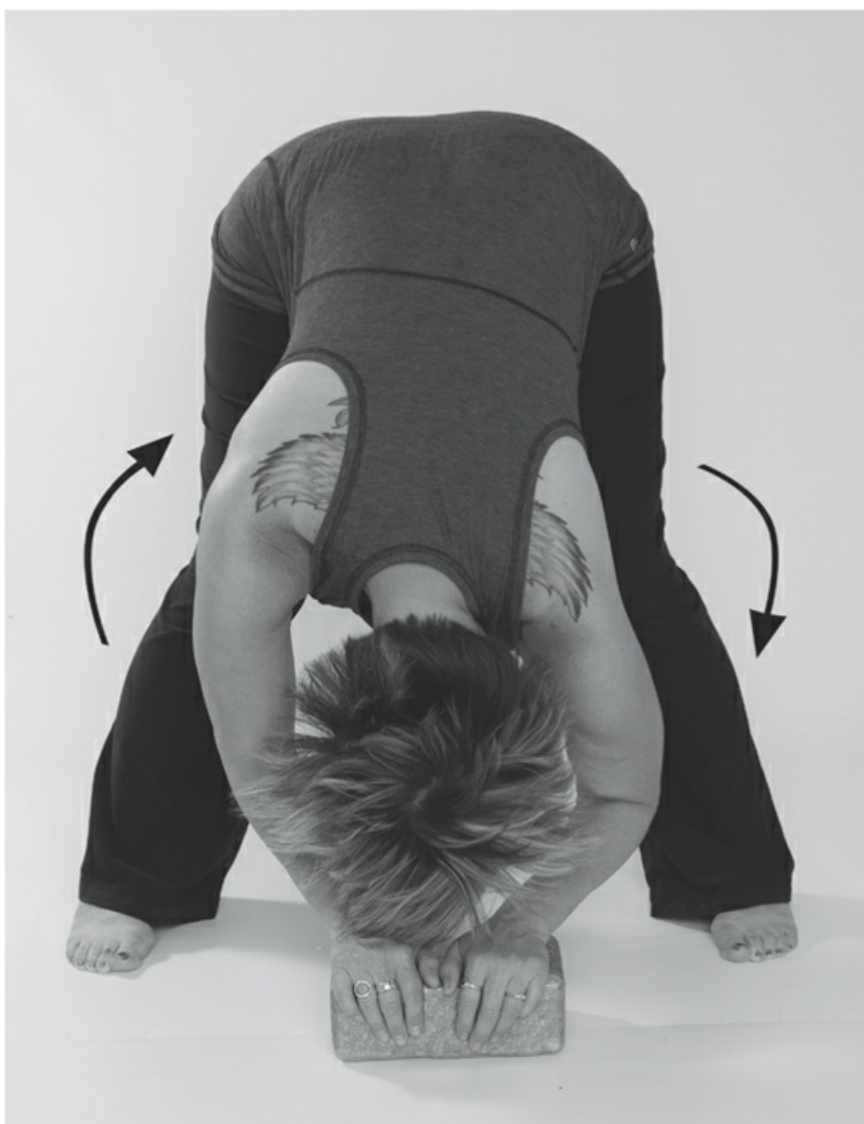
*Photo 111*



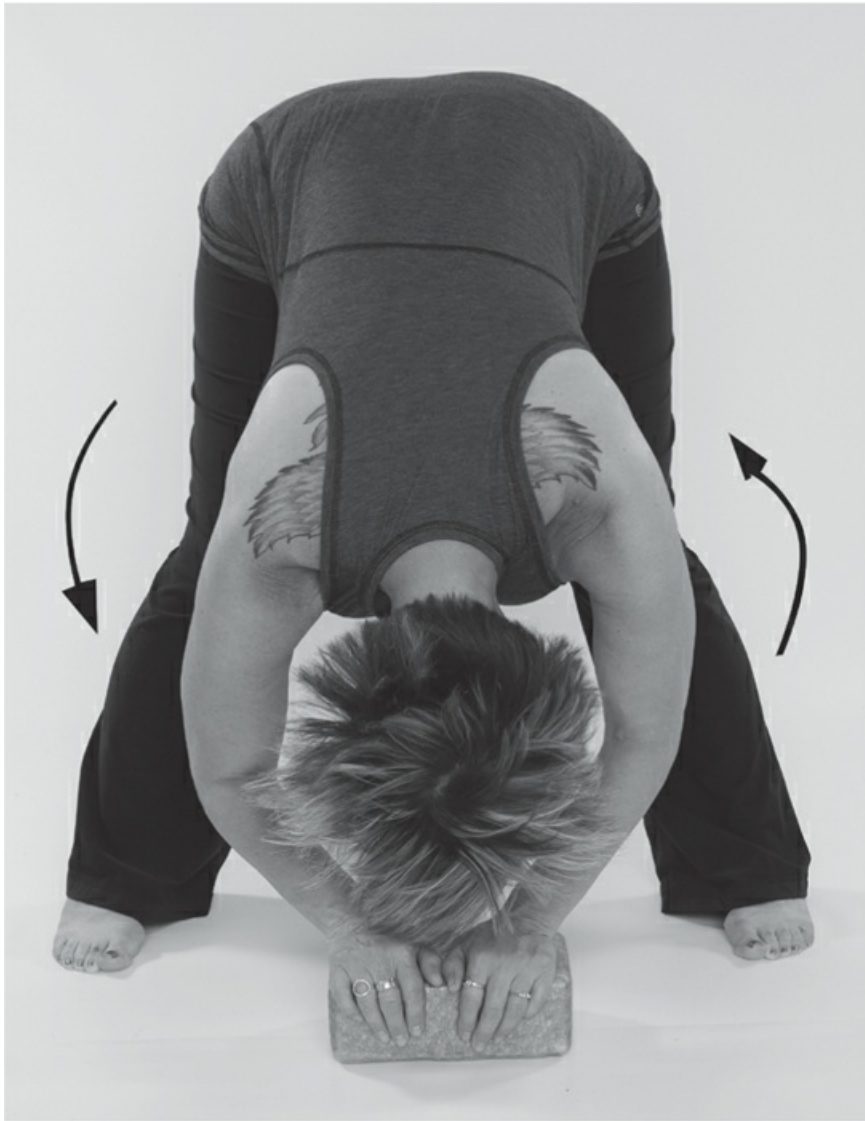
*Photo 112*



*Photo 113*



*Photo 114*



*Photo 115*



*Photo 116*



*Photo 117*





*Photo 118*



*Photo 119*



*Photo 120*



*Photo 121*



*Photo 122*



*Photo 123*



*Photo 124*



Photo 125

## Sequence B

1. **Seated Mountain Pose.** Take **Comfortable Pause (CP)** after exhale. ([Photo 126](#))
2. Do 2–3 rounds of **Diaphragmatic Hugs (Silent Hugs)** with hands on rib cage, pumping to fatigue. ([Photos 127 inhale; 128 exhale](#))
3. **Core Breathing** for 3 minutes; **Extended Breath Hold (CP + 5)**; **Core Breathing** for another 3 minutes. ([Photos 129 and 130](#))
4. **Thunderbolt Pose.** 2-part krama exhale, cue for TVA engagement and correct rib cage position (no rib-jut or slump). Repeat 4–6 times. ([Photos: 131 inhale; 132 exhale, pause; 133 exhale, pause](#))
5. **Diaphragmatic Push-Ups.** Repeat to fatigue. ([Photos 134 and 135](#))
6. **Cobra Pose with Wide V/Narrow V**—Block between calves. Cue for engagement of abdominals, mid-back, and neck core. ([Photos: 136 exhale, set core; 137 inhale,](#)

**lift chest, press scapula apart, wide V; 138 draw scapula together, narrow V)**  
Alternate the V position with the upper body 6 times.

7. Pause. Rest. Let breath settle completely.
8. **Baby Plank—Hover Position** on forearms with or without knee lifts. All core muscles engaged. Suspend breath 5–6–7 seconds after exhale while in pose. Keep rib cage in, neck core engaged. Gaze towards floor. Rest. Repeat 2–4 more times as able. (**Photos 139, 140**)
9. Press up into **Down Dog** from **Full Plank** on suspension, using core muscles. Repeat the **Full Plank (Photo 141)** to **Down Dog (Photo 142)** on suspension 3–4 times. Rest in **Child's Pose (Photo 143)**. Let breath settle.
10. **Wheel Pose**. Cue for TVA engagement and rib cage position. (**Photos: 144 inhale; 145 exhale halfway; 146 exhale all the way**)
11. **Child's Pose** with **Scapular Swirls** and **Paint the Floor** undulations. (**Photo 147**)
12. **Lying Twist with Suspension**. Suspend breath 6–7–8 seconds progressively as you stay in the twist. Cross right knee over left. (**Photo 149**) Inhale; twist on exhale. (**Photo 148**) Move deeper into twist progressively with breath suspension. (**Photo 147**) Inhale back to starting position. Repeat 3 repetitions on each side, increasing the length of suspension.
13. **Supine Leg Extensions with Block with Suspension**. Start with knees folded into the chest, a block placed between the calves, arms down. (**Photo 131**) Cue for core; mid-back set; shoulders externally rotated, neck supported, neck core engaged, chin in. Inhale. Extend legs, option to raise arms. (**Photo 133**) Draw knees into chest, engaging core muscles. (**Photo 132**) Keep knees hugged in and suspend the breath for 6–7–8 seconds. Individual option to keep arms overhead or bring the arms down into the starting position. (**Photo 131**) Repeat 4–6 times, letting breath settle between reps. Can do this with arms resting at sides if more comfortable for neck and shoulders.
14. **Apanāsana**. Rock knees to chest gently.
15. **Shavāsana**. Maintain an awareness of the **Subtle Breath**. (**Photo 153**)
16. **Seated Mountain Pose. Halo Breathing** 5 minutes. Then, maximum suspension after exhale. Stay in the range of medium challenge where you are still able to maintain natural relaxed nose breathing after the breath hold. One round. Then repeat 5 minutes of **Halo Breathing**. (**Photos 154 and 155**) Repeat a second round of **Maximum Breath Hold** followed by **Halo Breathing** if time allows.
17. Sit in meditation with relaxed breath. Observe natural breath pattern and effect of practice. 5–10 minutes.
18. Take **CP** again and compare to beginning of practice.



*Photo 126*



*Photo 127*



*Photo 128*





*Photo 129*



*Photo 130*



*Photo 131*



*Photo 132*



*Photo 133*



*Photo 134*



*Photo 135*



*Photo 136*



*Photo 137*



*Photo 138*



*Photo 139*



*Photo 140*



*Photo 141*



*Photo 142*





*Photo 143*



*Photo 144*



*Photo 145*





*Photo 146*



*Photo 147*



*Photo 148*



*Photo 149*



*Photo 150*



*Photo 151*



*Photo 152*



*Photo 153*



*Photo 154*



*Photo 155*

## Sequence C

1. **Seated Mountain Pose.** Take CP. (**Photo 156**)
2. Three rounds of **Single Nostril Breathing** holding hand in **Pran** or **Apana Mūdra**. Breathe through left nostril 10 breaths; then right 10 breaths. Alternate. Maintain **Subtle Breath** at all times. (**Photos 157 and 158**)
3. **Thunderbolt.** 2-part inhale and 2-part exhale. (**Photos: 159 inhale; 160 exhale, pause; 161 exhale, pause**) Divide the breath and movement into two parts as you fold forward and come up, pausing at the half-way point with spinal extension, cores engaged. Repeat 4–6 times, slowly. Pause and let breath settle as needed between movements.
4. **Gate Pose (Kneeling Side-Bend).** Keep turned out knee bent at right angle to stabilize pelvis. Work mid-back by tucking the wing of the scapula in with each exhale. Cue for core, rib, and neck alignment. Inhale and extend the left arm. Pause 4 seconds after inhale; exhale, draw left scapula in and turn head to look down, hold

position for 4 seconds after exhale. Repeat the arm movement with the breath 4–6 times. Then change to other side. (**Photos 162, 163**)

5. **Standing Mountain Pose.** Settle breath. (**Photo 164**)
6. **Uttanāsana (Standing Forward Fold).** 2-part krama inhale and exhale. Inhale half-breath and raise arms softly out to side, no rib-jut, pause. (**Photo 165**) Inhale the second half-breath, and raise arms comfortably overhead, no rib-jut. (**Photo 166**) Exhale halfway, engaging the core and lower arms, folding forward to **Table Top Position**, pause. (**Photo 167**) Exhale the remainder of the breath and fold all the way into the forward fold, neck relaxed. (**Photo 168**) Pause and let breath settle. Then reverse, breaking the movement and breath into two segments as you come up to **Standing Mountain Pose**. Rest as needed between repetitions to allow breath to settle.
7. **Warrior 1 with Waitress Arms.** Focus on engagement of all the cores, set of the mid-back and rib cage. Come into **Warrior 1** with a broad, stable stance, back heel grounded, pelvis squared. (**Photo 169**) Externally rotate the arms, positioning them like wide Vs; flatten the palms towards the ceiling, as if you were carrying trays of schooners in each hand. (**Photo 170**) Engage all three cores and with a gentle in-breath, raise the arms as far as you can while maintaining good core engagement and no rib-jut. Exhale, press arms down to starting position. (**Photo 171** shows incorrect position, with sway back and rib-jut.) Repeat this action slowly 4–6 times, feeling the work throughout the body.
8. **Parsvottanāsana (Pyramid Pose).** Fold forward over front leg. Let breath settle. Undulate upper body and neck as needed. (**Photo 172**)
9. **Standing Mountain Pose.** Settle breath. (**Photo 173**)
10. Repeat **Warrior 1** to **Pyramid Pose** on second side.
11. **Prasarita Paddotanāsana (Wide-Legged Forward Bend) with Scapular Swirls.** (**Photos 174 and 175**) Take the legs wide and fold forward, undulating to release tension in upper back and neck.
12. **Upper Back Twist from Prasarita.** Emphasize action of the mid-back core, spinal extension, position of rib cage, and neck alignment. Keep inhale and exhale silent and light. Gently inhale and rotate into a thoracic twist to the left (right hand rests on a block). (**Photo 176**) Left hand extends across the left ear, pause 6 seconds, cores engaged, spine extended. (**Photo 177**) Exhale and gently draw arm back, tucking the wing of the shoulder blade to spine, and suspend breath 6 seconds. Repeat the arm extension/flexion movement 2–3 more times with breath retention and suspension. If neck is uncomfortable looking up, release head to gaze downward towards the floor; rock.
13. Fold forward. Let breath settle. Undulate. (**Photo 178**) Repeat twist sequence to the right. Fold forward and undulate to release upper back and neck.
14. **Sit in Mountain Pose. Core Breathing** 1–2 minutes. (**Photo 179**)
15. **SBH.** 6 rounds. Inhale/exhale/pinch nose, sway side to side while counting to 10. Gradually build to 11–12–13–14–15... Stay in the range of soft challenge where you

are still able to maintain natural, relaxed nose breathing between rounds. (**Photo 180**)

16. **Child's Pose.** Rest back and undulate as needed. (**Photo 181**)
17. **Supine Side-Bend with Snow Angel Arms.** Keep breath light. Support arm as needed. Extend right leg and right arm, creating a gentle crescent shape with your body. Keep left knee bent, foot on the floor to maintain stability in pelvis. Inhale gently in position. (**Photo 182**) As you exhale, sweep right arm down in an arc, like making a snow angel, rolling the head to the left. Repeat the arm and head movement for 3–4 more breaths and then stay in the side-bend for another few breaths with arm resting in extended position. (**Photo 183**) If the arm doesn't comfortably reach the floor, use a blanket to support it fully. (**Photo 184**)
18. **Apanāsana (Knees to Chest).** Rock gently to release back.
19. **Shavāsana.** Focus on light breath. (**Photo 185**)
20. **Seated Mountain Pose—Alternate Nostril Breathing with Subtle Breath.** Start on left side, use hand mūdra as in beginning of practice. Prop arms as needed to enable you to stay for 5–10 minutes without strain. (**Photos 186 and 187; 188 with props**)
21. Sit in meditation with relaxed breath. Observe. 5–10 minutes.
22. Take **CP**—compare to the beginning of session.

**Note:** If you take the final CP without pausing to allow the breath to fully settle and relax the number will likely be lower. Allow a minimum of three minutes meditative rest before checking your CP.



*Photo 156*





*Photo 157*



*Photo 158*



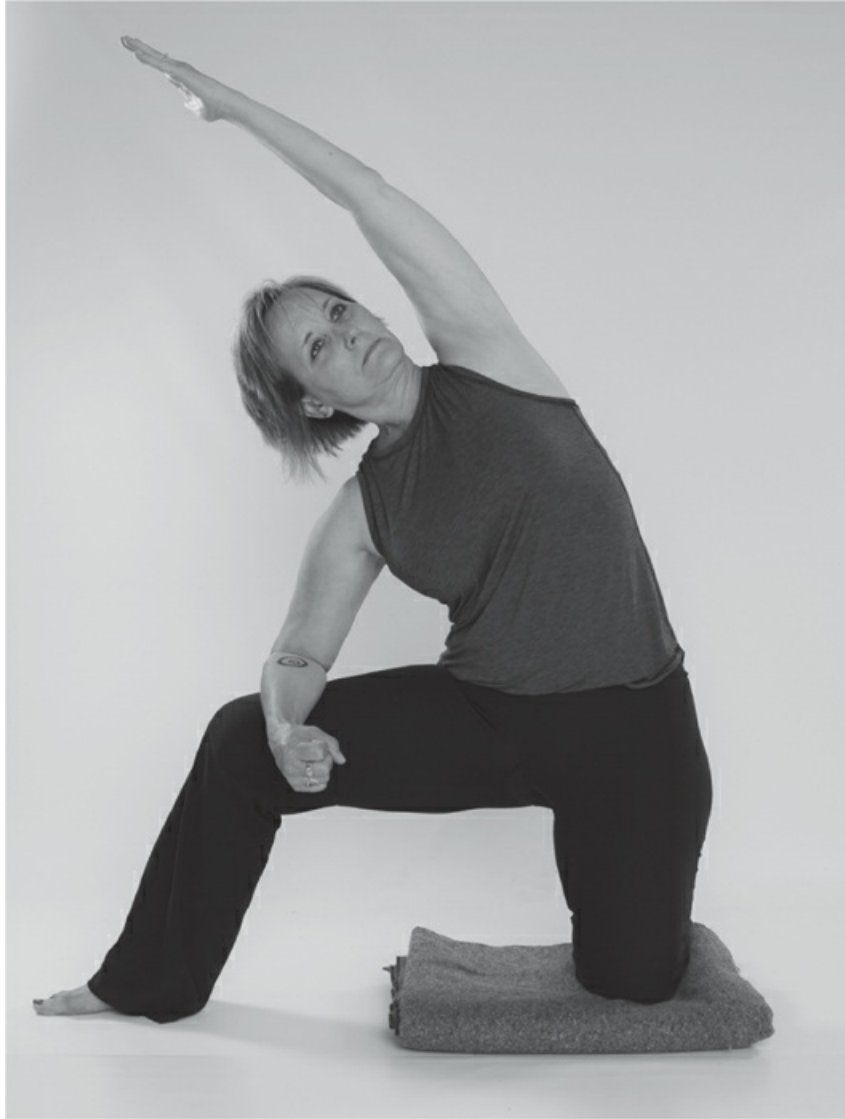
*Photo 159*



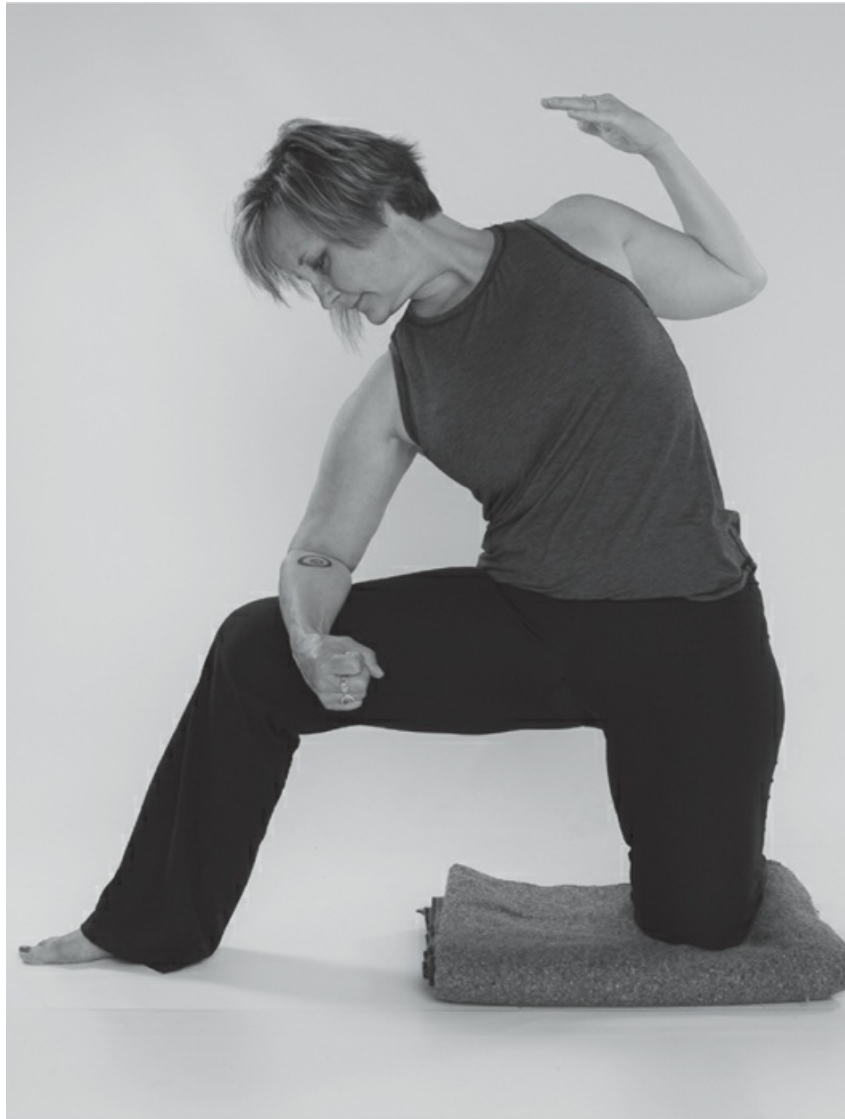
*Photo 160*



*Photo 161*



*Photo 162*



*Photo 163*



*Photo 164*





*Photo 165*



*Photo 166*



*Photo 167*



*Photo 168*



*Photo 169*



*Photo 170*



*Photo 171*



*Photo 172*

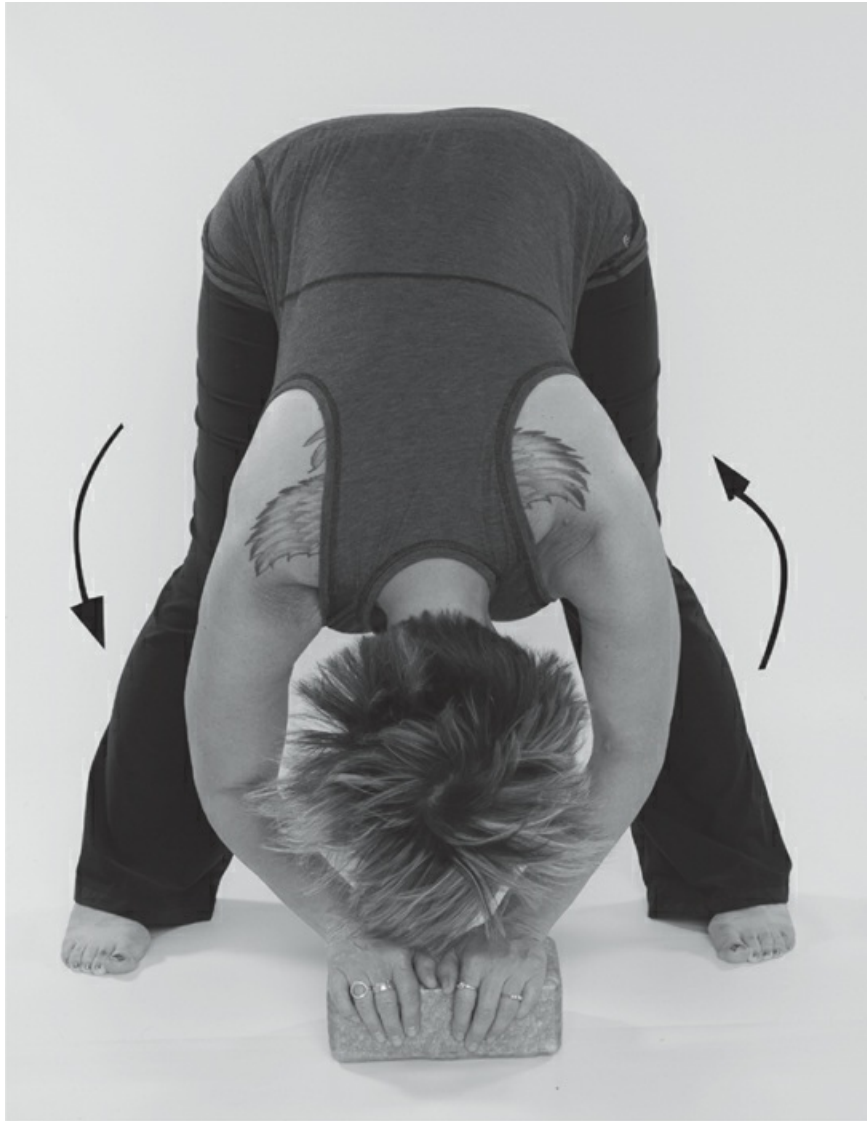




*Photo 173*



*Photo 174*



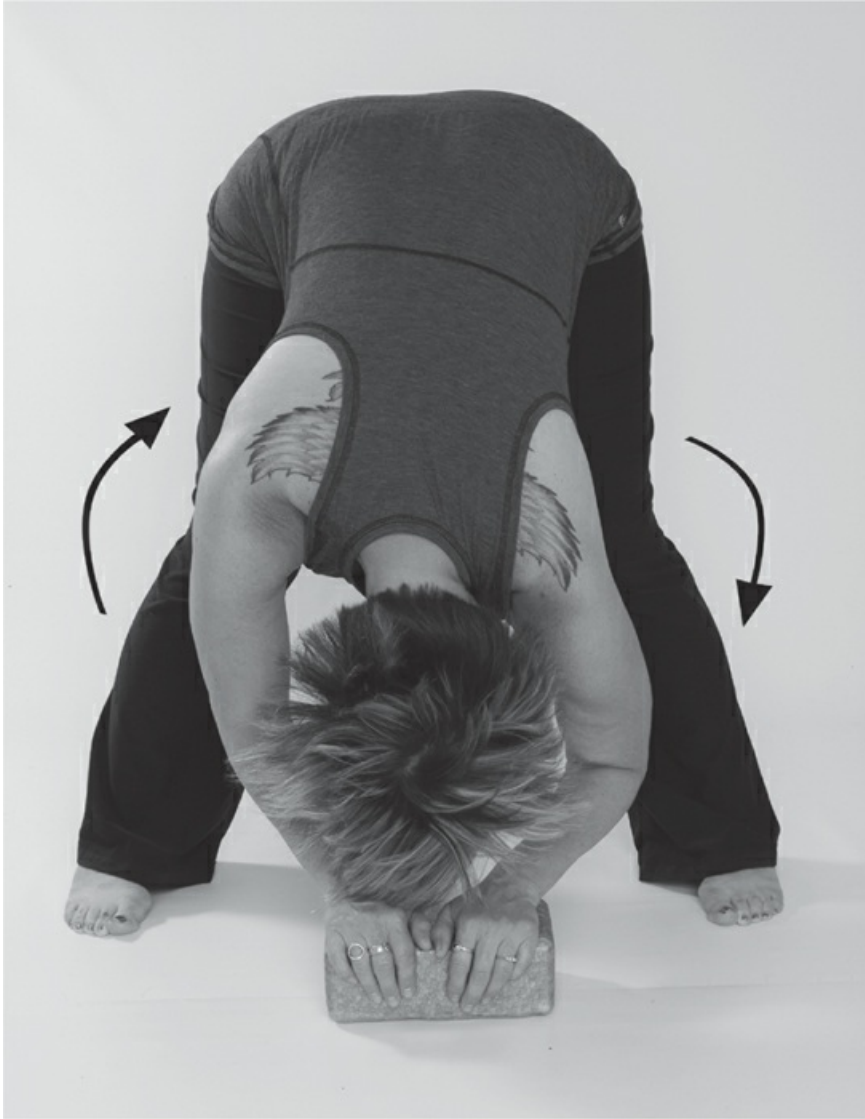
*Photo 175*



*Photo 176*



*Photo 177*



*Photo 178*



*Photo 179*



*Photo 180*



*Photo 181*





*Photo 182*



*Photo 183*



*Photo 184*



*Photo 185*



*Photo 186*



*Photo 187*



*Photo 188*

Once you are comfortable with the basics of these practices you can incorporate mantra, other mūdras, chakra visualizations, etc., through the practices.

As you have a sense of how to play with the components, you can, of course, weave them into your regular āsana sequences. You and your students will acclimate to this new breath style, as the language and rhythm of it becomes a part of your regular repertoire. When teaching, it's always good to sprinkle encouraging bits of education during the various exercises to satisfy the "whys" in the room. This is particularly important if you teach at a studio where students are going to a variety of teachers. They will be curious as to why your approach to the breath is so different from others they've experienced. Keep referring them back to their own experience as a guide, and support them in becoming more interoceptively aware by noticing their own felt difference with techniques, rather than getting into a competitive battle of "right/wrong" or "good/bad."

## Appendix II

# A GUIDE TO TEACHING FUNCTIONAL BREATHING FOR YOGA TEACHERS, YOGA THERAPISTS, AND HEALTHCARE PRACTITIONERS

*prāṇāyāma is a method for loosening and deleting negative conditions so we may experience life and the world as they truly are and not according to the painful imprints of our past.*<sup>1</sup>

Maehle, Cox & Watson

My personal experience with subtle, reduced breathing—and breath suspension—had proved nothing short of miraculous. Yet, when it came to transmitting that experience to my students and clients, I felt adrift on an island of one. How could I—should I—teach breathing and prāṇāyāma going forward? My teaching, founded on the principles of Viniyoga, centered around the breath. However, the cues I had become accustomed to using emphasized expanding the chest and abdomen with the inhale, and increasing both length and volume of the inhale and exhale. I became aware that, as a teacher, I had come to rely on the audible and visual reflection of my students breathing rhythmically in class. It supported a belief I held that they were calming their nervous system, and dropping into a healthy physiological state. Now, I had new information that ran directly contrary to that idea, and direct experience—pramāṇa—to support these new facts. **Subtle Breathing** is silent—and mostly imperceptible. How could I monitor the experience of my students with regard to their breathing, if not by seeing and hearing them breathe? I realized that I had to create a whole new set of parameters for assessing the breath and teaching it, in order to convey this new orientation.

This was, in part, what drove my frantic dive into the Vedic texts for help. I realized my Buteyko teachers couldn't assist me, because they didn't understand the culture of yoga and orientation to prāṇāyāma. My previous yoga teachers couldn't relate to this “non-yoga” breath modality—and either were mystified by my experience or dismissive of it. Validation from Patañjali's Yoga Sūtra, the Hatha Yoga Pradipika, and other texts gave me the courage to forge ahead. My students provided me with a soft receptive landing, and much-needed feedback, helping me hone new skills. The learning curve was steep. I was teaching therapeutic classes and individual therapy clients that clearly needed this information to

benefit their health. Simultaneously, I was attempting to weave the physiology of breathing and new techniques (all quite complex) into my training programs.

The process was clumsy and didn't always translate well. Both my verbal and non-verbal communication skills needed recalibrating. It was like learning a new language in how I spoke about the breath and how I breathed while speaking! Also, I had to shift in how I listened and watched for the breath. As I stepped out to face my students, I could hear the phrase T.K.V. Desikachar underscored, when I had the honor of studying with him at the Mandiram in Chennai. He said as yoga teachers we must "Never bluff!" So, in my conversation with students about the breath, I came "clean." I confessed that "I thought I knew—and then learned that I didn't know." As appropriate, I shared the truth of my own health struggles, which I had tried for years to disguise. It was humbling to say the least.

I brought my students in as allies, so we were navigating this new territory as a team. I made a point to frequently request feedback, leaving time at the end of class to allow them to share what was working, and what wasn't working for them, both in practice and in my instructions. I was pleased that the initial response was mostly positive. Over time, even those in my training programs who had been reticent to jump aboard the "lesser-breath train" came to appreciate the reduction in agitation, anxiety, and tension that it afforded. In this chapter, I share with you what I've learned from these past three transformative years. It is my intention to help guide you as teachers, program directors, and health practitioners in fostering a new relationship with the breath. Together, we are participating in a kind of "breath revolution" dedicated to offering our students and clients the very best in breath education and practical skills.

This appendix is organized in the following way. Depending on your particular interest, you can go directly to the sections that feel most useful to you:

- Putting it in Perspective: Healthy versus Rigid Breath Parameters
- Becoming Breath Detectives: Identifying Breathing Pattern Disorders
- Review of the Predominant Breathing Myths—and the Facts to Bust Them
- The Language of the Subtle Breath: Cuing to Help your Students Shift Focus

## **Putting it in Perspective: Healthy versus Rigid Breath Parameters**

In the early stages of my breath retraining program, I became a bit of a breath police dog, sniffing around for prāṇic leaks among everyone in my life. It took me some time to realize that withholding or suppressing the breath constantly wasn't much better than heaving and sighing all day. One of the most reassuring messages regarding the parameters of functional breathing came from Rosalba Courtney, DO, ND, PhD. Dr. Courtney is an internationally respected breath researcher and Buteyko trainer. Through her extensive study of breathing, she has established an acronym which she uses to define healthy breathing. According to Dr. Courtney, breath is functional when it has "EAARS"; that is, it is efficient, adaptive, appropriate, responsive, and supportive. With her permission, I offer you her description of EAARS.<sup>2</sup>

- *Efficient* means that the person is breathing in the way that is most efficient for their particular needs and circumstances. In the healthy person this means nasal breathing and abdominal-diaphragmatic breathing at rest. In the unhealthy person this can vary.

- *Adaptive* means that the breath needs to change according to activity, metabolic rate, or level of physiological or psychological arousal.
- *Appropriate* means that one's breathing (rate/volume and pattern) are properly matched to the metabolic, physical, postural, movement, and other needs of the moment.
- *Responsive* means that the breath needs to respond to the various body systems (e.g., the heart and circulatory system, the postural control system, the digestive system) that it interacts with in a way that maintains homeostasis for all systems.
- *Supportive* means the breath supports other body functions (i.e., vocalization, posture, core stability and motor control, gut motility and body systems, such as cardiovascular, lymphatic and digestive).

The way I interpret EAARS in everyday living is to recognize that healthy breathing means that the breath will change as we dial up or down activity, according to metabolic needs. Running for a bus requires a higher breath rate and volume than a leisurely stroll. Cheering on a sports team recruits the respiratory system differently than singing a lullaby. Emotional oscillations may sweep it higher in volume, or we may still it, as in moments of deep concentration or meditation. One's ability to gear-up, and then settle the breath afterwards reflects the qualities of efficiency, adaptability, appropriateness, and responsiveness. In other words, the breath should vacillate to meet the task of the moment, and also readily recover without signs of stress. With functional breathing, the breath is not flat-lined. Rigidity in the respiratory system would in fact reflect low *vīrya*—low vitality—and low *prāṇa*. As with the heart rate, there is a certain amount of variability to the breath that is healthy and well within the normative range. However, when EAARS is not present—in particular when there are signs of stress in the other systems, or a lack of stability in body or mind—the breath can become a regulatory mechanism we can consciously use to stabilize ourselves overall.

As yoga teachers and therapists, we want to have our radar attuned to those with conditions like asthma, sleep apnea, anxiety, depression, fatigue, systemic inflammation, auto-immune issues, and chronic pain. These are the folks we need to be particularly cautious about when suggesting breath protocols. Within the group class context, we won't always know the health history of any individual, which is why it's best to teach functional breathing basics as a general baseline. This keeps everyone safe—and will be especially beneficial for those who have an established *saṃskāra* of disordered or excessive breathing.

## **Becoming Breath Detectives: Identifying Breathing Pattern Disorders**

Identifying breathing pattern disorders is a yoga teacher/therapist's first job. As yoga teachers and therapists, we would likely notice if someone is having a full-on panic attack in class, but some of the more subtle signs of breathing pattern disorders are not always on our radar. Here are a few "tells" to look for in your students or clients to determine if their breath is in the functional zone:

- Observe how your students breathe before and after class when they are not aware that you are observing them. Is their mouth open, even when they are not talking? Do they gasp as they speak; rush their speech; inhale/exhale audibly; take frequent sighs; or yawn repetitively?

- Do you notice the movement of the breath when they are doing their seated meditation at the beginning of class? How about during Shavāsana at the end of class? If the movement is highly visible, it is likely they are breathing too much.
- How does the breath move when they are seated or standing: up and down, in a vertical direction? Or is it more lateral, that is, side to side? Do you see contraction around the neck, a raise of the collarbones, tightening of the jaw, or tension around the mouth as they breathe in? All of these can be indicators of chest breathing.
- Is the movement of the breath steady or erratic? Do the waves come in sets, whereby they are punctuated by a deep sigh, or period of non-breathing (apnea)?
- Can you hear them breathe? If you can hear the breath at rest, or even with light exertion, the volume is too high.
- Do their abdominal muscles engage and contract gently as they exhale, and release outward as they inhale? Is the belly held taut? Does the abdomen appear disengaged, flaccid, and disconnected from the breath?
- Once you become aware of your students' breath at rest, observe their breathing throughout their āsana practice:
  - Do they shift to thoracic breathing when their arms stretch overhead?
  - Does their breath automatically become harder, bigger, or more audible when holding stronger poses or doing bigger movements?
  - Are there audible sighs or big breaths when transitioning from one pose to another, or when shifting from sitting to stand, or from standing onto the knees?
  - What's the positioning of the rib cage in āsana—forward jut, neutral, or collapsed? Remember that the positioning of the ribs (the **ZOA**) conveys a lot of information about the functionality of the breath.
  - Do students unconsciously hold the breath with difficult postures, or tighten and tense the neck and upper body rather than stabilize with their core and base structures?
  - Which of the above cues help *you* as a teacher/therapist discern whether your students are using proper body mechanics to breathe and support themselves in their āsana practice? (e.g., engagement of the core muscles, neutral set of rib cage, proper alignment of the head, relaxation or tension in the face.)
- Do you ever find yourself confused by the pattern of breath you see in a student or client? I have found that sometimes I have trouble following the pattern because it is reversed—that is, the belly draws in with the inhale and releases out with the exhale. Can you train your eye to discern what is actually happening—even if it's not what you expect? This will help you identify when students are breathing in a paradoxical manner.

Learning to see and hear the breath through the lens of functional breathing takes time. Much like learning to “read” posture with āsana, we can train ourselves through practice. BPD abound everywhere in life, not just in yoga class. Begin to observe how people breathe while you walk down the street, or at the grocery store, or mall. When speaking on the phone, tune into the pattern of breath on the other end of the line. Does the person gasp between phrases



or sigh deeply at the end of a statement? The intention of this practice is not to pass judgement; it is offered as a means for you to develop a discerning eye and ear, so you can begin to understand the look, feel, and sound of functional and dysfunctional patterns.

Of course, the starting place in yoga is always with ourselves. I encourage you to bring a candid curiosity to the relationship between your own breath and prāṇa/vīrya/health, exploring the practices offered in this text with the intention to grow your svādhyāya. Through this, you'll be better equipped to translate what you see in others.

## **Review of the Predominant Breathing Myths—and the Facts to Bust Them**

Many people will think you are nuts as you try to explain that breathing less is healthier than breathing more. The pervasiveness of the many myths about the breath loom large. It's good to be prepared with a few brief statements of fact—your own set of myth-busters—to counter the skeptics and to make your case with confidence. Keep the explanations simple. If you pique curiosity, they'll ask for more. Then, you can begin to parcel out small threads of the physiology—always in digestible bytes. I strongly suggest you wait until you have fully digested the complexity of all the variables at play, and engaged in much self-study, before launching your lecture tour on the subject!

Here are some ideas to help you prepare for the onslaught of doubters:

### **Myth #1: The More We Breathe the Healthier We Are**

#### *Myth-Buster #1: More Isn't Better*

Compare breathing more to eating more. People understand that high caloric intake creates a burden on the system. Most, however, haven't considered that more breath can similarly cause our system to have to work harder. Explain that there is actually a "healthy" amount for us to breathe, just like there is a healthy daily caloric intake for food. Remind them that we can become habituated to anything—too much food or too much air—and that "too much" may start to feel "right" or at least familiar. This can help them understand why they may feel "hungry" while implementing a breath retraining practice—or "breath diet." Reinforce that it will require some consistency and patience until the new level becomes the new norm.

### **Myth #2: Taking a Bigger Breath Oxygenates Us More**

#### *Myth-Buster #2: Bigger Breathing De-Oxygenates Us*

Start by stating that "Breathing is primarily a chemical matter"—to paraphrase Leon Chaitow.<sup>3</sup> Oxygen and CO<sub>2</sub> are the building blocks of our chemical make-up. They need to be kept in balance with one another. The key to countering this myth is to differentiate between the act of breathing (Tier 1) and cellular respiration (Tier 3) (see [Chapter 3](#)). Inform people that breathing harder doesn't actually provide us more oxygen to utilize, but it will off-gas more CO<sub>2</sub>, which will diminish our ability to utilize oxygen efficiently (cellular respiration). This translates to less O<sub>2</sub> getting to the brain, the muscles...and all of the important organs and tissues of the body.

### **Myth #3: Taking a Deep Breath Means Taking a Big Breath**

#### *Myth-Buster #3: Deep Isn't the Same as Big*

Talk about the difference between “big” and “deep.” This is a good time to explain the location of the diaphragm, and then the importance of abdominal-diaphragmatic breathing. The lower lobes of the lungs are where the highest ventilation/perfusion (blood to gas exchange) happens, due to gravity. Abdominal-diaphragmatic breathing takes the inhalation deep into the lower ribs and increases the efficiency of ventilation/perfusion. One way to speak of this is to use a phrase like “Take the breath deep into the body.” Clarify that “bigger breaths” tend to recruit the accessory muscles of the chest—which is actually less efficient, and requires more oxygen to generate the action. It’s also good to remind your students that while the engagement of the abdominals assists breathing efficiency, the breath itself stays in the lungs!

#### **Myth #4: Our Need For Oxygen Governs Our Respiratory Rate**

##### *Myth-Buster #4: Carbon Dioxide Regulates Our Respiratory Rate*

I have found that people seem to understand the idea of a thermostat or “set point” in the brain that monitors our autonomic functions, like heart rate and breathing (the medulla). What most people don’t know is that the breath, specifically CO<sub>2</sub>, regulates pH levels in the blood (acidity and alkalinity). The rate and volume of breath is closely tied to maintaining pH at approximately 7.4. Breathing more or less (which will immediately impact CO<sub>2</sub> levels, but will not readily change oxygen levels in the blood) is the quickest way our body has to right the acid-alkaline balance in our body and maintain homeostasis (balance). Bottom line: CO<sub>2</sub> level is the regulator.

#### **MYTH #5: Carbon Dioxide Is Toxic and a Full Exhale Clears Space in the Lungs for Oxygen**

##### *Myth-Buster #5: Carbon Dioxide Is Critical for Maintaining Homeostasis (Health)*

There are actually two myths being addressed here. One is that CO<sub>2</sub> is toxic—which it is in its raw state. However, in our body it dissociates (which means it changes its chemical make-up) to bicarbonate, which acts as a buffer that supports homeostasis of pH, as mentioned in myth-buster #4. Additionally, CO<sub>2</sub> relaxes smooth muscle, decreases inflammation, and dilates the airways and arteries. Higher levels of CO<sub>2</sub> have a calming effect on the nervous system and neurological function. Lower than normal levels of CO<sub>2</sub> decrease our body’s ability to fully oxygenate—due to the Bohr effect. A final word on the second part of this myth: CO<sub>2</sub> does not “take up space” allocated for O<sub>2</sub>. They work synergistically together. Normal levels of CO<sub>2</sub> (40 mmHg) are necessary to our health, and the only way we can ensure the maintenance of that is by (1) increasing metabolism through movement (like daily exercise), and (2) sustaining a functional breathing pattern. MOVE MORE: BREATHE LESS!

#### **Myth #6: It Is Important to Empty the Lungs of Air**

##### *Myth-Buster #6: The Lungs Always Maintain a Residual Volume of Air*

The lungs always maintain 1–2 liters of residual air. It is impossible (unless you have a puncture or serious lung condition) to empty the lungs of air. This demonstrates the intelligence of the body, in that it maintains a reserve tank to ensure our survival. Attempting to empty the lungs through repetitive forceful exhalation will create short-term hyperventilation, and potentially throw our system out of chemical balance.

## **The Language of the Subtle Breath: Cuing to Help Your Students Shift Focus**

I was blessed to have Patrick McKeown as my primary trainer in the implementation of the Buteyko method. Patrick, an Irishman, has a naturally lyrical voice and his years of experience have honed his language of the breath to soothe and still. I have incorporated many of his ideas into the way I now cue my students in breathing. I also share with you some of my own wording, and others drawn from my practitioner network.

As teachers and therapists, the words we choose as we instruct impacts the mind of our students. We are modeling a way in which they can “speak” to themselves and guide themselves through life. It is important to have many ways to meet the many minds you encounter in any given class. Not everyone will respond the same to the same image. I always suggest you begin with the wording that resonates for you; however, it’s important to not get stuck there. Play with imagery and ways of modifying your instructions that maintain a firm foot on the vagal brake (PNS), while encouraging a curious and playful exploration of the breath.

The first challenge is knowing what to call this lighter breath. I interchangeably call it **Subtle Breathing**, **Akasha Breathing**, and **Feather Breathing**—although **Subtle Breathing** is my primary go-to. If I’m specifically cuing for TVA and/or PF engagement I’ll refer to it as **Core Breathing**. I deter people from calling it Shallow Breathing, as the association with shallow is chest breathing, which is dysfunctional and sympathetically driven. I also take time to explain why the breath is light but deep (as in abdominal-diaphragmatic—deep in the lungs) and what I mean by that, so they have a framework for understanding the difference. When people state that they breathe into their belly, I also take the opportunity to remind them that while the muscles of the abdomen can be recruited in a variety of ways, the air/breath stays in the lungs.

### ***Language to address volume and rate***

- Imagine the breath as a gentle wave on a placid lake.
- Make the breath light like a thin thread, barely perceptible.
- Breathe in just an inch into the nostrils, and out an inch.
- Imagine you had a feather in front of your nose and breathe so light that you don’t ruffle it.
- Keep the breath slow and low; notice that if you slow the rate too much, the volume will increase; if you lower the volume too much, the rate will increase. Find the sweet spot where you can sustain it: slow and low.
- Balance the breath rate and volume like a surfer riding the wave—find your Zen zone.
- Lower the breath to where you experience a slight air hunger—there’s an awareness of a desire for more—and yet it’s tolerable, sustainable.
- Breathe into your quiet center.
- Breathe as if you were Buddha—in a state of deep meditation.

### ***Language suggestions to address the biomechanics of breathing***

**Note:** The use of hands-on positions can be very helpful to build proprioceptive feedback (the student places their own hands on areas of their body).

- Observe a lateral flare of the lower rib cage: expanding gently on the inhale, contracting inward on the exhale.
- Pacify and neutralize the movement of the chest.
- Imagine the breath is only happening from the lower rib cage down.
- Engage the abdominals like zipping up a pair of jeans, hugging inward, with each exhalation.
- Tether the lower rib cage towards the bones of the pelvis to avoid “rib-jut.”
- Balance the front and back of the rib cage so they are even across the horizontal plane.
- Feel the lower ribs flaring like a jelly fish—expanding with the in-breath, gently folding in with the out-breath.
- Engage the muscles on the front of the neck in a slight tuck.
- Bring the chin very slightly in towards the throat, as if bowing the head subtly to the heart.
- Lengthen through the back of the neck as if pressing the head into an imaginary headrest.

### ***Addressing psycho-emotional fluctuations***

- Notice the effect of the breath on the mind; if you experience a sense of “not enough,” remind yourself that you are here—thinking—sensing—feeling...very much alive.
- Try repeating a silent mantra—“This is enough” or “I have enough”—with each exhalation breath. Or “om shanti,” blessing yourself with peace.
- If feelings of panic arise, think of this breathing as portion control. You are learning how to breathe within your needs—it’s assisting you in breaking your addiction to big breathing.
- If the level of breath gets too low (and you feel gaspy or panicky), remember you can always choose to take a few relaxed natural breaths, and then return to the **Subtle Breathing** when you’re ready. You always have the choice.
- Add a swaying or undulating movement if you find the reduced breathing agitating. Let yourself be rocked and soothed by the movement.

## Appendix III

# PRĀṆĀYĀMA CURRICULUM FOR PROGRAM DIRECTORS KEY CONCEPTS AND PRACTICES

As a program director, you need to know more than your teachers/therapists-in-training about the subjects you are teaching. While the detail in this book may suit your level of interest, within the confines of a training program, there is only so much information your students will be able to digest and assimilate. I have found that layering the information—and always keeping it tied to sadhana (experiential practice)—is critical in order for trainees to engage with the material. Too much theory alone keeps the information locked in the manomaya. The sequences offered in this appendix will provide you with a demonstration for how to develop practices.

To develop a prāṇāyāma curriculum, I recommend following the structure laid out in this text on a monthly basis, depending on the length of your program. Emphasize the key concepts associated with each of the first ten chapters, while adding in a few details from the chapter summaries. Ultimately, focus on the practices. These will offer your students a direct vehicle for personal transformation. As questions arise, you can weave in the facts contextually. The creation and maintenance of the **Svādhyāya Breath Journal** throughout the training program provides your students a way of self-monitoring their experience—and you a window into the allocation of their prāṇa and their progress.

Below is an outline of the key concepts and practices from [Chapters 1–10](#) as an easy reference guide.

## **Chapter 1: The Origins of Prāṇāyāma** **Chapter Overview**

- Prāṇa (animating life-force), citta (mind), and breath are intimately linked.
- A primary intention of yoga practice is to create a sattvic (harmonious) flow in prāṇa through the breath, so that citta (mind) will become still.
- The teachings of yoga call on us to become aware of and transform the saṃskāras (imprints created by habitual patterning) that lead to duḥkha (stuckness/suffering).
- Breath and thought are the most habitual saṃskāras that we engage in every day.
- Prāṇāyāma is the practice of restraining the breath to restore prāṇa and create a more sattvic mind.
- The practice of kriya yoga combines tapas (disciplined action to transform

saṃskāras), svādhyāya (self-awareness), and īśvara pranidhāna (devotion, dedication and surrender).

- Prāṇāyāma is considered the greatest tapas.

### ***Putting It into Practice***

Kriya Yoga Exploration:

- Creating your **Svādhyāya Breath Journal (SBJ)**
- Svādhyāya on the breath
- Tapas with the breath
- Īśvarapranidhāna with the breath

Create your **SBJ**, decorating as you like so it feels like it's representative of you. Keep this journal with you throughout your day, so you can make entries whenever you feel called to do so. Follow the instructions for the kriya yoga explorations and track your experiences in your **SBJ**.

## **Chapter 2: Prāṇa, the Subtle Body, and the Energy Bank Account**

### ***Chapter Overview***

- Prāṇāyāma is the primary tool from yoga given to balance our prāṇa.
- Prāṇāyāma practices need to be adapted and titrated appropriately according to environmental, cultural, and individual circumstance.
- Breath was used as a “diagnostic” tool by the yogis. Improper breathing was commensurate with health concerns and mental instability.
- The panchamaya (the five dimensions of your being) interrelate and inform one another.
- The prāṇamaya consists of the five winds (vāyus) and provides a window into your prāṇic or energy distribution: what you take in, what you eliminate, digest, assimilate, and offer up to the world.
- Before embarking on a prāṇāyāma practice, it is helpful to assess your Energy **Bank Account (EBA)** and to monitor it over time to observe how the practice is serving you.

### ***Putting It into Practice***

Monitor your **EBA**.

Respond to the suggested reflections and observe how you relate to your five prāṇas/vāyus through this tool over the course of a month. Record your reflections and your experience in your **SBJ**.

## **Chapter 3: The Biochemistry of Respiration**

## **Chapter Overview**

- The primary function of breathing is to oxygenate the cells of the body.
- Proper oxygenation depends on the balance between O<sub>2</sub> and CO<sub>2</sub>.
- Healthy breathing is primarily about efficient exchange of gases in the lungs and in the tissues to produce energy and maintain pH.
- Low levels of CO<sub>2</sub> in the blood compromise our health and make us vulnerable to disease.

## **Putting It into Practice**

Measure your CO<sub>2</sub>: Take your **Comfortable Pause (CP)**.

Understand and track your **CP**.

Track your **CP** daily, noting how your daily activities appear to relate to the variety or stability of your reading. Record observations in your **SBJ**.

## **Chapter 4: Hyperventilation: The Saṃskāra of Breathing Too Much**

### **Chapter Overview**

- Chronic hyperventilation is one of several breathing pattern disorders (BPD).
- The average person breathes 15,000–20,000 times a day. People with chronic pain, illness, or anxiety, or who talk for a living often breathe 2–3 times more than normal (both faster and more volume).
- The symptoms of hyperventilation syndrome (HVS) mimic many of the common maladies described by yoga students and yoga therapy clients.
- Taking a big sigh or gasp will alleviate the immediate sense of dyspnea (breathlessness) but may perpetuate the chemical imbalance that promotes hyperventilation.
- **Subtle Breathing** is a reduced breathing practice and the basis for all prāṇāyāma practices offered in this text.

## **Putting It into Practice**

**Subtle Breathing.**

Practice Subtle Breathing, as described, tracking your **CP** and your experience of it in your **SBJ**. How does the subtle breath effect your prāṇa, and your **EBA**?

## **Chapter 5: Biomechanical Considerations: Nose versus Mouth**

### **Chapter Overview**

- The nose was designed for breathing and is our immune system’s first line of defense.
- The nose warms, humidifies, and cleans the air, preparing it for the lungs.
- Mouth breathing is associated with chronic nasal congestion, cognitive impairment, memory and concentration difficulties, headaches, TMJD, and sleep issues.
- Breathing less, lighter, and through the nose reduces vata, balancing prāṇa.
- Breath retraining must be done slowly, as multiple factors—most critically the impact of the breath on the nervous system—need to be respected.

## ***Putting It into Practice***

Nose clearing exercise.

Tongue exercises:

- Jiva mūdra
- Washing the teeth with the tongue
- Tongue extensions
- Kechari mūdra
- Clucking with mouth closed
- Shīṭali/Shītkari

Speech exercises:

- Alphabet practice
- Reading aloud
- Mantra

Mouth taping:

Experiment with some or all of these practices and track how your breath awareness is evolving in your **SBJ**. If you realize you have had a consistent BPD, as in mouth, chest, belly, paradoxical breathing, or hyperventilation, reflect on the challenges you experience in the process of changing these saṃskāras. Are you able to bring humor and patience to the process? What helps you stay committed to your tapas and maintain a quality of saṁtosa—contentment, acceptance—as you deconstruct your patterns?

## **Chapter 6: Center Stage: The Diaphragm**

### ***Chapter Overview***

- The diaphragm is designed to synchronize with the abdominal core in functional breathing, and acts as a primary core stabilizer.
- The thoracic accessory muscles are only to be “called into action” in the case of intense physical activity (like running up a hill or with heavy lifting), or in times of emotional stress (e.g., to support the vocalization of a call for help).



- The diaphragm acts as a visceral muscle representing a central meeting point for the cardiovascular system, digestive system, musculoskeletal system, and the autonomic nervous system.
- Consistent movement of the diaphragm with breathing plays a vital role in maintaining physiological health in the other systems of the body.
- The **Zone of Apposition (ZOA)** represents the importance of placement of the rib cage in movement activities. Checking for rib-jut or rib collapse in āsana provides a powerful tool for transformation movement and breath to become more functional.
- Functional breathing supports functional movement and reduces risk of injury.

## ***Putting It into Practice***

Undulation as a pratikriya.

Undulation exercises:

- Scapular Swirls
- Passing Notes
- Paint the Floor
- Doodle with Your Nose
- Undulations from a forward bend position
- Rapunzel

Core breathing:

Developing the diaphragm

- Diaphragm Hugs
- Silent Hugs
- Diaphragmatic Push-Ups.

Weave these exercises and a **ZOA**, diaphragmatic awareness into your āsana practice. Notice how this affects your breathing, your core stability, and your overall awareness of the connection between body, breath and mind. Track these changes in your **SBJ**.

## **Chapter 7: The Core, The Bandhas, and the Breath**

### ***Chapter Overview***

- The yogis used the bandhas to regulate the ANS and sustain longer breath holds.
- The bandha muscles can help us maintain structural stability, functional diaphragmatic breathing, and parasympathetic regulation.
- It takes time to develop these core muscles, and they must be worked slowly, in a relaxed way with attention and awareness.

- Working the core muscles this way develops svādhyāya and containment of prāṇa in profound ways—even if one never utilizes the full bandhas.

### ***Putting It into Practice***

Developing the transversus abdominis (TVA):

- Block squeeze and 2-part exhale
- Apanāsana (Knees to Chest) with 2-part krama exhale
- Bridge with Block 2–3 part krama exhale
- Chakravakāsana (Wheel Pose) with 2-part exhale
- Baby Plank—Hover Position Knees Down
- Baby Plank with Alternate Knee Lifts

Developing the Pelvic Floor:

- Bolster Straddle
- Bolster Straddle Chair Variation with Blanket Roll
- Anemone Hand Pulses
- Dynamic Butterfly Pose

Developing the Mid-Back Core:

- Wide V/Narrow V with PF and TVA engagement from supine position
- Shalambhāsana (pronounced shah-law-bah-sah-nah, Locust Posture) with Wide V/Narrow V

Developing the Neck Core:

- Baby Fish 1-2-3-3-2-1
- Masthead
- Neck Core Lifts

Integration of core alignment at wall:

- Chair at the Wall

Once you’ve developed the capacity to access each of the “cores” individually, weave them more into your āsana practice and observe the effect on your breath, stability, endurance, and balance in postures. Also make note of the impact on your mind and your interoceptive awareness. Track these changes in your **SBJ**.

## **Chapter 8: The Emotional Brain and the Breath**

### ***Chapter Overview***

- Our brains are wired for survival—not for happiness.

- Yoga practices can help us to move from a fearful, avoidance reaction—the low road—to become resilient, high-road responders.
- Stress resilience is best assessed by our ability to apply the vagal brake, prior to a stressful event.
- Neural integration happens TOP-DOWN (brain-to-body) and BOTTOM-UP (body-to-brain).
- Combining prāṇāyāma with movement, relaxation practices, education, and awareness processes supports good neural integration.
- Breath retraining needs to adapt for the emotional resilience of the student or client, in order to foster compliance and facilitate success.

### ***Putting It into Practice***

Sensory svādhyāya practice.

Wiring up the vagus:

- Brahmari
- Silent Mantra
- Halo Breathing
- Short Breath Holds with Movement
- Combination Practice

Take some time with each of the suggested practices to understand which ones help your mind and ANS become more sattvic. Once you discover tools that are compatible for your make-up, practice them more regularly. Track your **CP**, your stress resilience (vagal brake), and overall expression of udāna. Note your experience in your **SBJ**.

## **Chapter 9: The Mind of the Subtle Body: Citta, Chakras, and the Breath**

### ***Chapter Overview***

- Citta (mind) houses the manas (sensory relay), ahaṁkāra (sense of “I”), and buddhi (wisdom mind/mind of discernment) and regulates the flow of sensory input.
- Our relationship to the senses and sensory input greatly determines our level of reactivity.
- Pratyāhāra (introspection and interoception) helps us to direct our attention away from sensory gratification and settles the mind—prāṇāyāma helps us develop pratyāhāra.
- The chakra model provides us a way of integrating the nervous, endocrine, and sensory system with the mind and the elements to achieve psychophysiological balance.
- The combination of prāṇāyāma nostril techniques with the bhāvana of the chakras, along with mantra and mūdra can be a very powerful means to direct prāṇa and

transform the mind.

### ***Putting It into Practice***

Svādhyāya chakra and mūdra practices:

- Color play
- Mantra practice
- Mūdras

Prāṇāyāma nostril techniques:

- Nādi shodhāna
- Viloma ujjayi
- Anuloma ujjayi
- Pratiloma ujjayi
- Chandra bhedana
- Sūrya bhedana

As with the previous chapter, explore these various techniques to discover which ones are most useful for you. Then, stay with that and work with it 2–3 times a day for 15 minutes at a session. Track your **CP** and your inner awareness. Add these notes to your **SBJ**.

## **Chapter 10: Prāṇāyāma as Kumbhāka**

### ***Chapter Overview***

- Prāṇāyāma is, in its essence, kumbhāka—the practice of breath retention and suspension.
- The capacity to suspend the breath for longer periods of time on a regular basis is developed through progressive reduction of the ventilatory response (the urge to breath), by consistent lowering of minute volume.
- Practice of prāṇāyāma for approximately one hour a day, spread throughout the day, is the recommended “dose” to experience consistent beneficial health effects.
- There are contraindications to breath holding that must be respected: in particular the effect on the cardiovascular system.

### ***Putting It into Practice***

Bāhya kumbhāka: developing suspension.

Bāhya kumbhāka in exercises: breathe less, move more!

- Walking Practice
- Single Nostril Breathing with Walking
- Extended Breath Holds with Walking

Add kumbhākas to your prāṇāyāma practice as suggested. Consistently work towards lowering your minute volume, and sustaining the length of bāhya kumbhāka. As able, take these tools into exercise, āsana practice, or simple walking and observe the effect. Track your **CP**, heart rate, and effect on sleep, diet, mental clarity, emotional resilience, and physical endurance. Write up your experience in your **SBJ**.

At the end of the course, I would highly recommend you have each student read back through their **SBJ** and write up a summary of their overall experience in the context of their **EBA**, their svādhyāya (awareness), the tapas they developed (overcoming saṃskāras), and their connection to their inner self, puruṣa. I would also ask them to reflect on their understanding of prāṇa and the elements, and how prāṇa and citta are connected. Through this process, I think yoga students at all levels of training will become more astute observers of prāṇa and more skillful at supporting students or therapy clients through transformative processes of this kind.

## SANSKRIT GLOSSARY

**abhinevesha** (*ah-bhee-na-vaysh-ah*) Fear, ultimately the fear of death.

**agni** (*ahg-nee*) Digestive fire.

**agni sara** (*ahg-nee sar-ah*) A rapid pumping action of the abdominal muscles to generate heat within the abdominal area. Taken on the suspension of breath after the exhale.

**ahaṃkāra** (*ah-hahm-kar-ah*) The ego or “I maker.” According to Vedic philosophy this is the part of the mind that allows us to think of ourselves as separate and say, “I am afraid,” or “That’s mine.”

**ahimsā** (*ah-him-sah*) Non-violence, cultivation of compassion and empathy for others.

**ajña** (*ahj-ñah*) The sixth chakra, known as the command wheel and located in the third eye region.

**akasha** (*ah-kah-sha*) Space—the most subtle of all the elements.

**alabdhabhūmikatva** (*ah-lob-da-boom-ee-cot-vah*) The state of not obtaining any degree of deep meditation.

**ālasya** (*aw-lahs-yah*) Sloth, laziness.

**ama** (*ah-ma*) Waste.

**amrit** (*ahm-rit*) The divine nectar that flows from the sinuses down into the back of the throat.

**anahata** (*ahn-aw-hah-tah*) The fourth chakra, known as the wheel of unstruck sound and often referred to as the lotus of the heart. Located in the heart region.

**ānandamaya** (*aw-nahn-dah-mai-yah*) The fifth maya and most subtle dimension of our being, composed of bliss or joy.

**anavasthitatvāni** (*ah-nah-vahs-teet-aht-vawn-ee*) Inability to maintain inner stability once attained.

**annamaya** (*ahn-nah-mai-yah*) The first maya or dimension of prakṛti, which encompasses the “food body” or structural body.

**antarāyāh** (*ahn-tar-ai-yah*) The obstacles along the way.

**antara kumbhāka** (*ahn-tara koom-bah-kah*) Retention (holding) of breath after inhale.

**anuloma ujjayi** (*ahn-u-low-mah oo-jai-yee*) A form of prāṇāyāma practice that involves alternate nostril exhale and ujjayi inhale.

**apāna** (*ah-pawn-ah*) The aspect of prāṇa responsible for eliminating waste products from the body.

**apanāsana** (*a-pa-nah-sa-na*) Supine posture, which involves drawing the knees into the chest. Also known as the Wind-Releasing Pose.

**apānavayu** (*ah-pawn-ah vai-yoo*) The wind of prāṇa that governs downward flow, elimination.

**aparigrahā** (*ah-par-i-grah-haw*) Living simply with what we need rather than hoarding what we want.

**āsana** (*aw-sah-nah*) Seat or posture. The ability to sit with stability and ease in order to practice prāṇāyāma and meditation. Commonly refers to the postures of hatha yoga practice.

**asmitā** (*ah-smee-taw*) I-am-ness. The awareness of oneself as a distinct being.

**asteya** (*ah-stay-ah*) Non-stealing; integrity in action; not taking what has not been offered to us.

**asthanga yoga** (*ahsh-tahn-gah yo-ga*) The eight-fold path of yoga.

**avidya** (*ah-vid-yah*) Ignorance.

**avirati** (*ah-vir-ah-tee*) Lack of detachment.

**Ayurveda** (*ai-yur-vay-dah*) The science of life or life knowledge, the ancient medical system of India.

**bāhya kumbhāka** (*buy-yah koom-bah-kah*) Suspension (holding) of breath after exhale.

**bandhas** (*bahn-dahs*) Muscular locks.

**bastrika** (*bah-streek-ah*) A cleansing breath practice commonly called Bellow's Breath.

**bhāvana** (*baw-vah-nah*) Cultivation, what we dwell upon, our intention.

**bhrānti** (*brawn-tee*) Confusion, error.

**bhrānti darśana** (*brawn-tee dar-sha-nah*) False or distorted perception.

**brahmacharya** (*bra-mah-char-yah*) Conservation of energy; abstaining from actions that deplete us or infringe on others.

**brahmari** (*brah-mar-ee*) The Bee Breath or humming.

**buddhi** (*bood-deeh*) According to Vedic philosophy this is the discriminating aspect of the mind that allows for higher, rational thinking.

**chakras** (*chah-krahs*) The energy centers.<sup>1</sup>

**chandra** (*chahn-drah*) Refers to the moon channel, the feminine or receptive energies within us. Correlates with idā nādi.

**chandra bhedana** (*chahn-drah bayd-ah-nah*) A prāṇāyāma practice that involves breathing in and out of the left nostril.

**citta** (*chit-ta*) Mind.

**dhāraṇā** (*d-har-ahn-aw*) Concentration; commonly refers to the object one chooses to concentrate on in meditation.

**dharma** (*dahr-mah*) Purpose.

**dhyāna** (*d-hee-yawn-ah*) Meditation.

**dīrgha** (*deer-gah*) Long (refers to the ability to sustain the space between breaths).

**dosha** (*doe-shah*) Ayurvedic term referring to the three bodily humors (or elemental constitutions) of vata (air + space), pitta (fire + water), and kapha (earth + water).

**duḥkha** (*dooh-khah*) Suffering or stuckness.

**dveṣa** (*di-vesh-ah*) Aversion.

**guṇas** (*goo-nahs*) The three energetic qualities of prakṛti or nature (lucidity, action, and inertia).

**hatha** (*hah-tah*) “Ha” refers to the sun or masculine energy, and “tha” to the moon or feminine energy; hatha yoga aims to merge and balance these two energies.

**hṛdaya** (*h-rid-ayah*) Heart.

**īḍā nāḍi** (*ee-dah nah-dee*) According to esoteric anatomy, this is one of the three major channels of energy running through the body. It is connected to the left nostril and is associated with cooling, quieting, and feminine and receptive energies.

**indriyas** (*in-dree-yahs*) The senses.

**īśvarapraṇidhāna** (*eesh-va-rah pra-nee-dha-nah*) Dedication to God.

**jālandhara bandha** (*jawl-ahn-dah-rah bahn-dah*) A hatha yoga technique referring to the action of “locking the throat” in order to contain energy.

**jiva mūdra** (*jee-vah moo-drah*) Tongue lock.

**kapālabhāti** (*kah-pall-ah-bah-tee*) A cleansing breath practice commonly called the Skull Shining Breath.

**kapha** (*kah-pha*) One of the three Ayurvedic doshas (bodily humors or elemental constitutions), kapha is made of earth and water and has the qualities of heavy, cold, oily, and sweet.

**kechari mūdra** (*kay-char-ee moo-drah*) You could think of this mūdra as a “tongue lift,” as it requires stretching the tongue up into the cavity of the soft palate.

**kevala prāṇāyāma** (*kay-vah-lah prawn-aw-yaw-mah*) The natural cessation of the breath.

**kleśas** (*klay-shas*) Afflictions or impediments. The Yoga Sūtras list five of them: ignorance, ego, attachment, aversion, and clinging to life.

**kriyas** (*kree-yahs*) Cleansing techniques of hatha yoga.

**kriya yoga** (*kree-yah yo-ga*) The yoga of action.

**kumbhā** (*koom-bah*) Water jar.

**kumbhāka** (*koom-baw-kah*) Retention or suspension of breath. Used synonymously with prāṇāyāma in the Vedic texts.

**manas** (*mah-nahs*) Sensory relay center. According to Vedic philosophy this is the part of the mind that takes in information from external and internal sources via the sense organs.



**maṇipūra** (*mah-nee-poor-ah*) The third chakra, known as the wheel of the jeweled city and located in the navel region.

**manomaya** (*mah-no-mai-yah*) The mental, sensory sheath of our being.

**manovahasrotas** (*mahn-o-va-ha-shro-tas*) The channels/nādis that govern the mind.

**mantra** (*mahn-trah*) Mental recitation that takes us out of our ordinary thought process, and connects us to something less fear-driven, like Light, Love, Peace or God.

**matra** (*mah-trah*) A form of measurement. In the context of prāṇāyāma it refers to the length of the distinct phases of the breath. In ancient times, a variety of means were used for keeping count of matras. Today, we can monitor matras of the breath in seconds.

**mokśa** (*mo-k-sha*) Freedom from any felt sense of separation from puruṣa (our divine nature).

**mūdra** (*moo-dra*) Literally means “seal” and refers to the practice of making intentional gestures with our hands or body.

**mūla bandha** (*moo-lah bahn-dah*) A hatha yoga technique referring to the action of “locking the root” in order to contain energy.

**mūladhāra** (*moo-lah-dah-rah*) The first chakra. Considered the root center and located at the base of the spine, near the coccyx.

**nādi** (*nah-dee*) Literally means “a river, channel, passageway, or pulse.”

**nādi shodhāna** (*nah-dee show-dah-nah*) A form of prāṇāyāma practice that involves alternate nostril inhale and exhale.

**nidra** (*ni-dra*) Nidra means “sleep” in Sanskrit and refers to both dreaming and dreamless sleep. However, the complete term here is yoga nidra. Yoga nidra is a specific meditative process that takes the practitioner systematically through the panchamaya to induce a state of deep relaxation and, ultimately, reunification with puruṣa.

**nirodhaḥ** (*ni-road-ah-hah*) Control or cessation. When all thoughts are still.

**niyama** (*ni-yah-mah*) The second limb of yoga, referring to the five self-disciplines of cleanliness, contentment, austerity, self-study, and dedication.

**ojas** (*oh-jahs*) The substance that, according to Ayurveda, provides us physical immunity and spiritual strength. It is also considered a store-house for sensory perceptions.

**Padmāsana** (*pahd-mah-sah-nah*) Lotus Posture.

**panchamaya** (*pawn-cha-mai-yah*) The dimensions of prakṛti. Also known as the koshas in some lineages.

**pancha vāyus** (*pawn-cha vai-yoos*) The five winds that move energy through us.

**Patañjali** (*pah-tawn-jah-lee*) The ancient sage credited with writing the Yoga Sūtras.

**piṅgalā nādi** (*pin-ga-lah nah-dee*) According to esoteric anatomy, this is one of the three major channels of energy running through the body. It is connected to the right nostril and is associated with heating, stimulating, masculine, and assertive energies.

**pitta** (*pit-tah*) One of the three Ayurvedic doshas (bodily humors or elemental constitutions), pitta is made of fire and water and has the qualities of hot, pungent, and liquid.

**prakṛti** (*prah-kri-tee*) Nature.

**pramāda** (*prah-maw-da*) Carelessness.

**pramāṇa** (*prah-mawn-ah*) Direct experience.

**prāṇa** (*prawn-ah*) Principal life air or life-force.

**prāṇamaya** (*prawn-ah-mai-yah*) The vital, energetic sheath of our being.

**prāṇavayu** (*prawn-ah-vai-yoo*) The wind of prāṇa that governs inward flow, ingestion.

**prāṇāyāma** (*prawn-aw-yaw-mah*) The practice of breath control.

**praṇidhāna** (*pra-nee-dha-nah*) Dedication and surrender. Wholeheartedly working towards spiritual progress.

**pratikriya** (*prah-tee-kree-ya*) Opposite action.

**pratiloma ujjayi** (*prah-tee-lo-mah oo-jai-yee*) A complex form of prāṇāyāma practice that combines anuloma and viloma ujjayi.

**pratipakṣa bhāvana** (*prah-tee-pahk-shah baw-vah-nah*) Cultivating the opposite of intention.

**pratyāhāra** (*prah-tee-ah-har-ah*) Sense withdrawal.

**prithivī** (*prih-tih-vee*) Earth.

**pūraka** (*poo-rah-kah*) The “sipping” of the inhale.

**puruṣa** (*pu-roo-sha*) The opposite of nature (prakṛti). Self, soul, pure awareness, unbound consciousness.

**raga** (*ra-ga* [hard “g”]) Interpreted in most texts as attachment, raga speaks to our tendency to become attached to the experiences that we “color” with the moniker of pleasure.

**rajas** (*rah-jahs*) Movement.

**rechaka** (*ray-cha-kah*) Controlled exhalation with diaphragmatic activation.

**ṛkshana** (*rik-shaw-na*) Protection for our body and mind.

**sahasrāra** (*sah-haws-ra-rah*) The seventh chakra, known as the thousand-spoked wheel or the thousand-petaled lotus and located in the crown of the head.

**samādhi** (*saw-mad-dee*) The deepest state of meditative consciousness. In samādhi, the movements of the mind have been stilled; all that remains is clear seeing.

**samāna/samānavayu** (*sah-maw-nah*) The wind of prāṇa responsible for digestion.

**sama vṛtti** (*sahm-ah v-rit-tee*) Equal movements, referring to a ratio where the four phases of breath (inhalation, retention, exhalation, suspension) are the same length (for example 1–1–1–1).

**Sāṃkhya** (*san-khi-ya*) One of six classical Indian philosophies designed to explain the nature of reality.

**samśāya** (*sum-shy-ah*) Indecision, doubt, skepticism.

**saṃskāra** (*sum-scar-ah*) Mental imprints or impressions created in the subconscious through every experience or thought we have.

**saṃyama** (*sum-yahm-ah*) The consistent and sequential practice of concentration, meditation, and absorption on an object of meditation.

**saṃtosa** (*sahn-toe-shah*) Contentment.

**Sarvāṅgāsana** (*sar-vahn-gah-sah-nah*) Shoulderstand.

**sat-saṃskāra** (*saht-sum-scar-ah*) Beneficial imprint or residue left from habituation of patterns (*sat* means true or good).

**sattva** (*saht-vah*) Light, balance. The energetic quality of clarity and illumination.

**satya** (*saht-yah*) Truthful communication, speaking of what's highest.

**śauca** (*shau-cha*) Purity, cleanliness of the body, mind, and heart.

**Shalambhāsana** (*shah-law-bah-sah-nah*) Locust Posture.

**shantiḥ** (*shahn-tee*) Peace.

**shatkarmas** (*shaht-kar-mahs*) Cleansing practices, used to reduce phlegm and congestion, and to aid digestion and elimination.

**Shavāsana** (*shah-vah-sah-nah*) Corpse Pose.

**shīṭali** (*shee-ta-lee*) The intake through the tongue which is also funneled and highly controlled.

**shītkari** (*sheet-kar-ee*) An adaptation of shīṭali practice for those who are unable to perform the tongue curl.

**Śīrṣāsana** (*sheer-sha-sah-nah*) Headstand.

**styāna** (*stee-yawn-ah*) Inefficiency, mental dullness, idleness.

**sūkṣma** (*sook-shmah*) Subtle.

**Supta Baddhakonāsana** (*soop-ta bahd-dah-kone-aw-sah-nah*) Traditionally translated as “reclined bound angle pose.” Referred to in this text as Dynamic Butterfly, a moving adaptation of the classic posture.

**sūrya** (*soor-yah*) Sun.

**sūrya bhedana** (*soor-yah bayd-ah-nah*) A prāṇāyāma practice that involves breathing in and out of the right nostril.

**suṣumnā** (*suh-shum-naw*) According to esoteric anatomy, this is the major channel of energy running from the base of the spine to the crown of the head.

**sūtra** (*soo-trah*) Literally means “thread” and refers to a style of writing employed in the major source books of Indian philosophy.

**svādhiṣṭhāna** (*s-vah-dih-staw-nah*) The second chakra, known as the “own-base center” and located in the genital region.

**svādhyāya** (*s-vah-dhee-yaw-yah*) Self-awareness and reflection that draws us closer to our Higher Self.

**swara** (*sva-rah*) The subtle flow of the breath.

**Tadāsana** (*ta-dah-sa-na*) Mountain Pose. Basic yoga standing posture using good alignment principles that balance the weight, front to back, right to left, and inside to out. This

posture name is used interchangeably with Samasthiti or Equal Stance depending on lineage.

**tamas** (*tah-mahs*) Inertia.

**tapas** (*tah-pahs*) Cultivation of willpower over the pull of the senses through practice.

**udāna/udānavayu** (*oo-dawn-ah*) The aspect of prāṇa responsible for upward movements in the body.

**udḍiyāna bandha** (*ood-dee-yaw-nah bahn-dah*) A hatha yoga technique referring to the action of “locking the abdominals” in order to contain energy.

**ujjayi** (*oo-jai-yee*) The “complete yoga breath.”

**Uttanāsana** (*oot-tah-nah-sah-nah*) Standing Forward Fold.

**vata** (*vah-tah*) One of the three Ayurvedic doshas (bodily humors or elemental constitutions), vata is made of air and space and has the qualities of dryness, coldness, and mobility.

**vāyu** (*vai-yoo*) Forces of air, wind.

**vidya** (*vid-yah*) Knowledge, wisdom.

**vijñānamaya** (*vig-nah-na-mai-yah*) The fourth maya or dimension of prakṛti, which encompasses our intuition, innate understanding, and wisdom.

**vikṛti** (*vik-ri-tee*) Used to indicate the current status of our prāṇa, as it reflects our vulnerability to disease.

**viloma ujjayi** (*vi-lo-mah oo-jai-yee*) A form of prāṇāyāma practice that involves alternate nostril inhale and ujjayi exhale.

**vinyasa krama** (*vin-yah-sah krah-mah*) Step-by-step progression.

**vīrya** (*veer-yah*) Vitality and energy.

**viryalābhaḥ** (*veer-yah-law-bha-hah*) To gain potency.

**viśama vṛtti** (*vi-shah-mah v-rit-tee*) Unequal movements, referring to a ratio where the four phases of breath (inhalation, retention, exhalation, suspension) are unequal in length (for example 1–4–2–1).

**viśuddhi** (*vi-shood-dee*) The fifth chakra, known as the pure wheel or wheel of purity and located in the throat region.

**vṛttis** (*v-rit-tees*) Literally means “whirl,” referring to the habitual patterns of thought that swirl through the mind.

**vyādhi** (*vi-yah-dee*) Disease.

**vyāna/vyānavayu** (*vee-yawn-ah*) The aspect of prāṇa responsible for circulation and assimilation.

**yama** (*yah-mah*) The first limb of yoga, referring to the five outward disciplines of non-harming, truth telling, non-stealing, containment of energy, and non-hoarding.

# PHYSIOLOGY GLOSSARY

**adenosine triphosphate (ATP)** The form of energy used in all cells in our body. It is produced in the mitochondria, which are energy “factories” within each cell. ATP is created through a complex process called metabolism in which glucose or other sugars, proteins, and fats are broken down and then combine with oxygen to fuel our system.

**adrenaline** A hormone secreted by the adrenal glands, especially in conditions of stress, increasing rates of blood circulation, breathing, and carbohydrate metabolism and preparing muscles for exertion.

**allostasis** The process of achieving stability, or homeostasis, through physiological or behavioral change.

**amygdala** One of the four basal ganglia in each cerebral hemisphere; part of the limbic system, consisting of an almond-shaped mass of gray matter in the anterior extremity of the temporal lobe.

**antioxidant** Compounds that inhibit oxidation.

**apnea** Temporary cessation of breathing.

**asthma** A condition in which a person’s airways become inflamed, narrow, and swollen, and produce extra mucus, which makes it difficult to breathe.

**autonomic nervous system (ANS)** A part of the nervous system that regulates key involuntary functions of the body, including heart rate, breath rate, digestion, and dilation or contraction of smooth muscle. It is divided into two parts: the sympathetic nervous system, which accelerates the heart rate, constricts blood vessels, and raises blood pressure, and the parasympathetic nervous system, which slows the heart rate, increases intestinal and gland activity, and relaxes sphincter muscles.

**Bohr effect** A decrease in the amount of oxygen associated with hemoglobin and other respiratory compounds in response to a lowered blood pH resulting from an increased concentration of carbon dioxide in the blood.

**carbon (C)** The chemical element of atomic number 6, a nonmetal that has two main forms (diamond and graphite) and that also occurs in impure form in charcoal, soot, and coal.

**carbon dioxide (CO<sub>2</sub>)** A colorless, odorless, incombustible gas that is formed during respiration, combustion, and organic decomposition.

**cellular respiration** The release of O<sub>2</sub> from the blood into the tissues (oxygenation) and the release of CO<sub>2</sub> from the tissue into the blood.

**central nervous system (CNS)** The central nervous system consists of the brain and spinal cord. It is referred to as “central” because it combines information from the entire body and coordinates activity across the whole organism.

**central sleep apnea** Central sleep apnea (CSA) or central sleep apnea syndrome (CSAS) is a sleep-related disorder in which the effort to breathe is diminished or absent, typically for 10–30 seconds, either intermittently or in cycles, and is usually associated with a reduction in blood oxygen saturation.

**Comfortable Pause, or Control Pause (CP)** This is a simple test that approximates one’s comfort level with breath suspension *after the exhale*. A higher CP would be indicative of one’s ability to tolerate higher levels of CO<sub>2</sub>. Derived from the work of Dr. Konstantin Buteyko.

**Core Breathing** Consciously synchronizing the abdominal core muscles, including the pelvic floor, transversus abdominis and obliques, with the diaphragmatic movement of the breath.

**cortisol** A steroid hormone produced by the adrenal cortex. Cortisol can help control blood sugar levels, regulate metabolism, help reduce inflammation, and assist with memory formulation. It has a controlling effect on salt and water balance and helps control blood pressure.

**Deep Front Line (DFL)** Derived from Tom Myers work with the fascial lines. Links the inner arches of the feet, through tibialis posterior, the adductor complex, pelvic floor, iliopsoas, diaphragm, pericardium to the longis colli in the neck.

**diaphragm** Our primary breathing muscle. Acts as a visceral muscle representing a central meeting point for the cardiovascular system, digestive system, musculoskeletal system, and the autonomic nervous system.

**diving reflex** A clever physiological mechanism enabling the body to manage and tolerate a lower level of oxygen. Three main changes occur in the body: bradycardia (a slowing of the heart rate), respiration rate, and peripheral vasoconstriction. The human heart rate slows down by 10–30 percent and up to 50 percent or more in trained individuals.

**dorsal vagal response** Of the three-part autonomic nervous system, the “oldest” is the unmyelinated *dorsal* part of the parasympathetic nervous system. It regulates mostly visceral organs below the diaphragm, such as the bladder and bowel, but it connects to the heart and the lungs as well. It consists mostly of unmyelinated fibers, so its response is the slowest. Its overall tendency is towards shut-down or freezing.

**dyspnea** Breathlessness, difficult or labored breathing.

**endocrine (hormonal) system** Part of the body’s main control mechanism. It comprises a number of ductless glands that produce hormones, which act as chemical messengers that are secreted into the bloodstream to stimulate or inhibit physical processes.

**exhalation** Occurs as the diaphragm relaxes upwards, pressing on the lungs, deflating them in what is known as a “passive recoil.”

**functional breathing** Healthy diaphragmatic movement in correspondence with normal breath rate and volume—a good measure of core strength. At rest it is through the nose, silent, slow rate, and abdominal-diaphragmatic.

**Functional Movement Screen (FMS)** A pre-participation screening tool designed to identify compensatory movement patterns that are indicative of increased injury risk and inefficient movement that causes reduced performance.

**heart rate variability (HRV)** Measures the fluctuation between the number of heartbeats during inhalation relative to exhalation.

**hippocampus** The elongated ridges on the floor of each lateral ventricle of the brain, thought to be the center of emotion, memory, and the autonomic nervous system.

**homeostasis** The tendency towards a relatively stable equilibrium between interdependent elements, especially as maintained by physiological processes.

**hydrogen (H)** A colorless, odorless, flammable gas that combines chemically with oxygen to form water; the lightest of the known elements.

**hyperinflation** Occurs when inhalation precedes a complete exhalation, forcing the lungs to continuously expand with each successive breath.

**hypertonic** A state of a muscle that is chronically tight, lacking in resting tonus (the ability to relax).

**hyperventilation syndrome (HVS)** Breathing at a higher rate/volume than the metabolic production of carbon dioxide. One of the most common breathing pattern disorders (BPD).

**hypocapnia** Low CO<sub>2</sub>.

**hypothalamus–pituitary–adrenal axis (HPA)** The HPA axis controls digestion, modulates the immune system, regulates mood and emotions, promotes sexual function, and mediates our reactions to stress.

**hypoxia** Hypoxia is a condition in which the body or a region of the body is deprived of adequate oxygen supply at the tissue level.

**inhalation** The result of the downward contraction of the diaphragm, which creates a vacuum, drawing fresh air into the lungs.

**insula** A region of the brain deep in the cerebral cortex. The insular cortex, in particular its most anterior portion, is considered a limbic-related cortex. The insula has increasingly become the focus of attention for its role in body representation and subjective emotional experience.

**interoception** The faculty of bodily perception; sensory systems associated with the body; includes skin senses, proprioception, and the internal organs.

**medulla oblongata** The continuation of the spinal cord within the skull, forming the lowest part of the brain stem and containing control centers for the heart and lungs.

**minute volume (MV)** Calculated by multiplying tidal volume (quantity of air breathed per minute) and respiratory rate (breaths per minute); provides the basis for the rest of the respiratory process. The average MV will range between 4 and 6 liters for healthy adults depending on age, weight, sex, and height of the person.

**myelin** A fatty sheath that insulates the nerves, allowing this circuitry to flow faster and with greater efficiency.

**myofunctional therapy** A growing field made up of highly skilled professionals, many of whom are dental hygienists and speech therapists. They specialize in assessing and retraining children and adults with poor tongue and jaw development.

**nasal resistance** Positive resistance offered to funnel the air through the nasal cavity.

**neuroplasticity** The adaptability of our brain, indicating infinite capacity to adapt and change.

**obstructive sleep apnea (OSA)** Intermittent airflow blockage during sleep.

**olfactory system** The part of the sensory system used for smelling.

**oxygen (O)** A colorless, odorless, reactive gas, the chemical element of atomic number 8 and the life-supporting component of the air.

**paradoxical breathing** A type of trauma breathing in which the movement of the diaphragm is actually reversed with an upward and inward contraction on inhale and a small release down on exhale.

**parasympathetic nervous system (PNS)** The parasympathetic nervous system is one of three divisions of the autonomic nervous system. Sometimes called the rest and digest system, the parasympathetic system conserves energy as it slows the heart rate, increases intestinal and gland activity, and relaxes sphincter muscles in the gastrointestinal tract.

**partial pressure** Partial pressure indicates the percentage of one component of a mixture of gases to the total pressure of the atmosphere. The partial pressure of gases within our body are calculated accordingly, and signified by a “P” before the gas, such as PO<sub>2</sub>, meaning partial pressure of oxygen in the lungs, or PaO<sub>2</sub>, which means partial pressure of oxygen in the arterial system or bloodstream.

**pelvic floor** The pelvic floor (PF) or pelvic diaphragm is composed of muscle fibers of the levator ani, the coccygeus muscle, and associated connective tissue which span the area underneath the pelvis.

**perfusion** The transmission of blood and lymph through the capillaries of the alveoli, where oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) are exchanged.

**pericardium** The membrane enclosing the heart, consisting of an outer fibrous layer and an inner double layer of serous membrane.

**peristalsis** The movement of digestion through the intestines.

**pH** A measure of acidity or alkalinity of water-soluble substances (pH stands for “potential of hydrogen”). A pH value is a number from 1 to 14, with 7 as the middle (neutral) point. Values below 7 indicate acidity, which increases as the number decreases, 1 being the most acidic. Normal pH in humans ranges between 7.35 and 7.45.

**pheromones** A chemical substance produced and released into the environment by an animal, especially a mammal or an insect, affecting the behavior or physiology of others of its species.

**phrenic nerve** A nerve that originates in the neck, and passes down between the lung and heart to reach the diaphragm. It is important for breathing, as it passes motor information to the diaphragm and receives sensory information from it. There are two phrenic nerves, a left and a right one.



**Porges' polyvagal theory** Specifies two functionally distinct branches of the vagus, or tenth cranial nerve. It serves to identify the relationship between visceral experiences and the vagus nerve's parasympathetic control of the heart, lungs, and digestive tract. The theory was introduced in 1994 by Dr. Stephen Porges, director of the Brain–Body Center at the University of Illinois at Chicago.

**prefrontal cortex** The cerebral cortex covering the front part of the frontal lobe. This brain region has been implicated in planning complex cognitive behavior, personality expression, decision making, and moderating social behavior.

**proprioception** The ability to sense the position, location, orientation, and movement of the body and its parts.

**reduced breathing** A practice of intentionally breathing less than desired for 10–20-minute blocks of time, multiple times a day. Derived from the work of Dr. Konstantin Buteyko.

**residual volume (RV)** Reservoir of air. We were born with it and we die with it. RV ensures that the lungs do not collapse, and keeps them ventilated between breaths. RV for healthy adults ranges between 1.1 and 1.2 liters of air.

**respiratory rate (RR)** The measurement of how many breaths are taken per minute at rest. This averages between 10 and 15 breaths, for most adults.

**respiratory system** The human respiratory system is a series of organs responsible for taking in oxygen and expelling carbon dioxide. The primary organs of the respiratory system are lungs, which carry out this exchange of gases as we breathe.

**rhinencephalon** The part of the brain once thought to be concerned entirely with olfactory mechanisms, including olfactory nerves, bulb, tract, and subsequent connections (all olfactory in function), and the limbic system (not primarily olfactory in function); homologous with olfactory portions of the brain in lower animals.

**smooth muscle** Smooth muscle is a non-striated muscle, which wraps around and is enmeshed within tissues, blood vessels, the airways, and most of the major organs of the body.

**social engagement system (SES)** A two-way interaction system (receptive and expressive) based mainly in the eyes, ears, larynx, and mouth, but incorporating the entire face and the torso above the diaphragm. All 12 cranial nerves participate in the social and expressive functions.

**sympathetic nervous system (SNS)** The part of the autonomic nervous system that contains chiefly adrenergic fibers and tends to depress secretion, decrease the tone and contractility of smooth muscle, and increase heart rate. Also, activates the fight/flight/freeze response.

**tidal volume (TV)** The measure of how much air is moved in and out of the lungs during a single breath.

**trigeminal nerve** The fifth cranial nerve. This nerve is responsible for sensations in the mouth, teeth, face, and nasal cavity. When triggered by cold water, it transmits a message to the vagus nerve, which immediately slows the heart rate in response.

**undulation** Undulation is a unique form of therapeutic exercise that stretches muscles and fascia. Undulation helps connective tissues rehydrate, muscles rebuild lost strength, and joints regenerate.

**vagus nerve** The primary nerve modulating the parasympathetic nervous system.

**ventilation** The act of breathing in and out.

**ventilation/perfusion ratio** The ratio of the amount of air reaching the alveoli to the amount of blood reaching the alveoli.

**zone of apposition (ZOA)** The ZOA is the area between the inside of the bottom ribs where the diaphragm attaches and the top of the diaphragm. It is controlled primarily through the activation of the abdominal muscles and will be evident by a domed positioning of the rib cage at the end of exhalation.

# ENDNOTES

## Introduction

- 1 Ganong, W.F. (1995) *Review of Medical Physiology*, 15th edn. London: Prentice Hall.  
Guyton, A.C. (1984) *Physiology of the Human Body*, 6th edn. Philadelphia, PA: Saunders College Publishing.  
Straub, N.C. (1998) The Respiratory System. Section V in R.M. Berne & M.N. Levy (eds.) *Berne and Levy Physiology*, 4th edn. St. Louis, MI: Mosby, pp. 415–477.
- 2 Cobelli, F. & Rampulla, C. (1998) The development of hyperventilation in patients with chronic heart failure and Cheyne-Stokes respiration. *Chest* 114, 1083–1090.  
Johnson, B.D., Scanlon, P.D. & Beck, K.C. (1995) Regulation of ventilatory capacity during exercise in asthmatics. *Journal of Applied Physiology* 79 (3), 892–901.  
Tantucci, C. (2003) Sleep-disordered breathing in nonobese diabetic subjects with autonomic neuropathy. *European Respiratory Journal* 22, 654–660.  
Travers, J., Dudgeon, D.J., Amjadi, K., McBride, I. et al. (2008) Mechanisms of exertional dyspnea in patients with cancer. *Journal of Applied Physiology* 104 (1), 57–66.
- 3 Miyamura, M., Nishimura, K., Ishida, K., Katayama, K., Shimaoka, M. & Hiruta, S. (2002) Is man able to breathe once a minute for an hour? The effect of yoga respiration on blood gases. *Japanese Journal of Physiology* 52, 313–316.
- 4 Myers, T.W. (2014) *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*. Edinburgh: Churchill Livingstone/Elsevier.
- 5 Muktibodhananda (1998) *Hatha Yoga Pradipika—Light on Hatha Yoga: Including the Original Sanskrit Text of the Hatha Yoga Pradipika with English Translation*, 3rd edn. Munger, Bihar: Bihar School of Yoga. p. 180.
- 6 Maehle, G., Cox, R. & Watson, A. (2012) *Prāṇāyāma: The Breath of Yoga*. Doubleview, WA: Kaivalya Publications. p. 116.
- 7 Stark, J. (2005) Asthma: Ignorance or design? *Nexus Magazine* 13 (1). Accessed on March 12, 2019 at [www.whale.to/a/stark.html](http://www.whale.to/a/stark.html)
- 8 Stark, J. & Stark, R. (2002) *The Carbon Dioxide Syndrome: Learn Why Changing Your Breathing Can Improve Your Health and Wellbeing*. Auckland: Buteyko On Line.

## Chapter 1

- 1 Muktibodhananda (1998) *Hatha Yoga Pradipika—Light on Hatha Yoga: Including the Original Sanskrit Text of the Hatha Yoga Pradipika with English Translation*, 3rd edn. Munger, Bihar: Bihar School of Yoga. p. 150.
- 2 Dass, H. & Diffenbaugh, D. (1999) *The Yoga Sūtras of Patañjali: A Study Guide for Book I: Samādhi Pāda*. Santa Cruz, CA: Sri Rama Publishing. Sūtra 1:2, pp. 5–8.
- 3 Chödrön, P. (n.d.). *Going to the Places That Scare You* [video file]. Accessed on March 12, 2019 at [www.youtube.com/watch?v=sLw5QFaFUGI](https://www.youtube.com/watch?v=sLw5QFaFUGI)
- 4 Dass, H. & Diffenbaugh, D. (1999) *The Yoga Sūtras of Patañjali: A Study Guide for Book I: Samādhi Pāda*. Santa Cruz, CA: Sri Rama Publishing. Sūtra 1:2, pp. 5–8.
- 5 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press. p. 29.
- 6 Saraswati, N. (2010) *Prāṇa and Prāṇāyāma*. Munger, Bihar: Yoga Publication Trust. p. 17.
- 7 Bhārati, S.V. (2004) *Yoga Sūtras of Patañjali with the Exposition of Vyāsa: A Translation and Commentary*, 2nd edn. Delhi: Motilal Banarsidass. Sūtra 2:49, p. 590.

- 8 Ibid., p. 592.
- 9 Ibid., p. 593.
- 10 Ibid.
- 11 Ibid.
- 12 Ibid., p. 601.
- 13 Dass, H. & Diffenbaugh, D. (1999) *The Yoga Sūtras of Patañjali: A Study Guide for Book II: Samādhi Pāda*. Santa Cruz, CA: Sri Rama Publishing. Sūtra 2:50, p. 186.
- 14 Ibid., Sūtra 2:51, p.188.
- 15 Bhāratī, S.V. (2004) *Yoga Sūtras of Patañjali with the Exposition of Vyāsa: A Translation and Commentary*, 2nd edn. Delhi: Motilal Banarsidass. Sūtra 2:49, p. 590.
- 16 Dass, H. & Diffenbaugh, D. (1999) *The Yoga Sūtras of Patañjali: A Study Guide for Book II: Samādhi Pāda*. Santa Cruz, CA: Sri Rama Publishing. Sūtra 2:50, p. 184.
- 17 Ibid., Sūtra 2:51, p. 188.
- 18 Bhāratī, S.V. (2004) *Yoga Sūtras of Patañjali with the Exposition of Vyāsa: A Translation and Commentary*, 2nd edn. Delhi: Motilal Banarsidass. Sūtra 2:51, p. 623.
- 19 Ibid., Sūtra 2:52, p. 625.
- 20 Ibid., Sūtra 2:52, p. 631.
- 21 Dass, H. & Diffenbaugh, D. (1999) *The Yoga Sūtras of Patañjali: A Study Guide for Book II: Samādhi Pāda*. Santa Cruz, CA: Sri Rama Publishing. Sūtra 2:52–2.53, p. 191.
- 22 Ibid., pp. 189–191.

## Chapter 2

- 1 Frawley, D. (1997) The secrets of prana. *Yoga International* (October/November), 25–29. Accessed on March 12, 2019 at <https://kulaannextt2013.files.wordpress.com/2013/10/the-secrets-of-prana.pdf>
- 2 Lysebeth, A.V. (2013) *Prāṇāyāma: The Energetics of Breath*, 2nd edn. Edinburgh: Harmony. p. 10.
- 3 Saraswati, N. (2010) *Prāṇa and Prāṇāyāma*. Munger, Bihar: Yoga Publication Trust. p. 14.
- 4 Saraswati, N. (2010) *Prāṇa and Prāṇāyāma*. Munger, Bihar: Yoga Publication Trust. pp. 58–59.
- 5 Frawley, D. (1997) The secrets of prana. *Yoga International* (October/November), 25–29. Accessed on March 12, 2019 at <https://kulaannextt2013.files.wordpress.com/2013/10/the-secrets-of-prana.pdf>
- 6 Frawley, D. (1997) The secrets of prana. *Yoga International* (October/November), 25–29. Accessed on March 12, 2019 at <https://kulaannextt2013.files.wordpress.com/2013/10/the-secrets-of-prana.pdf>
- 7 Frawley, D. (1997) The secrets of prana. *Yoga International* (October/November), 25–29. Accessed on March 12, 2019 at <https://kulaannextt2013.files.wordpress.com/2013/10/the-secrets-of-prana.pdf> (p. 27).
- 8 Lysebeth, A.V. (2013) *Prāṇāyāma: The Energetics of Breath*, 2nd edn. Edinburgh: Harmony. p. 19.
- 9 Frawley, D. (1997) The secrets of prana. *Yoga International* (October/November), 25–29. Accessed on March 12, 2019 at <https://kulaannextt2013.files.wordpress.com/2013/10/the-secrets-of-prana.pdf>
- 10 Dass, H. & Diffenbaugh, D. (1999) *The Yoga Sūtras of Patañjali: A Study Guide for Book I: Samādhi Pāda*. Santa Cruz, CA: Sri Rama Publishing. p. 82.

## Chapter 3

- 1 Guyton, A.C. (1976) *Textbook of Medical Physiology*, 5th edn. Philadelphia, PA: Saunders.
- 2 Gardner (2004) Hyperventilation. *American Journal of Respiratory and Critical Care Medicine* 170 (2), 105–106.  
Studer, R., Danuser B., Hildebrandt, H., Arial, M. & Gomez, P. (2011) Hyperventilation complaints in music performance anxiety among classical music students. *Journal of Psychosomatic Research* 70 (6), 557–564.
- 3 Margarian, G.J. (1982) Hyperventilation syndromes: Infrequently recognized common expressions of anxiety and stress. *Medicine* 61 (4), 219–236.
- 4 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone. p. 61.
- 5 Crespo, A.S., Hallberg, J., Lundberg, J.O, Sten, G.E. et al. (2010) Nasal nitric oxide and regulation of human pulmonary blood flow in the upright position. *Journal of Applied Physiology* 108, 181–188.
- 6 Ibid.

- 7 West, J.B. & Luks, A.M. (2016) *West's Respiratory Physiology: The Essentials*, 10th edn. Alphen aan den Rijn, Netherlands: Wolters Kluwer.
- 8 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.
- 9 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 10 Santiago, T.V. & Edelman, N.H. (1986) Brain Blood Flow and Control of Breathing. In A.P. Fishman (ed.) *Handbook of Physiology*, vol. 3, part 1, The Respiratory System. Bethesda, MA: American Physiological Society. pp. 163–179.
- 11 McKeown, P. (2015) *The Oxygen Advantage: The Simple, Scientifically Proven Breathing Techniques for a Healthier, Slimmer, Faster, and Fitter You*. New York, NY: William Morrow.
- 12 Online Etymology Dictionary (2010) Aerobics. Accessed on March 12, 2019 at [www.etymonline.com/word/aerobics#etymonline\\_v\\_26513](http://www.etymonline.com/word/aerobics#etymonline_v_26513)
- 13 Aarnoudse, J.G., Oeseburg, B., Kwat, G., Zwart, A., Zijlstra, W.G. & Huisjes, H.J. (1981) Influence of variations in pH and PCO<sub>2</sub> on scalp tissue oxygen tension and carotid arterial oxygen tension in the fetal lamb. *Biology of the Neonate* 40 (5–6), 252–263.  
Monday, L.A. & Tetrault, L. (1981) Hyperventilation and vertigo. *Laryngoscope* 90 (6, Pt 1), 1003–1010.  
Gottstein, U., Zahn, U., Hel, K., Gabriel, F.H., Textor, T. & Berghoff, W. (1976) Effect of hyperventilation on cerebral blood flow and metabolism in man: Continuous monitoring of arterio-cerebral venous glucose differences (author's transl.) [Article in German], *Klin Wochenschr* 54 (8), 373–381.
- 14 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.
- 15 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.
- 16 Brown, R.P. & Gerbarg, P.L. (2012) *The Healing Power of the Breath: Simple Techniques to Reduce Stress and Anxiety, Enhance Concentration, and Balance Your Emotions*. Boston, MA: Shambhala Publications.
- 17 Duennwald, T., Gatterer, H., Groop, P.-H., Burtscher, M. & Bernardi, M.D. (2013) Effects of a single bout of interval hypoxia on cardiorespiratory control in patients with type 1 diabetes. *Diabetes* 62 (12), 4220–4227. Accessed on February 11, 2019 at <http://diabetes.diabetesjournals.org/content/62/12/4220.figures-only>
- 18 Bernardi L. (2006) *Yoga, Oxygen and Respiration*. Accessed on March 12, 2019 at <https://cdn.ymaws.com/www.iayt.org/resource/collection/BCD9CE96-E8BA-45D3-908A-A421A8E3EA86/kripalu-handout-rid1.pdf>  
Keyl, C., Schneider, A., Gamboa, A., Spicuzza, L. et al. (2003) Autonomic cardiovascular function in high-altitude Andean natives with chronic mountain sickness. *Journal of Applied Physiology* 94 (1), 213–219.  
Bernardi, L., Schneider, A., Pomidori, L., Paolucci, E. & Cogo, A. (2006) Hypoxic ventilatory response in successful extreme altitude climbers. *European Respiratory Journal* 27 (1), 165–171.
- 19 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 20 Jennett, S. (1994) Control of Breathing and Its Disorders. In B.H. Timmons & R. Ley (eds.) *Behavioral and Psychological Approaches to Breathing Disorders*. Boston, MA: Springer. pp. 67–80.
- 21 Buteyko, K.P. & Khorscho, A.E. (1990) *Buteyko Method: The Experience of Implementation in Medical Practice*, collected papers. Moscow: Patriot Publishers.  
Kazarinov, V.A. (1991) The Biochemical Basis of K.P. Buteyko's Theory of the Diseases of Deep Respiration [in Russian]. In K.P. Buteyko (ed.) *Buteyko Method: The Experience of Implementation in Medical Practice*. Moscow: Patriot Publishers.
- 22 McKeown, P. (2018) Buteyko Education Training Manual (unpublished).
- 23 McKeown, P. (2015) *The Oxygen Advantage: The Simple, Scientifically Proven Breathing Techniques for a Healthier, Slimmer, Faster, and Fitter You*. New York, NY: William Morrow.
- 24 Van Wijk, R., Van Wijk, E.P., Wiegant, F.A. & Ives, J. (2008) Free radicals and low-level photon emission in human pathogenesis: State of the art. *Indian Journal of Experimental Biology* 46 (5), 273–309.
- 25 Peat, R. (2011) *Protective CO<sub>2</sub> and Aging*. Accessed on 11 February, 2019 at <http://raypeat.com/articles/articles/co2.shtml>
- 26 Baev, V.I., Vasil'ev, V.V. & Nikolaeva, E.N. (1978) Role of CO<sub>2</sub> fixation in increasing the body's resistance to acute hypoxia [in Russian]. *Fiziol Zh SSSR* 64 (10), 1456–1462.  
Bari, F., Errico, R.A., Louis, T.M. & Busija, D.W. (1996) Differential effects of short-term hypoxia and hypercapnia on N-methyl-D-aspartate-induced cerebral vasodilatation in piglets. *Stroke* 27 (9), 1634–1639; discussion 1639–1640.  
Brzecka, A. (2007) Role of hypercapnia in brain oxygenation in sleep-disordered breathing. *Acta Neurobiologiae Experimentalis (Wars)* 67 (2), 197–206.

- Kogan, A.K.H., Manuilov, B.M., Grachev, S.V., Bolevich, S., Tsylin, A.B. & Daniliak, I.G. (1994) CO<sub>2</sub>—a natural inhibitor of active oxygen form generation by phagocytes [in Russian]. *Bulletin of Experimental Biology and Medicine* 118 (10), 395–398.
- Malyshev, V.V., Vasil'eva, L.S., Belogorov, S.B. & Nefedova, T.V. (1995) Adaptation to high altitude hypoxia facilitates a limitation of lipid peroxidation activation in inflammation and stress [in Russian]. *Bulletin of Experimental Biology and Medicine* 119 (6), 590–593.
- 27 Muktibodhananda (1998) *Hatha Yoga Pradipika—Light on Hatha Yoga: Including the Original Sanskrit Text of the Hatha Yoga Pradipika with English Translation*, 3rd edn. Munger, Bihar: Bihar School of Yoga. Sūtra 2:41, p. 230.
- 28 Ibid., Sūtra 2:11, p. 173.
- 29 McKeown, P. (2004) *Close Your Mouth: Buteyko Clinic Handbook for Perfect Health*. Dublin, Ireland: Buteyko Books.

## Chapter 4

- 1 From the Vedic text Yoga-bhaskara, referencing the effect of prāṇāyāma, specifically retention, to be practiced intensely four times a day; Bhārati, S.V. (2004) *Yoga Sūtras of Patañjali with the Exposition of Vyāsa: A Translation and Commentary*, 2nd edn. Delhi: Motilal Banarsidass. p. 724.
- 2 Dass, H. & Diffenbaugh, D. (1999) *The Yoga Sūtras of Patañjali: A Study Guide for Book I: Samādhi Pāda*. Santa Cruz, CA: Sri Rama Publishing. p. 82.
- 3 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press. p. 101.
- 4 Ibid., pp. 4–5.
- 5 Da Costa, J.M. (1871) On irritable heart: A clinical study of a form of functional cardiac disorder and its consequences. *American Journal of Medicine* 61, 17–51.
- 6 Soley, M.H. & Shock, N.W. (1938) The etiology of effort syndrome. *American Journal of Medical Science* 196, 840.
- 7 Jones, M., Harvey, A., Marston, L. & O'Connell, N.E. (2013) Breathing exercises for dysfunctional breathing/hyperventilation syndrome in adults. *Cochrane Database of Systematic Reviews* 31 (5), CD009041.
- 8 Felcar, J., Bueno, I., Massan, A., Torezan, R. & Cardoso, J. (2010) Prevalence of mouth breathing in children from an elementary school. *Cien Saude Colet* 15 (2), 437–444.
- Abreu, R.R., Rocha, R.L., Lamounier, J.A. & Guerra, A.F. (2008) Prevalence of mouth breathing among children. *Jornal de Pediatria* 84 (5), 467–470.
- De Menezes, V.A., Rossana Barbosa Leal, R.B., Pessoa, R.S. & Pontes, R.M. (2006) Prevalence and factors related to mouth breathing in school children at the Santo Amaro project—Recife, 2005. *Brazilian Journal of Otorhinolaryngology* 72 (3), 394–398.
- 9 Hornsvelt, H. & Garsson, B. (1997) Hyperventilation syndrome: An elegant but scientifically untenable concept. *Netherlands Journal of Medicine* 50 (1), 13–20.
- 10 Yoga Alliance (n.d.) *Yogamonth: 10 Reasons to Practice Yoga*. Accessed on February 11, 2019 at [www.yogahealthfoundation.org/images/uploads/documents/YM\\_10Reasons.pdf](http://www.yogahealthfoundation.org/images/uploads/documents/YM_10Reasons.pdf)
- 11 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.
- 12 Lum, L.C. (1975) Hyperventilation: The tip and the iceberg. *Journal of Psychosomatic Research* 19, 375–383.
- 13 McArdle, W., Katch, F. L. & Katch, V.L. (2009) Pulmonary Structure and Function. In *Exercise Physiology: Nutrition, Energy, and Human Performance*, 7th edn. Philadelphia, PA: Lippincott Williams & Wilkins.
- 14 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 15 Johnson, B.D., Scanlon, P.D. & Beck, K.C. (1995) Regulation of ventilatory capacity during exercise in asthmatics. *Journal of Applied Physiology* 79 (3), 892–901.
- Bowler, S.D., Green, A. & Mitchell, C.A. (1998) Buteyko breathing techniques in asthma: A blinded randomised controlled trial. *Medical Journal of Australia* 169, 575–578.
- McNicholas, W.T., Coffey, M. & Boyle, T. (1993) Effects of nasal airflow on breathing during sleep in normal humans. *American Review of Respiratory Disease* 147 (3), 620–623.
- Jordan, A.S., McEvoy, R.D., Edwards J.K., Schory, K. et al. (2004) The influence of gender and upper airway resistance on the ventilatory response to arousal in obstructive sleep apnoea in humans. *Journal of Physiology* 558 (Pt 3), 993–1004.
- Radwan, L., Maszczyk, Z., Koziorowski, A., Koziej, M. et al. Control of breathing in obstructive sleep apnea and in patients with the overlap syndrome. (1995) *European Respiratory Journal* 8 (4), 542–545.
- 16 Stark, J. (2005) Asthma—Ignorance or design? *Nexus Magazine* 13 (1). Accessed on March 12, 2019 at [www.whale.to/a/stark.html](http://www.whale.to/a/stark.html)

- 17 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press. p. 4.
- 18 Ibid., pp. 4–11.
- 19 DeGuire, S., Gervitz, R., Kawhara, Y. & Maguire, W. (1992) Hyperventilation syndrome and the assessment and treatment for functional cardiac symptoms. *American Journal of Cardiology* 70 (6), 673–677.  
Hamer, H.P. & McCallin, A. (2006) Cardiac pain or panic disorder? Managing uncertainty in the emergency department. *Nursing and Health Sciences* 8, 224–220.
- 20 Lum, L.C. (1987) Hyperventilation syndromes in medicine and psychiatry: A review. *Journal of the Royal Society of Medicine* 80 (4), 229–231.
- 21 Krapf, R., Beeler, I., Hertner, D. & Hulter, H. (1991) Chronic respiratory alkalosis: The effect of sustained hyperventilation or renal regulation of acid-base equilibrium. *New England Journal of Medicine* 324 (20), 1394–1401.
- 22 McKeown, P. (2015) *The Oxygen Advantage: The Simple, Scientifically Proven Breathing Techniques for a Healthier, Slimmer, Faster, and Fitter You*. New York, NY: William Morrow.
- 23 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 24 McKeown, P. (2015) *The Oxygen Advantage: The Simple, Scientifically Proven Breathing Techniques for a Healthier, Slimmer, Faster, and Fitter You*. New York, NY: William Morrow.
- 25 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone. p. 61.
- 26 Koppen, B.M. & Stanton, B.A. (2006) *Berne & Levy Physiology*, 6th edn. Philadelphia, PA: Mosby.
- 27 Brown, R.P. & Gerbarg, P.L. (2012) *The Healing Power of the Breath: Simple Techniques to Reduce Stress and Anxiety, Enhance Concentration, and Balance Your Emotions*. Boston, MA: Shambhala Publications.
- 28 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 29 Hetzel, M.R., Clark, T.J. & Houston, K. (1977) Physiological patterns in early morning asthma. *Thorax* 32 (4), 418–423.  
Yasue, H. & Kugiyama, K. (1997) Coronary spasm: Clinical features and pathogenesis. *Internal Medicine* 36, 760–765.  
Cummings, K.J., Swart, M. & Ainslie, P.N. (2007) Morning attenuation in cerebrovascular CO<sub>2</sub> reactivity in healthy humans is associated with a lowered cerebral oxygenation and an augmented ventilatory response to CO<sub>2</sub>. *Journal of Applied Physiology* 102, 1891–1898.  
Nagao, H., Morimoto, T., Takahashi, M., Habara, S., Nagai, H. & Matsuda, H. (1990) The circadian rhythm of typical absence seizures: The frequency and duration of paroxysmal discharges. *Neuropediatrics* 21 (2), 79–82.
- 30 Rakhimov, A. (2012) *Yoga Benefits Are in Breathing Less: Introduction to Yoga Spirit and Anatomy for Beginners*. Scotts Valley, MD: CreateSpace.
- 31 Buteyko Breathing Educators Association: <https://buteykoeducators.org>  
Buteyko Clinic International: [www.buteykoclinic.com](http://www.buteykoclinic.com)
- 32 Saraswati, N. (2010) *Prāṇa and Prāṇāyāma*. Munger, Bihar: Yoga Publication Trust.
- 33 <https://itunes.apple.com/us/app/buteykoclinic-self-help-program/id553440749?mt=8>

## Chapter 5

- 1 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.
- 2 Ibid.
- 3 Elad, D., Wolf, M. & Keck, T. (2008) Air-conditioning in the human nasal cavity. *Respiratory Physiology and Neurobiology* 163 (1–3), 121–127.
- 4 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.  
Rogan, M.P., Geraghty, P., Greene, C.M., O'Neill, S.J., Taggart, C.C. & McElvaney, N.G. (2006) Antimicrobial proteins and polypeptides in pulmonary innate defence. *Respiratory Research* 7, 29.
- 5 McKeown, P. (2010). *Asthma-Free Naturally*, 3rd edn. Moycullen, Ireland: AsthmaCare.
- 6 West, J.B. & Luks, A.M. (2016). *West's Respiratory Physiology: The Essentials*, 10th edn. Alphen aan den Rijn, Netherlands: Wolters Kluwer.
- 7 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.



- 8 Lundberg, J.O., Settergren, G., Gelinder, S., Lundberg, J.M., Alving, K. & Weitzberg, E. (1996) Inhalation of nasally derived nitric oxide modulates pulmonary function in humans. *Acta Physiologica Scandinavica* 158, 343–347.
- 9 Selimoglu, E. (2005) Nitric oxide in health and disease from the point of view of the otorhinolaryngologist. *Current Pharmaceutical Design* 11 (23), 3051–3060.
- 10 Kern, E.B. (1986) The nasal valve: A rhinomanometric evaluation of maximum nasal inspiratory flow and pressure curves. *Annals of Otology, Rhinology and Laryngology* 95, 229–232.  
Stoksed, P. (1952) The physiologic cycle of the nose under normal and pathologic conditions. *Acta Otolaryngologica* 42, 175–179.  
Wernitz, D.A., Bickford, R.G., Bloom, F.E. & Shannahoff-Khalsa, D.S. (1983) Alternating cerebral hemispheric activity and the lateralization of autonomic nervous function. *Human Neurobiology* 2, 39–43.
- 11 Saraswati, N. (2010) *Prāṇa and Prāṇāyāma*. Munger, Bihar: Yoga Publication Trust.
- 12 Swift, A., Campbell, I. & McKown, T. (1988) Oronasal obstruction, lung volumes, and arterial oxygenation. *Lancet* 1, 73–75.
- 13 Cottle, M.H. (1972) *The Work, Ways, and Patterns of Nasal Breathing (Relevance in Heart and Lung Illness)*. Presented at American Rhinologic Society seminar on Respiratory Physiology and Rhinomanometry, New Orleans, LA, September 19, 1972. Accessed on March 12, 2019 at [www.aipro.info/wp/wp-content/uploads/2017/08/work\\_ways\\_patterns.pdf](http://www.aipro.info/wp/wp-content/uploads/2017/08/work_ways_patterns.pdf)  
Rohrer, F. (1915) Der stroemungswiderstand inden menschlichen atemwgen und der einfluss der unregelmaessigen verzweigung des bonchialsystems auf den atmungsverlaug in verschiedenen lungenbezirken. *Pfluer's Archiv* 62, 225–299.
- 14 Cappel, B.M. & Holmes, D.S. (1984) The utility of prolonged respiratory exhalation for reducing physiological and psychological arousal in non-threatening and threatening situations. *Journal of Psychosomatic Research* 28, 265–273.
- 15 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.
- 16 Ibid.
- 17 Cottle, M.H. (1980) *Rhinomanometry*. Kansas City, MO: American Rhinologic Society.
- 18 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 19 Swift, A., Campbell, I. & McKown, T. (1988) Oronasal obstruction, lung volumes, and arterial oxygenation. *Lancet* 1, 73–75.  
Tanaka, Y., Morikawa, T. & Honda, Y. (1988) An assessment of nasal functions in control of breathing. *Journal of Applied Physiology* 65, 1520–1524.
- 20 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 21 Plum, F. (1992) Breathing is controlled independently by voluntary, emotional and metabolically related pathways. *Archives of Neurology* 49, 441.
- 22 Angell James, J.E. & de Burgh Daly, M. (1969) Nasal reflexes. *Proceedings of the Royal Society of Medicine* 61, 1287–1293.
- 23 Albert, M.S. & Winters, R.W. (1966) Acid base equilibrium of blood in normal infants. *Pediatrics* 37, 7–28.  
Butler, J. (1960) The work of breathing through the nose. *Clinical Science* 19, 55–62.  
Edison, B.D. & Kerth, J.D. (1973) Tonsilloadenoid hypertrophy resulting in Cor Pulmonale. *Archives of Otolaryngology* 98, 205–208.
- 24 Davies, A.M., Koenig, J.S. & Thach, B.T. (1989) Characteristics of upper airway chemoreflex prolonged apnea in infant humans. *American Review of Respiratory Diseases* 139, 668–673.  
Javorka, K., Tomori, Z. & Zavorska, L. (1985) Upper airway reflexes in newborns with respiratory distress syndrome. *Bulletin Européen Physiopathologie Respiratoire* 21, 345–349.
- 25 Jefferson, Y. (2010) Mouth breathing: Adverse effects on facial growth, health, academics, and behavior. *General Dentistry* 58, 18–25.  
Sano, M., Sano, S., Oka, N., Yoshino, K. & Kato, T. (2013) Increased oxygen load in the prefrontal cortex from mouth breathing: A vector-based near-infrared spectroscopy study. *Neuroreport* 24 (17), 935–940.
- 26 Kuroishi, R.C., Garcia, R.B., Valera, F.C., Anselmo-Lima, W.T. & Fukuda, M.T. (2015) Deficits in working memory, reading comprehension and arithmetic skills in children with mouth breathing syndrome: Analytical cross-sectional study. *Sao Paulo Medical Journal* 133 (2), 78–83.
- 27 Bartley, J. (2011) Breathing and temporomandibular joint disease. *Journal of Bodywork and Movement Therapies* 15 (3), 291–297.
- 28 Bakor, S.F., Pereira, J.C., Frascino, S., Ladalarido, T.C., Pignatari, S.S. & Weckx, L.L. (2010) Demineralization of teeth in mouth-breathing patients undergoing maxillary expansion. *Brazilian Journal of Otorhinolaryngology* 76, 709–712.



- 29 Bartley, J. (2011) Breathing and temporomandibular joint disease. *Journal of Bodywork and Movement Therapies* 15 (3), 291–297.  
Woolf, C.J. (2011) Central sensitization: Implications for the diagnosis and treatment of pain. *Pain* 152, S2–S15.
- 30 Gardner, W.N. (1996) The pathophysiology of hyperventilation disorders. *Chest* 109, 516–554.
- 31 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.
- 32 Cottle, M.H. (1987) Clinical benefits and disorders following nasal surgery. In P.A. Barelli, W.E.E. Loch, E.R. Kern & A. Steiner (eds.) *Rhinology: The Collected Writings of Maurice H. Cottle, M.D.* Kansas City, MO: American Rhinologic Society, pp. 425–431.
- 33 Ibid.
- 34 Hallini, M., Wheatley, J.R. & Amis, T.C. (2008) Enforced mouth breathing decreases lung function in mild asthmatics. *Respirology* 13, 553–558.
- 35 Brant, T.C.S., Parreira, V.F., Mancini, M.C., Becker, H.M.G., Reis, A.F.C. & Brito, R.R. (2008) Breathing pattern and thoracoabdominal motion in mouth-breathing children. *Brazilian Journal of Physical Therapy* 12 (6), 495–501.
- 36 Braunstahl, G.J., Overbeek, S.E., Kleinjan, A., Prins, J.B., Hoogsteden, H.C. & Fokkens, W.J. (2001) Nasal allergen provocation induces adhesion molecule expression and tissue eosinophilia in upper and lower airways. *Journal of Allergy and Clinical Immunology* 107, 469–476.  
Braunstahl, G.J., Overbeek, S.E., Fokkens, W.J., Kleinjan, A. et al. (2001) Segmental bronchoprovocation in allergic rhinitis patients affects mast cell and basophil numbers in nasal and bronchial mucosa. *American Journal of Respiratory and Critical Care Medicine* 164, 858–865.
- 37 Krouse, J., Brown, R., Fineman, S., Han, J.K. et al. (2007) Asthma and the unified airway. *Otolaryngology—Head and Neck Surgery* 136, S75–S106.
- 38 Walsh, W.E. & Kern, R.C. (2006) Sinonasal Anatomy Function and Evaluation. In B.J. Bailey & J.T. Johnson (eds.) *Bailey’s Head and Neck Surgery: Otolaryngology*, 4th edn. Philadelphia, PA: Lippincott, Williams and Wilkins. pp. 307–318.
- 39 Felcar, J.M., Bueno, I.R., Massan, A.C., Torezan, R.P. & Cardoso, J.R. (2010) Prevalence of mouth breathing in children from an elementary school. *Cien Saude Colet* 15 (2), 437–444.
- 40 Okuro, R.T., Morcillo, A.M., Ribeiro, M.A., Sakano, E., Conti, P.B. & Ribeiro, J.D. (2011) Mouth breathing and forward head posture: Effects on respiratory biomechanics and exercise capacity in children. *Jornal Brasileiro de Pneumologia* 37 (4), 471–479.
- 41 Courtney, R. (2009) The functions of breathing and its dysfunctions and their relationship to breathing therapy. *International Journal of Osteopathic Medicine* 12 (3), 78–85.
- 42 Graham, T. (2014) *Relief from Snoring and Sleep Apnea: A Step-By-Step Guide to Restful Sleep and Better Health through Changing the Way You Breathe*. North Charleston, SC: CreateSpace.
- 43 Ibid.
- 44 Ibid.
- 45 Ibid.
- 46 [www.lipsealtape.com](http://www.lipsealtape.com)
- 47 Felcar, J.M., Bueno, I.R., Massan, A.C., Torezan, R.P. & Cardoso J.R. (2010) Prevalence of mouth breathing in children from an elementary school. *Cien Saude Colet* 15 (2), 437–444.  
Abreu, R.R., Rocha, R.L., Lamounier, J.A. & Guerra, A.F. (2008) Prevalence of mouth breathing among children. *Jornal de Pediatria* 84 (5), 467–470.  
De Menezes, V.A., Leal, R.B., Pessoa, R.S. & Pontes, R.M. (2006) Prevalence and factors related to mouth breathing in school children at the Santo Amaro project—Recife, 2005. *Brazilian Journal of Otorhinolaryngology* 72 (3), 394–398.  
Yamaguchi, H., Tada, S., Nakanishi, Y., Kawaminami, S. et al. (2015) Association between mouth breathing and atopic dermatitis in Japanese children 2–6 years old: A population-based cross-sectional study. *PLoS One* 10 (4). doi: 10.1371/journal.pone.0125916 27.
- 48 Okuro, R.T., Morcillo, A.M., Ribeiro, M.A., Sakano, E., Conti, P.B. & Ribeiro, J.D. (2011) Mouth breathing and forward head posture: Effects on respiratory biomechanics and exercise capacity in children. *Jornal Brasileiro de Pneumologia* 37 (4), 471–479.
- 49 Bourke, R., Anderson, V., Yang, J.S., Jackman, A.R. et al. (2011) Cognitive and academic functions are impaired in children with all severities of sleep-disordered breathing. *Sleep Medicine* 12 (5), 489–496.
- 50 Seo-Young, L., Guilleminault, C., Hsiao-Yean, C. & Sullivan, S. (2015) Mouth breathing, “nasal dis-use” and pediatric sleep-disordered-breathing. *Sleep and Breathing*. Stanford University Sleep Medicine Division, Stanford Outpatient Medical Center, Redwood City, CA.
- 51 McKeown, P. (2018) Buteyko Education Training Manual (unpublished).

- 52 D'Ascanio, L., Lancione, C., Pompa, G., Rebuffini, E., Mansi, N. & Manzini, M. (2010) Craniofacial growth in children with nasal septum deviation: A cephalometric comparative study. *International Journal of Pediatric Otorhinolaryngology* 74 (10), 1180–1183.
- 53 Jefferson, Y. (2010) Mouth breathing: Adverse effects on facial growth, health, academics, and behavior. *General Dentistry* 58,18–25.
- 54 McKeown, P. & Mew, J. (2011) Cranio-facial changes and mouth breathing. *Irish Dentist*. Accessed on February 16, 2019 at <https://buteykoclinic.com/wp-content/uploads/2016/11/Buteyko-Mouth-Breathing.pdf>
- 55 Buteyko Clinic International (2018) Breathing and the influence of childhood development. Accessed on February 16, 2019 at <https://buteykoclinic.com/crookedteeth>
- 56 See <https://aomtinfo.org>
- 57 [www.aafo.org](http://www.aafo.org)
- 58 [www.banyanbotanicals.com](http://www.banyanbotanicals.com)

## Chapter 6

- 1 Lindgren, H. (2011) Diaphragm function for core stability. Accessed on February 11, 2019 at <http://hanslindgren.com/articles/diaphragm-function-for-core-stability>
- 2 Farhi, D. & Stuart, L. (2017) *Pathways to a Centered Body: Gentle Yoga Therapy for Core Stability, Healing Back Pain, and Moving with Ease*. Christchurch, New Zealand: Embodied Wisdom Publishing.
- 3 Ibid.
- 4 Brian, C. & Lyons, J. (2008) Etymology of Thoracic Terms. Dartmouth Medical School. Accessed on February 11, 2019 at [www.dartmouth.edu/~humananatomy/resources/etymology/Thoracic\\_viscera.htm](http://www.dartmouth.edu/~humananatomy/resources/etymology/Thoracic_viscera.htm)
- 5 Myers, T.W. (2014) *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*. Edinburgh: Churchill Livingstone/Elsevier. p. 198.
- 6 Ibid.
- 7 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 8 David, P., Laval, D., Terrien, J. & Petitjean, M. (2012) Postural control and ventilatory drive during voluntary hyperventilation and carbon dioxide rebreathing. *European Journal of Applied Physiology* 112 (1), 145–154.
- 9 Lindgren, H. (2011). Diaphragm function for core stability. Accessed on February 11, 2019 at <http://hanslindgren.com/articles/diaphragm-function-for-core-stability>
- 10 Courtney, R. (2017) Breathing training for dysfunctional breathing in asthma: Taking a multidimensional approach. *ERJ Open Research* 3. doi: 10.1183/23120541.00065-2017
- 11 Lindgren, H. (2011) Diaphragm function for core stability. Accessed on February 11, 2019 at <http://hanslindgren.com/articles/diaphragm-function-for-core-stability>
- 12 Hruska, R. (2005) *ZOA Position & Mechanical Function*. Postural Restoration Institute. Accessed on February 11, 2019 at [www.posturalrestoration.com/resources/dyn/files/1051512z69443dbe/\\_fn/ZOA.pdf](http://www.posturalrestoration.com/resources/dyn/files/1051512z69443dbe/_fn/ZOA.pdf)
- 13 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 14 Hu, F., Comtois, A. & Grassino, A.E. (1992) Optimal diaphragmatic blood perfusion. *Journal of Applied Physiology* 72 (1), 149–157.  
Bartelink, D.L. (1957) The role of abdominal pressure in relieving the pressure on the lumbar intervertebral discs. *Journal of Bone and Joint Surgery* 39 (B4), 718–725.
- 15 Myers, T.W. (2014) *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*. Edinburgh: Churchill Livingstone/Elsevier.
- 16 Farhi, D. & Stuart, L. (2017) *Pathways to a Centered Body: Gentle Yoga Therapy for Core Stability, Healing Back Pain, and Moving with Ease*. Christchurch, New Zealand: Embodied Wisdom Publishing.
- 17 Ibid.
- 18 Kolar, P., Sulc, J., Kyncl, M., Sanda, J. et al. (2010) Stabilizing function of the diaphragm: Dynamic MRI and synchronized spirometric assessment. *Journal of Applied Physiology* 109 (4), 1064–1071.  
Kolar, P., Neuwirth, J., Sanda, J., Suchanek, V. et al. Analysis of diaphragm movement during tidal breathing and during its activation while breath holding using MRI synchronized with Spirometry. *Physiological Research* 58, 383–392.
- 19 Smith, M.D., Russell, A. & Hodges, P.W. (2006) Disorders of breathing and continence have a stronger association with back pain than obesity and physical activity. *Australian Journal of Physiotherapy* 52, 11–16. p. 11.

- 20 Bradley, H. & Esformes, J. (2014) Breathing pattern disorders and functional movement. *International Journal of Sports Physical Therapy* 9 (1), 28–39.
- 21 Nagarwala, R., Dhotre, P. & Gelani, I.. (2011) Correlation between core strength and breath holding time in normal young adults. *Journal of Orthopedics and Rehabilitation* 1 (1), 75–78.
- 22 O’Sullivan, P.B., Beales, D.J., Beetham, J.A., Cripps, J. et al. (2002) Altered motor control strategies in subjects with sacroiliac joint pain during the active straight-leg-raise test. *Spine* 27 (1), E1–E8.  
Roussel, N.A., Nijs, J. & Truijen, S. (2007) Low back pain: Clinimetric properties of the Tredelenburg test, active straight leg raise test and breathing pattern during active straight leg raising. *Journal of Manipulative and Physiological Therapeutics* 30 (4), 270–278.
- 23 Ibid.
- 24 Farhi, D. & Stuart, L. (2017) *Pathways to a Centered Body: Gentle Yoga Therapy for Core Stability, Healing Back Pain, and Moving with Ease*. Christchurch, New Zealand: Embodied Wisdom Publishing. p. 45.
- 25 Boser, A. (2008) *Relieve Stiffness and Feel Young Again with Undulation*. Issaquah, WA: Vital Self.  
Boser, A. (n.d) Undulation Break: The “Feel Better Software.” Accessed on February 17, 2019 at [www.undulationbreak.com](http://www.undulationbreak.com)

## Chapter 7

- 1 Gharote, M.L. (2006) *Yogic Techniques*. Lonavla, India: Lonavla Yoga Institute. p. 81.
- 2 Muktibodhananda (1998) *Hatha Yoga Pradipika—Light on Hatha Yoga: Including the Original Sanskrit Text of the Hatha Yoga Pradipika with English Translation*, 3rd edn. Munger, Bihar: Bihar School of Yoga.
- 3 Saraswati, N. (2010) *Prāṇa and Prāṇāyāma*. Munger, Bihar: Yoga Publication Trust. p. 56.
- 4 Maehle, G., Cox, R. & Watson, A. (2012). *Prāṇāyāma: The Breath of Yoga*. Doubleview, WA: Kaivalya Publications.
- 5 I use the informal name “Wheel Pose” for this movement, as many of my therapeutic clients find the Sanskrit name a bigger mouthful than they can manage. I recognize that Chakrāsana, the official “Wheel Pose,” is quite a dramatically different posture. The movement created by Chakravakāsana (which incidentally means Ruddy Goose Pose) is circular, thus resembling a wheel.

## Chapter 8

- 1 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press. p. 90.
- 2 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 3 The Hebbian rule or theory postulates that persistent repetition in synaptic activity between neurons will increase the likelihood of repeated firing between those neurons in the future. Hebb’s rule, introduced by Donald Hebb in his 1949 book *The Organization of Behavior*, has been cited as an explanation for neuroplasticity and the learning process.
- 4 Le Doux, J. (1996) *The Emotional Brain: The Mysterious Underpinnings of Emotional Life*. New York, NY: Simon & Schuster. p. 252.
- 5 Van der Kolk, B. (2015) *The Body Keeps the Score: Brain, Mind, and Body in the Healing of Trauma*. New York, NY: Penguin Books. p. 60.
- 6 Le Doux, J. (1996) *The Emotional Brain: The Mysterious Underpinnings of Emotional Life*. New York, NY: Simon & Schuster.
- 7 Van der Kolk, B. (2015) *The Body Keeps the Score: Brain, Mind, and Body in the Healing of Trauma*. New York, NY: Penguin Books.
- 8 Williams, J.M. & Kabat-Zinn, J. (2007) *The Mindful Way through Depression: Freeing Yourself from Chronic Unhappiness*. New York, NY: Guilford Press.
- 9 Davidson, R.J. & Lutz, A. (2008) Buddha’s brain: Neuroplasticity and meditation. *IEEE Signal Processing Magazine* 25 (1), 176–174.
- 10 Van der Kolk, B. (2015). *The Body Keeps the Score: Brain, Mind, and Body in the Healing of Trauma*. New York, NY: Penguin Books.
- 11 Porges, S.W. (2001) The polyvagal theory: Phylogenetic substrates of a social nervous system. *International Journal of Psychophysiology* 42 (2), 123–146.
- 12 Lehrer, P.M. & Gervitz, R. (2014) Heart rate variability biofeedback: How and why does it work? *Frontiers in Psychology* 5, 756–765.

- 13 Brown, R.P. & Gerbarg, P.L. (2005) Sudarshan Kriya yogic breathing in the treatment of stress, anxiety, and depression: Part I—Neurophysiologic model. *Journal of Alternative and Complementary Medicine* 11, 189–201.  
Porges, S.W. (2011) *The Polyvagal Theory: Neurophysiological Foundations of Emotions, Attachment, Communication, and Self-Regulation*. New York, NY: W.W. Norton.  
Brown, R.P., Gerbarg, P.L. & Muench, F. (2013) Breathing practices for treatment of psychiatric and stress-related medical conditions. *Psychiatric Clinics of North America* 36, 121–140.
- 14 Medina, J. (2014) *Brain Rules*. Seattle, WA: Pear Press.
- 15 Ibid.
- 16 Van der Kolk, B. (2015) *The Body Keeps the Score: Brain, Mind, and Body in the Healing of Trauma*. New York, NY: Penguin Books.
- 17 Ibid.
- 18 Aupperle, R.L. & Paulus, M.P. (2010) Neural systems underlying approach and avoidance in anxiety disorders. *Dialogues in Clinical Neuroscience* 12 (4), 517–531.
- 19 Van der Kolk, B. (2015) *The Body Keeps the Score: Brain, Mind, and Body in the Healing of Trauma*. New York, NY: Penguin Books.
- 20 Berthoud, H.R. & Neuhuber, W.L. (2000) Functional and chemical anatomy of the afferent vagal system. *Autonomic Neuroscience* 85 (1–3), 1–17.
- 21 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 22 Ibid.
- 23 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.
- 24 Krouse, J., Brown, R., Fineman, S., Han, J.K. et al. (2007) Asthma and the unified airway. *Otolaryngology—Head and Neck Surgery* 136, S75–S106.  
Rassovsky, Y., Abrams, K. & Kushner, M.F. (2006) Suffocation and respiratory responses to carbon dioxide and breath holding challenges in individuals with panic disorder. *Journal of Psychosomatic Research* 60, 291–298.
- 25 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone. p. 245.
- 26 Rosenkranz, M.A. & Davidson, R.J. (2009) Affective neural circuitry and mind-body influences in asthma. *Neuroimage* 47 (3), 972–980.
- 27 Lehrer, P.M., Vaschillo, E., Vaschillo, B., Lu, S.E., Eckberg, D., Edelberg, R. et al. (2003) Heart rate variability biofeedback increases baroreflex gain and peak expiratory flow. *Psychosomatic Medicine* 65, 796–805.
- 28 Cappo, B.M. & Holmes, D.S. (1984) The utility of prolonged respiratory exhalation for reducing physiological and psychological arousal in nonthreatening and threatening situations. *Journal of Psychosomatic Research* 28 (4), 265–273.  
Brown, R.P. & Gerbarg, P.L. (2005) Sudarshan Kriya yogic breathing in the treatment of stress, anxiety, and depression: Part I—Neurophysiologic model. *Journal of Alternative and Complementary Medicine* 11, 189–201.  
Porges, S.W. (2011) *The Polyvagal Theory: Neurophysiological Foundations of Emotions, Attachment, Communication, and Self-Regulation*. New York, NY: W.W. Norton.  
Brown, R.P., Gerbarg, P.L. & Muench, F. (2013) Breathing practices for treatment of psychiatric and stress-related medical conditions. *Psychiatric Clinics of North America* 36, 121–140.
- 29 Brown, R.P. & Gerbarg, P.L. (2012) *The Healing Power of the Breath: Simple Techniques to Reduce Stress and Anxiety, Enhance Concentration, and Balance Your Emotions*. Boston, MA: Shambhala Publications. pp. 34–35.
- 30 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.
- 31 Nixon, P.G.F. (1989) Hyperventilation and cardiac symptoms. *Internal Medicine* 10 (12), 67–84.
- 32 Courtney, R. (2017) Breathing training for dysfunctional breathing in asthma: Taking a multidimensional approach. *ERJ Open Research* 3. doi: 10.1183/23120541.00065-2017
- 33 Van der Kolk, B. (2015) *The Body Keeps the Score: Brain, Mind, and Body in the Healing of Trauma*. New York, NY: Penguin Books. p. 92.
- 34 Lu, C., Yang, T., Zhao, H., Zhang, M., Meng, F., Fu, H. & Xu, H. (2016) Insular cortex is critical for the perception, modulation, and chronification of pain. *Neuroscience Bulletin* 32 (2), 191–201.
- 35 Wiebking, C., Duncan, N.W., Turet, B., Hayes, D.J. et al. (2013) ABA in the insula—a predictor of the neural response to interoceptive awareness. *Neuroimage* 86, 10–18.

## Chapter 9

- 1 Saraswati, N. (2010) *Prāṇa and Prāṇāyāma*. Munger, Bihar: Yoga Publication Trust. p. 93.
- 2 Welch, C. (2005) *Secrets of the Mind: The 10 Channels Revealed* (ebook). New South Wales: Big Shakti. Available from <http://drclaudiawelch.com/estore/books-ebooks> (p. 13).
- 3 Ibid.
- 4 Ibid., p. 10.
- 5 Carrera, J. (2006) *Inside the Yoga Sūtras: A Comprehensive Sourcebook for the Study and Practice of Patañjali's Yoga Sūtras*. Buckingham, VA: Integral Yoga Publications. Sūtras 2:7 & 2:8.
- 6 Desikachar, T.K.V. & Kishnamacharya, T. (1998) *Sri Nāthamuni's Yoga Rahasya*. Chennai, India: Krishnamacharya Yoga Mandiram.
- 7 Welch, C. (2005) *Secrets of the Mind: The 10 Channels Revealed*. (ebook). New South Wales: Big Shakti. Available from <http://drclaudiawelch.com/estore/books-ebooks> (p. 9).
- 8 Ibid.
- 9 Ibid.
- 10 Carrera, J. (2006). *Inside the Yoga Sūtras: A Comprehensive Sourcebook for the Study and Practice of Patanjali's Yoga Sūtras*. Buckingham, VA: Integral Yoga Publications. p. 43.
- 11 Dass, H. & Diffenbaugh, D. (1999) *The Yoga Sūtras of Patañjali: A Study Guide for Book I: Samādhi Pāda*. Santa Cruz, CA: Sri Rama Publishing.
- 12 Feuerstein, G. (2008) *The Yoga Tradition: Its History, Literature, Philosophy, and Practice*. Prescott, AZ: Hohm Press.
- 13 Lad, V. (2002) *Textbook of Ayurveda: Fundamental Principles of Ayurveda*. Albuquerque, NM: Ayurvedic Press. p. 306.
- 14 Bean, C.R. (2009–2017) Nādis—Channels and Meridians. Accessed on February 19 at [www.sandiegocollegeofayurveda.com/ayurveda-meridians](http://www.sandiegocollegeofayurveda.com/ayurveda-meridians)
- 15 Niharika, N., Hankey, A. & Nagendra, H.R. (2013) Effects of yoga practice on acumeridian energies: Variance reduction implies benefits for regulation. *International Journal of Yoga* 6 (1), 61–65.  
Patwardhan, B., Warude, D., Pushpangadan, P. & Bhatt, N. (2005) Ayurveda and traditional Chinese medicine: A comparative overview. *Evidence-Based Complementary and Alternative Medicine* 2, 465–73.
- 16 Saraswati, N. (2010) *Prāṇa and Prāṇāyāma*. Munger, Bihar: Yoga Publication Trust.
- 17 Raghuraj, P. & Telles, S. (2008) *Applied Psychophysiology and Biofeedback* 33 (2), 65–75.
- 18 Naveen, K.V., Nagarathna, R., Nagendra, H.R. & Telles, S. (1997) Yoga breathing through a particular nostril increases spatial memory scores without lateralized effects. *Psychological Reports* 81 (2), 555–561.
- 19 Welch, C. (2005) *Secrets of the Mind: The 10 Channels Revealed* (ebook). New South Wales: Big Shakti. Available from <http://drclaudiawelch.com/estore/books-ebooks>.
- 20 Loizzo, J. (2016) The subtle body: An interoceptive map of central nervous system function and meditative mind-brain-body integration. *Annals of the New York Academy of Sciences* 1373 (1), 78–95.
- 21 Ibid.
- 22 Pasricha, P.J. (2011) *Stanford Hospital: Brain in the Gut—Your Health* [Video file]. Accessed on March 13, 2019 at [www.youtube.com/watch?v=UXx4WTVU34Y](http://www.youtube.com/watch?v=UXx4WTVU34Y)
- 23 Soudry, Y., Lemogne, C., Malinvaud, D., Consoli, S. & Bonfils, P. (2011) Olfactory system and emotion: Common substrates. *European Annals of Otorhinolaryngology, Head and Neck Diseases* 128 (1), 18–23.
- 24 Pause, B.M., Hellmann, G., Göder, R., Aldenhoff, J.B. & Ferstl, R. (2008) Increased processing speed for emotionally negative odors in schizophrenia. *International Journal of Psychophysiology* 70, 16–22.  
Schneider, F., Habel, U., Reske, M., Toni, I., Falkai, P. & Shah, N.J. (2007) Neural substrates of olfactory processing in schizophrenia patients and their healthy relatives. *Psychiatry Research* 155, 103–112.
- 25 Johari, H. (2000) *Chakras: Energy Centers of Transformation*. Rochester, VT: Destiny Books.
- 26 Wisneski, L. & Anderson, L. (2005) The scientific basis of integrative medicine. *Evidence-Based Complementary and Alternative Medicine* 2 (2), 257–259.
- 27 Miller, R. (n.d.) *Mudra: Gateways to Self-Understanding*. San Rafael, CA: Anahata Press.
- 28 Ibid.
- 29 Le Page, J. & Le Page, L. (2014) *Mudras for Healing and Transformation*. Sebastopol, CA: Integrative Yoga Therapy.  
Arora, I. (2015) *Mudra: The Sacred Secret*. Bedford, MA: Yogsadhna LLC.

## Chapter 10



- 1 Maehle, G., Cox, R. & Watson, A. (2012) *Prāṇāyāma: The Breath of Yoga*. Doubleview, WA: Kaivalya Publications. p. 69.
- 2 Dass, H. & Diffenbaugh, D. (1999) *The Yoga Sūtras of Patañjali: A Study Guide for Book I: Samādhi Pāda*. Santa Cruz, CA: Sri Rama Publishing. Sūtra 2:49, p. 17.
- 3 Audicya, R., Devnath, P. & Gharote, M.L. (2000) *Kumbhāka Paddhati of Raghuvira: Science of Prāṇāyāma*. Lonavala, India: The Lonavala Yoga Institute. pp. xli–xlii.
- 4 Ibid., Stanzas 158–160.
- 5 Mallinson, J. (2004) *The Gheranda Samhita: The Original Sanskrit and an English Translation*. Woodstock, NY: Yogavidya. Stanza 81, p. 109.
- 6 Ibid., pp. 109–110.
- 7 Ibid., Stanzas 83–84, p. 110.
- 8 Muktibodhananda (1998) *Hatha Yoga Pradipika—Light on Hatha Yoga: Including the Original Sanskrit Text of the Hatha Yoga Pradipika with English Translation*, 3rd edn. Munger, Bihar: Bihar School of Yoga. II:2, p. 151.
- 9 Mallinson, J. (2004). *The Gheranda Samhita: The Original Sanskrit and an English Translation*. Woodstock, NY: Yogavidya. Stanza 57, p. 103.
- 10 Maehle, G., Cox, R. & Watson, A. (2012) *Prāṇāyāma: The Breath of Yoga*. Doubleview, WA: Kaivalya Publications. p. 86.
- 11 Muktibodhananda (1998) *Hatha Yoga Pradipika—Light on Hatha Yoga: Including the Original Sanskrit Text of the Hatha Yoga Pradipika with English Translation*, 3rd edn. Munger, Bihar: Bihar School of Yoga. Sūtra 2:15, p. 149.
- 12 Maehle, G., Cox, R. & Watson, A. (2012) *Prāṇāyāma: The Breath of Yoga*. Doubleview, WA: Kaivalya Publications. p. 63.
- 13 Campbell, L.B., Gooden, B.A. & Horowitz, J.D. (1969) Cardiovascular responses to partial and total immersion in man. *Journal of Physiology* 202 (1), 239–250.
- 14 Rennie, J. (2012) How the dive reflex extends breath-holding. Accessed on February 11, 2019 at [www.scientificamerican.com/article/breath-holding-dive-reflex-extends](http://www.scientificamerican.com/article/breath-holding-dive-reflex-extends)
- 15 Allison, D.J. (1977) Dangerous reflexes from the nose (letter). *Lancet* 1 (8017), 909.  
Cottle, M.H. (1980) *Rhinomanometry*. Kansas City, MO: American Rhinologic Society.
- 16 Fong, K. (2018) Free divers have long defied science—and we still don’t really understand how they go so deep. The Conversation. Accessed on February 11, 2019 at <http://theconversation.com/free-divers-have-long-defied-science-and-we-still-dont-really-understand-how-they-go-so-deep-92690>
- 17 Campbell, L.B., Gooden, B.A. & Horowitz, J.D. (1969) Cardiovascular responses to partial and total immersion in man. *Journal of Physiology* 202 (1), 239–250.
- 18 Maehle, G., Cox, R. & Watson, A. (2012) *Prāṇāyāma: The Breath of Yoga*. Doubleview, WA: Kaivalya Publications.  
Lysebeth, A.V. (2013) *Prāṇāyāma: The Energetics of Breath*, 2nd edn. Edinburgh: Harmony.
- 19 Ibid.
- 20 Maehle, G., Cox, R. & Watson, A. (2012) *Prāṇāyāma: The Breath of Yoga*. Doubleview, WA: Kaivalya Publications.  
Gharote, M.L. (2003) *Prāṇāyāma: The Science of Breath*. Lonavla, India: Lonavla Yoga Institute.
- 21 Verges, S., Chacaroun, S., Godin-Ribuot, D. & Baillieul, S. (2015) Hypoxic conditioning as a new therapeutic modality. *Frontiers in Pediatrics* 3, 58. doi: 10.3389/fped.2015.00058.
- 22 Ibid.
- 23 Hageman, W. (2011) Living at altitude: People are living longer, healthier lives higher up. Accessed on July 7, 2018 at [http://articles.chicagotribune.com/2011-09-07/health/sc-health-0907-living-at-altitude-20110907\\_1\\_heart-disease-high-altitude-lung-disease](http://articles.chicagotribune.com/2011-09-07/health/sc-health-0907-living-at-altitude-20110907_1_heart-disease-high-altitude-lung-disease)
- 24 Ibid.
- 25 Ibid.
- 26 Ibid.
- 27 Basovich, S.N. (2010) The role of hypoxia in mental development and in the treatment of mental disorders: A review. *Bioscience Trends* 4, 288–296.
- 28 Bailey, D.P., Smith, L.R., Christmas, B.C., Taylor, L. et al. (2015) Appetite and gut hormone responses to moderate-intensity continuous exercise versus high-intensity interval exercise, in normoxic and hypoxic conditions. *Appetite* 89, 237–245.
- 29 Bailey, D.P., Smith, L.R., Christmas, B.C., Taylor, L. et al. (2015) Appetite and gut hormone responses to moderate-intensity continuous exercise versus high-intensity interval exercise, in normoxic and hypoxic conditions. *Appetite* 89, 237–245.  
Basovich, S.N. (2010) The role of hypoxia in mental development and in the treatment of mental disorders: A review. *Bioscience Trends* 4, 288–296.

- 30 Ibid.
- 31 Ibid.
- 32 Ibid.
- 33 Ibid.
- 34 Desikachar, K., Jayaraman, M. & Jaganathan, S. (2016) *Hathayogapradīpikā: Jyotsnāyutā*. Chennai, India: Media Garuda. Sūtra 2:12, p. 100.
- 35 Muktibodhananda (1998) *Hatha Yoga Pradipika—Light on Hatha Yoga: Including the Original Sanskrit Text of the Hatha Yoga Pradipika with English Translation*, 3rd edn. Munger, Bihar: Bihar School of Yoga. Sūtra 2:11, p. 173.
- 36 Ibid., p. 175.
- 37 Ibid., Sūtra 2:35, p. 220.
- 38 Ibid., Sūtra 2:35, pp. 254–255.
- 39 Ibid., Sūtra 2:35, p. 220.
- 40 Wim Hof is the founder of a popular breathing practice that combines intense hyperventilation and retention techniques with exposure to cold to bolster immune function.
- 41 Timmons, B.H. & Ley, R. (1994) *Behavioral and Psychological Approaches to Breathing Disorders*. New York, NY: Plenum Press.

## Chapter 11

- 1 Desikachar, T.K.V., Desikachar, K. & Jaganathan, S. (trans.) (2018) *The Yogarahasya of Nāthamuni*. Chennai, India: Krishnamacharya Healing & Yoga Foundation. p. 63.
- 2 Bowler, S., Green, A. & Mitchell, C. (1998) Buteyko breathing and asthma: A controlled trial. *Medical Journal of Australia* 169, 575–578.
- 3 Hallini, M., Wheatley, J.R. & Amis, T.C. (2008) Enforced mouth breathing decreases lung function in mild asthmatics. *Respirology* 13, 553–558.
- 4 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.
- 5 Lum, C. (1996) Treatment difficulties and failures: Causes and clinical management. *Biological Psychology* 43 (3), 243.
- 6 Lum, L.C. (1987) Hyperventilation syndromes in medicine and psychiatry: A review. *Journal of the Royal Society of Medicine* 80 (4), 229–231.
- 7 Joulia, F., Steinberg, J.G., Faucher, M., Jamin, T. et al. (2003) Breath-hold training of humans reduces oxidative stress and blood acidosis after static and dynamic apnea. *Respiratory Physiology and Neurobiology* 137, 19–27. p. 21.
- 8 Schagatay, E., Haughey, H. & Reimers, I. (2005) Speed of spleen volume changes evoked by serial apneas. *European Journal of Applied Physiology* 93, 447–452.
- 9 Lewis, B.I. (1954) Chronic hyperventilation syndrome. *JAMA* 151, 1204–1208.
- 10 McKeown, P. (2015) *The Oxygen Advantage: The Simple, Scientifically Proven Breathing Techniques for a Healthier, Slimmer, Faster, and Fitter You*. New York, NY: William Morrow.
- 11 van Dixhoorn, J., Duivenvoorden, H.J., Staal, H.A. & Pool, J. (1989) Physical training and relaxation therapy in cardiac rehabilitation assessed through a composite criterion for training outcome. *American Heart Journal* 118 (3), 545–552.
- 12 van Dixhoorn, J. & Duivenvoorden, H.J. (1999) Effect of relaxation therapy on cardiac events after myocardial infarction: A 5-year follow-up study. *Journal of Cardiopulmonary Rehabilitation* 19 (3), 178–185.
- 13 Bernardi, L., Spadacini, G., Bellwon, J., Hajric, R., Roskamm, H. & Frey, A.W. (1998) Effect of breathing rate on oxygen saturation and exercise performance in chronic heart failure. *The Lancet* 351 (9112), 1308–1311.
- 13 Duennwald, T., Gatterer, H., Groop, P.-H., Burtscher, M. & Bernardi, M.D. (2013) Effects of a single bout of interval hypoxia on cardiorespiratory control in patients with Type 1 diabetes. *Diabetes* 62 (12) 4220–4227. Accessed on February 11, 2019 at <http://diabetes.diabetesjournals.org/content/62/12/4220.figures-only>
- 14 Buteyko, K.P. (2018) *Buteyko's Book*. Accessed on February 11, 2019 at <https://buteykoclinic.com/wp-content/uploads/2018/08/Dr-Buteykos-Book.pdf>
- 15 Kolb, P. (2001) *Buteyko: Guide for Doctors*, Revision 1.1. Accessed on February 11, 2019 at <https://buteykoclinic.com/wp-content/uploads/2016/11/Buteyko-Breathing.pdf>
- 16 Ott, H.W., Mattle, V., Zimmermann, U.S., Licht, P. et al. (2006) Symptoms of premenstrual syndrome may be caused by hyperventilation. *Fertility and Sterility* 86 (4). doi: 1001e17-1001e19.
- 17 Kontos, H., Richardson, D. & Raper, A. (1972) Mechanism of action of hypocapnic alkaldosis on limb blood vessels in man and dog. *American Journal of Physiology* 223, 1296–1307.
- 18 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone.

- 19 Casale, T., Onder, R., Berkowitz, R. & Korenblat, P.E. (2018) Nasal carbon dioxide used as needed in the symptomatic treatment of seasonal allergic rhinitis. *Journal Of Allergy And Clinical Immunology* 6 (1), 183–189.  
Pawankar, R . (2005) Mast Cells in Allergic Airway Disease and Chronic Rhinosinusitis. In H. Saito & Y. Okayama (eds.) *Mast Cells in Allergic Diseases. Chemical Immunology and Allergy*, Vol. 87. Basel: Karger. pp. 111–129.
- 20 Margarian, G.J. (1982) Hyperventilation syndromes: Infrequently recognized common expressions of anxiety and stress. *Medicine (Baltimore)* 61 (4), 219–236. Review.  
Rho, M.J. (2009) Arresting a seizure by dropping a little acid. *Epilepsy Currents* 9 (2), 55–56.  
Miller, J. (2011) Stopping seizures with carbon dioxide. *Epilepsy Currents* 11 (4), 114–115.  
Mazarati, A.M. (2007) Respiratory alkalosis: “Basic” mechanism of febrile seizures? *Epilepsy Currents* 7 (1), 25–27.
- 21 Tiwari, P., Dwivedi, S., Singh, M.P., Mishra, R. & Chandy, A. (2017) Basic and modern concepts on cholinergic receptor: A review. *Asian Pacific Journal of Tropical Disease* 3 (5), 413–420.
- 22 Basovich, S.N. (2010) The role of hypoxia in mental development and in the treatment of mental disorders: A review. *Bioscience Trends* 4, 288–296.

## Appendix 1

- 1 Maehle, G., Cox, R. & Watson, A. (2012) *Prāṇāyāma: The Breath of Yoga*. Doubleview, WA: Kaivalya Publications. p. 30.

## Appendix 2

- 1 Maehle, G., Cox, R. & Watson, A. (2012) *Prāṇāyāma: The Breath of Yoga*. Doubleview, WA: Kaivalya Publications. p. 86.
- 2 See Dr. Courtney’s website at [www.rosalbacourtney.com](http://www.rosalbacourtney.com).
- 3 Chaitow, L., Gilbert, C. & Bradley, D. (2014) *Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach*, 2nd edn. Edinburgh: Churchill Livingstone. p. 61.

## Appendix 3

- 1 The “c” in Sanskrit is always pronounced “ch.” “Chakra” is the phonetic spelling of “cakra,” and also the one easily recognized in the mainstream. I have tried to use the correct Sanskrit spelling for as many terms as possible, but “chakra” is familiar in the West and “cakra” isn’t. For ease and clarity, I use “chakra” throughout the text.



# INDEX

abdominal breathing 46, 347  
abdominal muscles 148–52, 183  
abhinevesha 41  
abstinence 42  
accessory breathing muscles 27, 112, 142, 158  
    activation from mouth breathing 118  
    in chest and paradoxical breathing 146–7  
    in dysfunctional breathing 96  
    lower and upper body 143  
acetylcholine, carbon dioxide and nitric oxide effects 300  
acid-alkaline balance 24  
    hydrogen partial pressure and 82–3  
    tumor growth and 297  
adenosine triphosphate (ATP) 78  
    targeting by free radicals 85  
aerobic exercise 79  
agni 64  
agni sara 173  
ahamkāra 244, 264  
ahimsā 42  
air element 56  
    air diet 63  
    prāṇa and 60  
    sense of touch and 60  
air flow, control by nose 115–16  
air hunger 105, 106, 297  
    nostril techniques and 243  
    soft edge 109  
    sustaining slight 271  
    tolerable 265  
ājñā chakra 256  
Akasha Breathing 106, 350  
alabdhabhūmikatva 66  
ālasaya 66  
allergic hyperresponsiveness 296  
alphabet practice 136  
alternate nostril breathing 179, 243, 262  
    with Subtle Breath 332  
alternate nostril exhale 262  
alternate nostril inhale 262  
alveoli 76  
ama 65  
    removal by breath of fire 278  
amygdala 221, 222, 241  
anahata chakra 256  
anal sphincter 182  
ānandamaya 58  
anatomy, recent yoga focus on 26, 27, 152

- anavasthitatvāni 66
- anemone hand pulses 200–2, 203, 308, 359
- annamaya 27, 58
  - stabilization via bandhas 179
- antara kumbhāka 61
- antarāyāh 66, 70
- anticipatory anxiety 228
- Anuloma ujjayi 261, 262–3
- anxiety 288, 292, 293, 346
  - anticipatory 228
  - big breathing as trigger 231
  - Buteyko breathing for 29
  - case study 292–3
  - paradoxical breathing in 147
  - Subtle Breathing for 289
- apāna mūdra 330
- apanāsana 308, 320, 331
- apānasana 169
- apānavayu 60, 61
  - in Energy Bank Account 64–5
  - exhalation and 61
- aparigrahā 42
- apnea
  - daytime 93
  - hyperventilation and 104–5
  - recovery from 92
- approach vs. avoid orientation 222, 241
- Arora, I. 259
- āsana 22, 52
  - combining with breath and mantra 225
  - as preparatory mechanism 52
  - as seat 44
  - as third limb of yoga 43–5
- āsana practices
  - for restoring prāṇā 307
  - Sequence A 307–18
  - Sequence B 319–29
  - Sequence C 330–41
- asmitā 40–1
- assimilation energy 65, 69
- asteya 42
- asthanga yoga 41–2
- asthma 288, 346
  - breath volume and rate 97
  - Buteyko Breathing for 28, 29
  - case study 298–9
  - exercise-induced 298–9
  - loss of carbon dioxide and 291
  - lung hyperinflation in 151
  - ZOA reduced in 176
- asthmatic airway, Ayurvedic perspective 122
- athletic performance
  - Buteyko breathing benefits 29
  - leaps in 292
- attachment 41
- audible breathing, dysfunctionality 96
- auto-immune issues 346
- autonomic nervous system (ANS) 24, 82, 96, 139, 221
  - altering through Subtle Breathing 106
  - breath impacts on 225
  - carbon dioxide role 73
  - effects of inhalation and exhalation on 28
  - maneuvering with nostril techniques 244
  - nādis and 247–8

- aversion 41
- avidya 31, 233
  - as affliction 40
  - reducing 42
- avirati 66
- awareness, elevating through prāṇāyāma 55
- Ayurveda 305
  - asthmatic airway according to 122
  - basis in Sāṃkhya philosophy 56
  - breath biomechanics perspective 121–2
  - breath manipulation and health in 27
- Baba Hari Dass 46, 48, 92
- baby fish 1-2-3-3-2-1 210–12, 359
- baby plank
  - with alternate knee lifts 359
  - hover position knees down 195–6, 319, 359
- baby plank—hover position with alternate knee lifts 196–7
- bad breath 140
- bāhya kumbhāka 362
  - during exercise 281–3
- bāhya kumbhāka exercise 280–1
- bandha muscles 180
- bandhas 179–80, 182, 246, 358–60
  - with breath suspension 272
  - core engagement and 180–2
  - jālandhara bandha 184–6
  - mūla bandha 182
  - phrenic and vagus nerve control 180
  - supposed conditions for practice 179
  - uḍḍiyāna bandha 183–4
  - use by traditional yogis 186
- Banyan Botanicals 132
- basal rate 296
- bastrika 278–9
- bee breath 235–6
- belching 288
- bellow’s breath 278–9
- belly breathing 143, 157, 176
- Bernardi, L. 82, 296
- bhṛānti darśana 66
- bicarbonate, carbon dioxide conversion to 349
- big breathing 62
  - as anxiety trigger 21
  - confusion over 47
  - contradiction by yoga texts 31
  - decreased oxygenation with 80
  - deep breathing 349
  - detrimental effects on oxygenation 89
  - during exercise 90
  - myths 22, 23, 24
  - oxygenation myths 348–9
  - during pose transitions 347
- bija mantras 259
  - chakra specific 254–7
- biochemistry
  - of breathing 71–3, 355
  - speech exercises 136–7
- biomechanics 113–14
  - Ayurvedic perspective 121–2
  - core engagement and alignment issues 123–5
  - cuing language for 351–2
  - of diaphragm 142
  - mouth breathing causes 120–2

- mouth breathing experiment 125
- mouth closing practices 122–3
- mouth taping explanation 137–9
- nighttime mouth breathing 125–6
- nose clearing exercise 131
- nose functions 114–18
- nose mouth 118–19
- pediatric mouth breathing 127–30
- tongue exercises 132–6
- block squeeze and 2-part exhale 188–9, 359
- blood pressure regulation, medulla oblongata role 81
- body mechanics, encouraging in students 347
- Bohr effect 30, 78, 80, 89, 103
- bolster straddle 198–9, 359
  - chair variation 359
- Boser, A. 160
- brachial plexus 250
- brahmacharya 42
- brahmari exercise 235–6, 241, 258, 360
  - yogic tradition 230
- brain
  - fear network 221, 229
  - HPA axis chart 226
  - modern issues 228
  - nervous system 223–5
  - pattern retraining 231
  - polyvagal theory chart 224
  - stress effects on 220–3
  - symbiosis with breath 228–30
- breath
  - as afterthought in yoga 22
  - changes with posture 347
  - diagnosing health through 67, 68
  - effect on mind 352
  - emotional brain and 219–20
    - and emotions 72
  - enough 91
  - four phases 236, 267–8, 284
    - as gateway to samādhi 67
  - impacts on ANS 225
  - influence on vagal brake 233
  - inseparability from movement 44
  - īśvarapraṇidhāna with 51
  - long and subtle 46–7
  - measuring with matras 268–9
  - natural cessation 47
  - observing others' 347
  - pancha vāyus and 62
    - and prāṇa 48
  - prāṇa and inhalation 61
  - prāṇamaya and 58
  - rajasic 49, 57
  - recommended practices 50
  - relation to citta and chakras 243
  - sattvic 49
  - slowing 30
  - stilling 265
  - symbiosis with brain 228–30
  - tamasic 49
  - uncontrolled 46
- breath assessment 343
- breath detective 346–8
- breath frequency 94
- breath holds 91, 112

- after exhale 105
- carbon dioxide increases with 266
- contraindications 277, 280
- correlation with core strength 156
- effect on athletes 293
- extended 266
- Sanskrit terms 267
- tremor reduction with 300
- unconscious 93
- with walking 283–4, 294
- breath instruction, importance in yoga teaching 157
- breath manipulation, effect on psychophysiology 27
- breath measurement 270
- breath movement
  - identifying visible 346
  - in seated/standing position 346
  - steady vs. erratic 346
- Breath of Fire 25, 278
- breath oscillation 116
- breath parameters 345–6
- breath phases 267–8
- breath quantity, myths 22, 23
- breath rate
  - carbon dioxide as regulator 349
  - cuing language 351
  - reducing 268, 273
  - reduction with diving reflex 271
- breath ratios 269–71
- breath reduction 299
- breath retention 62, 90, 236, 280, 284, 362
  - after exhale 61
  - after inhale 267, 268
  - Buteyko practice recommendations 276
  - contraindications 285
  - duration increases 269
  - in Sanskrit classics 266
  - suspension 272–3
- breath retraining processes 89, 152, 231, 233, 356
- breath revolution 344
- breath rhythm, chaotic 96
- breath suspension 30, 46, 90, 179, 218, 236, 270, 280, 284, 362
  - after exhale 267, 268
  - author's experience 343
  - in Buteyko method 35
  - exercise 280–1
  - during exercise 281–4
  - health and 28
  - prāṇāyāma as 265–6
  - as preparatory practice for meditation/samādhi 272
  - progressive increase in length 273
  - relative safety 277
  - retention 272–3
  - safe practice 277–9, 285
  - striving issues 270
  - therapeutic effects 30
  - and vyānavayu 65
  - without effort 47–8
- breath teaching 341
- breath volume, cuing language 351
- breathing
  - audible 347
  - as biochemical process 27–8
  - biochemistry 72
  - cellular respiration 348–9

- complexity of 72
- core stability and 181
- dysfunctional 26
- effects on emotions 220
- as habitual pattern 39
- myths about 21–2
- oxygenation function 87
- as portion control 352
- breathing dysregulation, negative implications 158
- breathing habits, noticing 49
- breathing myths 21–4, 348–50
  - big breathing and oxygenation 348–9
  - breath rate regulator 349
  - carbon dioxide toxicity 349–50
  - deep breath big breath 349
  - empty lungs 350
  - more as better 348
- breathing pattern disorders (BPD) 26
  - and chronic hyperventilation 92–3
  - diaphragm/abdominal core dysregulation in 176
  - identifying 346–8
  - misunderstanding of 72
  - recognizing 287
  - screening for 303
- bridge pose 208
  - with block 359
  - with diaphragmatic hugs 308
- bridge with block 2-3-part krama exhale 192–3
- bronchioles
  - constriction with hyperventilation 299
  - smooth muscle 85
- bronchodilator usage, reducing 291
- bucket breathing 101
- buddhi 244, 245, 264
- Buteyko Breathing Educators Association (BBEA) 105
- Buteyko Breathing Method 26, 28–9, 97, 141, 179, 235, 243, 265
  - emphasis on breath suspension 273, 285
  - emphasis on volume reduction 270
  - pacifying chest in 141
  - quieting breath through 35
  - reduced breathing technique 105
- Buteyko Clinic International 105, 130
- Buteyko, K. 28, 112, 121
- butterfly pose 208, 308
- capnometer 87–8
- carbon dioxide 72
  - and allergic hyperresponsiveness 296
  - ANS and 73
  - as antioxidant 86, 90
  - blood levels 78
  - as breath regulator 24, 84, 349
  - building with reduced breathing technique 105
  - calming effects 349
  - deficit cycle 230
  - depletion with big breathing 90
  - increases with extended breath holds 266, 276
  - and lactic acid levels 79
  - low blood levels 87, 90
  - low levels in chronic hyperventilation 92
  - measuring 87–8
  - myths 22
  - oxidative stress and 85–6
  - partial pressure 77

- pH balancing function 30
  - as pH regulator 349
  - physiological functions 80
  - reduced levels in breathing dysregulation 158
  - role in gas exchange 77–8
  - smooth muscle effects 30, 84–5
  - sustained low levels 111
  - toxicity myths 24, 349–50
- cardiovascular disease
  - beneficial effects of intermittent hypoxia 274
  - Buteyko breathing for 29
- cat/cow pose 193, 194
- cellular respiration 23
  - differentiating from act of breathing 348–9
- central sleep apnea 296
  - hyperventilation and 104
- central tendon 144, 145
- cervical plexus 250
- cessation of movement 35
- chair pose 208
  - variation with blanket roll 200
  - at wall with block 189, 216–17, 308, 359
- Chaitow, L. 72, 103
- chakra centers 254–7
- chakra model 248–9
  - chakra centers 254–7
  - emotional fixations 254
  - emotions and 253–4
  - five elements and 252–3
  - hormones and 251
  - nerve plexuses and 250–1
  - neural integration perspective 249–50
  - sensory correlations 251–2
- chakra system 361
  - citta, breath and 243
  - hatha yoga and 246–7
  - smell and 117
- chandra bhavana 261, 263
- chest breathing 92, 98, 146–7, 290
  - anxiety and 140
  - correlation with mouth breathing 119
  - indicators of 346
  - observing tendencies to 288
  - postural results 143
  - thoracic over-recruitment in 151
- Child's Pose 175, 210, 308, 319, 331
  - painting the floor exercise in 164–5
- children
  - jaw development and facial construct 128–30
  - mouth breathing in 118, 127–8
- chronic heart failure 295
- chronic hyperventilation 105, 111
  - among yoga practitioners 93–4
  - and breathing pattern disorders 92–3
  - defined 92
  - identifying 98–9
  - impacts on health 99–101
  - mouth breathing and 120
- chronic inflammatory conditions 111
- chronic obstructive pulmonary disease (COPD), Buteyko breathing for 28
- chronic pain 346
  - bandhas techniques for 179
- chronic tension, mistaking for strength 152
- citta 36, 37, 48, 244–6, 257, 264, 361

- link to prāṇa 67
  - relation to breath and chakras 243
- cleansing practices 171
- clenching, preventing 132
- clucking exercise 135
- cobra pose, with wide V/narrow V 319
- coccygeal plexus 250
- cognitive behavioral therapy 225
- cognitive impairment
  - mouth breathing and 118, 130
  - in mouth-breathing children 128
- coherence 103
- color play exercise 258, 361
- combination practice 360
- Comfortable Pause (CP) 88, 91, 109, 239, 241, 263, 265, 271, 319, 320, 332, 355
  - effects of food/alcohol on 219
  - health increases with 266
  - increasing 287
  - before Subtle Breathing practice 108
  - as tool for healing 288
  - tracking 291, 298
  - understanding test results 88–9
- common variable immune deficiency (CVID) 290
- compassion, cultivating 42
- compensation signs 215
- complex breath technique 263
- concentration, deep 45
- connectivity, inner knowing of 53
- constipation 292, 293
- contentment 35, 43
- continuous positive airway pressure (CPAP) machines 104, 126
  - reduction in use 296
- Cooper, K.H. 79
- COPD 116, 176
  - lung hyperinflation in 151
- core alignment, integration at wall 216–17
- core breathing 350, 358
- core breathing exercises 159, 167, 177, 186, 188, 190, 192, 205, 206, 210, 214, 257, 260, 271, 280, 319, 331
  - for chronic chest/paradoxical breathers 169
  - diaphragm development 171–2
  - diaphragmatic hugs 172–3
  - diaphragmatic push-ups 174–5
  - encouragement 169
  - with hi-low position 167–8
  - recruitment of abdominals 289
  - from seated mountain pose 170–2
  - silent hugs 173
  - Subtle Breathing 289–90
  - teaching 288
  - tricks for engagement 168–9
- core engagement
  - bandhas and 180–2
  - mouth breathing effects on 123–5
- core stabilization
  - breathing and 181
  - role of diaphragm 142, 153–5
- core strength
  - correlation with breath hold time 156
  - functional breathing as measure of 155, 176
- cortisol
  - as long-term stress hormone 227
  - recovery 223
  - regulation by carbon dioxide 296
- cough



- chronic 288
- reduction with lesser breath 92
- counter poses 159
  - after baby plank 198
  - for baby fish 212
  - for back-bending 210
  - for masthead 214
- Courtney, R. 124, 345
- cuing language 350–2
- DaCosta syndrome 93
- daytime sleepiness 125
- dead space air 75
- death, fear of 41
- deep abdominal muscles 180
- deep breathing
  - big breathing 349
  - myths 22, 24
- deep front line (DFL) 152–3, 180, 211
  - engaging in sinking lunge 155
- dental cavities 140
  - from mouth breathing 118
- depression 346
- Desikachar, T.K.V. 344
- detox reactions 270
- deviated septum 117, 120
- devotion 39
  - to God connection 43
- dhāraṇā 44, 45
- dhyāna 44, 45
- diabetes, case study 295–6
- diaphragm 141–4
  - anatomical diagram 144
  - control over respiration and posture 155–6
  - as core stabilizer 153–5, 158
  - developing 171–2
  - engaging in bandhas 180
  - and functional movement 155–6
  - in inhalation and exhalation 142
  - loss of elasticity/resilience 152
  - mind of 144–6
  - muscular attachments 145
  - organ connections 146
  - role in core stabilization 142
  - role in heart rate variability 143
  - as trunk stabilizer 154
- diaphragm development exercises 169, 171–2
- diaphragmatic breathing 28, 46, 72, 357–8
  - parasympathetic system and 117
  - vagus nerve engagement with 227
- diaphragmatic hugs exercise 172–3, 209, 257, 279, 308, 319, 358
- diaphragmatic push-ups 174–5, 319, 358
  - counter pose after 175–6
- digestive fire 61, 64
- digestive function, enhanced with functional breathing 96
- dirgha 46–7
- discipline 43
- dissociation, PNS and 226
- diving reflex 271–2, 279
- doodle with your nose exercise 165, 206, 358
- dopamine, enteric brain and 251
- dorsal vagal response
- doshas 56–7, 69, 121
- down dog 319

- duḥkha 27, 36
  - and kleśas 40
  - major sources of 51
  - reducing through yoga 38
- dveṣa 41
- dynamic butterfly pose 202–4, 359
- dysfunctional breathing patterns 94, 111
  - complete yoga breath 102
  - functional breathing 95–7
  - nighttime 104
- dyspnea 100, 111, 152
- EAARS acronym 345, 346
- earth element 56
- efficient, adaptive, appropriate, responsive, supportive (EAARS) 345
- effort syndrome 93
- eight limbs of practice 41–2
  - āsana 43–5
  - dhāraṇa 45
  - dhyāna 45
  - niyama 43
  - prāṇāyāma 45
  - pratyāhāra 45
  - samādhi 45
  - yama 42
- eight-fold path 37
- elemental mūdra 260
- Elgelid, S. 197
- elimination 61, 62
  - apānavayu as 64–5
- emotional brain, breath and 219–20, 360
- emotional fixations 254
- emotional resilience 219
- emotions
  - and breath 72
  - chakra model and 253–4
  - as hyperventilation triggers 228
  - odor and 252
  - slow breathing effects 229
- emphysema 116
  - lung hyperinflation in 151
- endocrine system
- energy
  - interpretation problems 63
  - prāṇa as 63
- Energy Bank Account (EBA) 53, 70, 71, 149, 180, 234, 305, 354–5
  - monitoring 68–9
  - prāṇic accounting and 63–6
  - Subtle Breathing benefits 106
- energy intake 61, 64
- enteric nervous system 250
  - chakra correspondences 251
- erectile dysfunction
  - carbon dioxide and smooth muscle effects 84
  - snoring and 125
- ether element 56
- ethical restraints 42
- executive function 222
- exercise tolerance
  - in chronic fatigue/fibromyalgia 102
  - low 93, 112
- exercises
  - anemone hand pulses 200–2
  - āsana Sequence A 307–18

- āsana Sequence B 319–29
- āsana Sequence C 330–41
- baby fish 1-2-3-3-2-1 210–12
- baby plank—hover position knees down 195–6
- baby plank—hover position with alternate knee lifts 196–7
- bāhya kumbhāka 280–1
- block squeeze and 2-part exhale 188–9
- bolster straddle 198–9
- brahmari/bee breath 235–6
- breath suspension during exercise 281–4
- bridge with block 2-3-part krama exhale 192–3
- chair pose at wall 216–17
- chair variation with blanket roll 200
- child’s pose 210
- color play 258
- combination practice 240–1
- counter pose after baby plank 198
- counter pose for baby fish 212
- counter pose for back-bending 210
- dynamic butterfly pose 202–4
- extended breath holds with walking 283–4
- halo breathing 237–8
- hyperventilation and 102–3
- knees to chest with 2-part krama exhale 190–2
- linking it together 207–8
- locust pose 208–10
- mantra practice 258–9
- masthead 212–14
- mūdra practice 259–60
- neck core lifts 214–16
- nose clearing 131
- nostril techniques 261
- paint the floor 210
- scapular swirls 210
- short breath holds with movement 239–40
- silent mantra 236–7
- single nostril breathing with walking 283
- speech exercises 136–7
- Svādhyāya (Self-Awareness) Chakra Practice 257–8
- svādhyāya practice 233–4
- tongue exercises 132–6
- for vagus nerve 235–8
- wheel pose 210
- wheel pose with 2-part exhale 193–5
- wide V/narrow V with PF and TVA engagement from supine position 205–7
- exhalation 267
  - ANS effects 28
  - controlled 46, 47
  - diaphragm movements 142
  - extending 30
  - internal and external spaces 47
  - pause after 50
  - quieting effects 236
  - relaxation response via 28
  - resting pause after 95
  - Sanskrit terms 267
  - synchronizing with upper TVA and obliques 173
- expiratory reserve volume 74
- extended breath hold 319
  - with walking 362
- extended exhale, effects on HRV 82
- external space 50
- facial development

- in children 140
  - with mouth nose breathing 129
- fatigue 346
- fear center, olfactory bulb and 252
- Feather Breathing 350
- feedback, requesting from students 344
- fifth chakra 254, 256
- fight or flight 221
- fire element 56
- first chakra 254, 255
- five afflictions 40, 46
  - leading to suffering 232
- five elements 56–7, 121
  - chakras correlations 252–3, 264
- five guṇas 69
- five kleśas 52
- five niyamas 43
- five panchamayās 57–8, 59, 70
- five senses, chakra correlations 251–2
- five yamas 42
- forward bend position 217
  - undulations from 165–6
- forward head posture 124, 149, 185
  - due to chest breathing 143
- foundational principles 32
- fourth chakra 254k 256
- Frawley, D. 53, 65
- free radicals 85
- freeze response 226
- full plank 319
- full yoga breath 141, 295
  - misunderstanding 266
  - myths 101–2
  - Subtle Breathing 293
- functional breathing 89, 111, 155, 289
  - benefits 96
  - description 95
  - diagram 95
  - dysfunctional 95–7
  - EAARS acronym 345
  - light but deep 350
  - modulating reactivity with 242
  - teaching 288, 343–52
- functional movement, diaphragm and 155–6
- functional movement screen (FMS) 156
- functional orthodontists 130
  
- gas exchange 76, 77–8, 87
- gasp 105
  - in chronic hyperventilation 98–9
- gasping, identifying 346
- gate pose 330
- generosity 42
- GERD 111
- Gharote, Dr. M.L. 26, 179, 267
- Gheranda Samitā 134, 268
- Gorton, L. 237
- Graham, T. 26
- grinding, preventing 132
- guṇas 51, 69
  - balancing with prāṇāyāma 36
  - observing predominant 49
- Guyton, A.C. 72
  
- habitual patterns

- changing 39, 90
- overbreathing 87
- as source of suffering 51
- stilling 38
- halo breathing exercise 237–8, 280, 282, 290, 291, 320, 360
- hand gestures 243, 259–60, 264
- Hanna, T. 27
- hatha yoga 44
  - chakra system and 246–7
- Hatha Yoga Pradipika 30, 31, 36, 39, 44, 48, 106, 134, 269, 344
  - breath retention in 266
  - breath suspension recommendations 275
- headaches, from mouth breathing 128
- healthcare practitioners, functional breathing cues 343–51
- heart disease, breath volume and rate 97
- heart rate (HR) 109, 263
  - before and after Subtle Breathing practice 108
  - effect of lotus posture on 272–3
  - reduction in diving reflex 271
- heart rate variability (HRV) 82
  - diaphragm role in 143
  - and stress resilience 224
- heart rhythm, slowing with bandhas 179
- hemoglobin transport 77–8
  - improvements with breath holding 293
- Hi-low hand position, as screening mechanism 303
- high altitude, health benefits 274
- histamine levels, and hyperventilation 298
- homeostasis
  - carbon dioxide role 349–50
- hormones, chakra correlations 251
- HPA axis chart 226
- hṛdaya 245, 264
- huffing and puffing 79
- humming exercise 230, 235–6
- hydrogen
  - partial pressure 82–3
- hyperinflation 92
- hyperventilation 23, 82, 91–2, 158, 293
  - in children 111
  - chronic 92–3
  - daytime 112
  - defined 111
  - emotional triggers 228
  - exercise and 102–3
  - histamine levels and 298
  - muscular recruitment and 103–4
  - negative health effects 29
  - risk from kriyas 285
  - sleep-disordered breathing and 104–5
  - smooth muscle effects 84–5
- hyperventilation syndrome (HVS) 92, 111
  - Buteyko and 105
  - prevalence 93
- hypervigilance 226
- hypocapnia 79, 94
  - in chronic hyperventilation 92
- hypothalamus-pituitary-adrenal (HPA) axis 226
- hypoventilation 93
- hypoxia 89
  - intermittent 274–5
- īḍā 244, 247
  - cooling effect 247

- as moon channel 248
- nostril technique 261, 263
- īḍā nādi 261, 263
- iliopsoas 145, 148, 154
  - shortening in scoliosis 155
- immune system disorders, case studies 290–1, 296–8
- incoming energy 68
  - prāṇa as 61
- inflammation
  - carbon dioxide as modulator 85–6
  - decreased with carbon dioxide 80
  - oxidative stress and 85–6
  - systemic 346
- inhalation 267
  - ANS effects 28
  - diaphragm movements 142, 148
  - energizing effects 236
  - internal and external spaces 47
  - myths of expansive 31
  - pause after 50
  - Sanskrit terms 267
  - sipping 4, 47
- inner core, developing 182, 186–7
- insomnia, due to hyperventilation 104
- inspiratory reserve volume 74
- insula 231
  - activating 232
- integrity 42
- intercostals 143
- intermittent hypoxia 266, 291
  - health benefits 274–5
- internal space 50
- internal transport processes 65
- interoception 232, 242, 307
  - cultivating 45
- interoceptive awareness, practices enhancing 232
- irritable bowel syndrome (IBS) 111
- īśvarapraṇidhāna 39, 43, 46
  - with breath 51
- Iyengar, B.K.S. 32
  
- jālandhara bandha 181, 184–6, 218
- jaw development, with mouth nose breathing 128–30
- Jiva Mūdra exercise 132, 140
  
- kapālabhāti 25, 278
- kapha dosha 56, 69, 121
- Katha Upanishad 233
- Kechari Mūdra exercise 134–5
- kevala prāṇāyāma 47
- kinetic chain 207
- Kiraly, P. 29, 91
- kleśas
  - as basis of suffering 40, 52
- kneeling side-bend 330
- Knees to Chest pose 169, 309, 331, 359
  - with 2-part krama exhale 190–2
- koshas 57
- krama exhale 188–9, 308
- Krishnamacharya 23
  - nostril techniques 261–2
- Krishnamacharya lineage 60
- kriya yoga 38, 52
  - as foundation of prāṇāyāma 40
  - practices 49–52

- kriya yoga exploration 354
- kriyas 171, 246, 285
  - as cleansing practices 278–9
  - contraindications 279
- kumbhā 46
- kumbhāka 46, 62, 362
  - 70 types 267
  - diving reflex analogy 271–2
  - and intermittent hypoxia 274–5
  - prāṇāyāma as 265–6
  - retention or suspension 272–3
  - safe practice issues 277–9
  - Sanskrit text confusion over 266–7
  - short and long 288
- kundalini rising 248, 264
- lactic acid
  - high in hyperventilation 102, 103
  - increase with reduced carbon dioxide 86
  - low carbon dioxide and 79
- Le Page, L. 259
- learning disabilities, in mouth-breathing children 128
- left-nostril breathing 247
- letting go 69
- limbic system 221
- lineage loyalty 26
- locust pose 208–10, 359
- Loizzo, J. 249, 253
- lotus posture, effect on heart rate and spleen 272–3
- low back pain 195
- lower respiratory tract 75, 89
- Lum, C. 94
- lumbar plexus 250
- lung hyperinflation 151
  - reduced ZOA in 151
- lunge pose, with DFL engaged 155
- lupus 290
- lying twist with suspension 319
- Maehle, G. 270, 307, 343
- Majmundar, M. 237
- manas 244, 264
- maṇipūra chakra 255
- manomaya 58
- manovahasrotas 245
- mantra 51, 230, 242, 243, 264
  - in breath reduction 271
  - during breath retraining 91
  - combining with āsana and breath 225
  - as matra 269
  - in place of counting 284
  - silent 236–7
  - transforming vṛttis with 236
- mantra practice 137, 258–9, 361
- Marm test 303
- masthead exercise 212–14, 359
- matras
  - breath measurement with 268–9
  - ratio and 269–71
- McKeown, P. 26, 30, 111, 113, 139, 292, 293, 350
- meditation 45, 285
  - breath suspension as preparatory 272
- meditators, shift in brain function 222–3
- medulla oblongata 80–2, 89
  - changing set point 99

- difficulty of resetting 112
  - role in ventilatory response 268
  - set point alterations 111
- mental health, benefits of intermittent hypoxia 274–5
- micro-movements 175, 196, 203, 214, 218
- mid-back core, developing 205–10, 359
- mid-back stabilizers 162
- mid-brain, self-awareness and 231
- migraine headaches, mouth breathing and 118
- mind loops 40–1
- minute volume (MV) 74, 82, 84, 89, 285
  - in dysfunctional breathing 96
  - in functional breathing 95
  - reduction in Buteyko method 270, 273, 280
  - resetting by SNS 100
- mokṣa 44
- moon breath 263
- mountain pose 331
  - seated 309
  - with subtle breathing 308
- mouth breathing 96, 98, 290, 297, 299, 356–7
  - alignment issues 123–5
  - brahmari exercise to counter 235
  - causes 120
  - in children 127–30, 140
  - cognitive impairment from 118
  - core engagement issues 123–5
  - discouragement of 46
  - in dysfunctional breathing 95, 98
  - experiment 125
  - facial development 129
  - health risks 125
  - in HVS 92
  - nasal congestion and 140
  - negative effects 118–19
  - nighttime 125–6
  - observing tendencies to 288
- mouth closing 122–3
- mouth taping 126, 137–9, 292–3, 357
  - building tolerance for 138–9
  - for children 139
- movement 90
  - inseparability from breath 44
  - release of carbon dioxide though 44
  - and respiration 79–80
- mūdras 243, 259–60, 264, 361
  - for nostril techniques 261–3
- mūla bandha 181, 182, 218
- mūladhāra chakra 254–5
- multifidi 154
- multiple sclerosis 290, 300
  - case study 300
- muscular recruitment, hyperventilation and 103–4
- Myers, T. 27, 152
- myofascial meridians 152
- myofunctional therapy 123
- myths 21
  
- nādi shodhāna 262
- nādis 243
  - acupuncture meridians and 247
  - ANS and 247–8
  - chakras and 264
  - manipulation 246



- three primary 248
- nasal cavity 114, 139
- nasal congestion, during sleep 118
- nasal flow, nighttime 118
- nasal polyps 117
- nasal reflexes 115, 116–17
- nasal resistance 114, 116, 140
- nasya oil 132
- neck core
  - developing 210–15, 359
  - diagram 184
  - engagement without forward flexion 185
  - lifts 214–16, 359
- neck strengtheners 210
- negative thoughts/emotions, storing 64–5
- nerve plexuses, chakras and 250–1
- nervous system 223–5
- neural integration 225, 233
  - chakra system perspective 249–50
- neurogenesis, stimulation by IH 274
- neuroplasticity 94, 220, 224
- Nijmegen Questionnaire 303
- nine obstacles 66, 70
- nirodhaḥ 36
- nitric oxide 76
  - and acetylcholine levels 300
  - role in nose breathing 115
  - as vasodilator 77
- niyama 43, 52
- non-violence 42
- nose biomechanics 114–15
  - air flow control 115–16
  - air preparation functions 115
  - nasal cavity 114
  - nasal reflexes 116–17
  - nasal resistance 116
  - nighttime nasal flow 118
  - smell reflex 117
- nose breathing 46, 50, 89, 295, 356–7
  - and diaphragmatic action 119
  - facial development and 129
  - in functional breathing 95
  - maintaining steady breath through 79
  - mouth breathing 76, 118–19
  - reduction of asthma by 291
  - retraining speech patterns with 123
- nose clearing exercise 120, 127, 131, 357
  - additional suggestions 132
- nose mouth 113–14, 118–19
- nostril dominance, oscillation 247
- nostril techniques 257, 261, 361
  - mūdras for 261–3
- nostril valving 243, 278
- nutrition, pancha vayus and 61
- obliques 143, 148, 154, 183
- obstacles to practice 66–7
- obstructive sleep apnea (OSA) 72
  - hyperventilation and 104–5
  - oxygen deprivation in 274
  - snoring and 125
- odor, emotion and 252
- ojas 245
- olfactory bulb 252

- outgoing energy 61
- overbreathing 67, 91–2, 111, 290
  - breath holding as response to 93
  - habituation of 87, 100
  - medulla oblongata effects 82
  - as obstacle 70
  - physiological instability from 113
  - as root of chronic illness 72
- oxidative stress
  - carbon dioxide and 85–6
  - modulation by carbon dioxide 80
- oxygen 72
  - myths about 22, 24
  - partial pressure 77
- oxygen deprivation, negative associations 274
- oxygen dissociation curve 30
- oxygen saturation, measuring 277
- oxygenation
  - increased with carbon dioxide blood levels 276
  - myths 348–9
- pace 69
- paint the floor exercise 164–5, 206, 210, 257, 307, 358
  - with forehead 308
  - with undulations 319
- pancha vāyus 59–62, 70
  - stabilization by treatment 59
- panchamaya 57–8, 70, 73, 146
  - facilitating homeostasis 158
- paper tape 137
  - mouth taping with 126
- paradoxical breathing 92, 143, 146–7, 226, 347
- parasympathetic dominance 116, 223
  - diaphragmatic breathing and 117
  - nasal resistance and 116
- parasympathetic nervous system (PNS) 80, 82
  - in belly breathing 157
  - exhalation effects on 30
  - iḍā and 247
  - myelinated branch 227
  - two branches 223
  - unmyelinated branch 226
- Parkinson's disease 300
- parsvottanāsana 331
- partial pressure 75–6
  - carbon dioxide 77, 84, 86
  - hydrogen 82–3
  - oxygen 77
- passing notes exercise 163–4, 206, 358
- passive recoil 142
- Patañjali's Yoga Sūtra 21, 31, 35, 38, 51, 63, 66, 74, 141, 305, 344
- pathology, addressing through breathing 32
- pectorals 143
- pelvic floor muscles 143, 154, 182
  - developing 198–204, 359
  - diagram 183
  - male and female variations 199
  - use in bandhas 180
- Pema Chodron 41
- perfusion 23, 73–7
  - in lower lungs 76
- peristalsis
  - aid from kriyas 279
  - serotonin and 250

- pH balance 30, 298
  - carbon dioxide role 80, 83, 90, 349
  - chronic hyperventilation effects 99
  - delicate nature of 103
  - with functional breathing 96
  - uterine fibroids and 297
- phrenic nerves 144, 145
  - control by bandhas techniques 180
  - hyper-activation 152
- piṅgalā 244, 247
  - heating effect 247
  - nostril technique 261, 263
  - as sun channel 248
- pitta dosha 56, 69, 121
  - aggravating by nostril technique 263
- polyvagal theory 220, 223, 226–7, 241
  - chakras and 249
  - chart 224
- Porges, S. 223, 226–7
- portion control breathing 352
- post-digestive energy 62
- post-nasal drip 121
- postsurgical disability 288
  - case study 293–5
- postural alignment, healthy ZOA with 152
- posture
  - abdominals and 148–52
  - diaphragm and 141
  - mouth-breathing and 125
  - zone of apposition and 148–52
- prakṛti 36, 51
- pramāda 66
- prāṇa 36
  - air element and 60
  - āsana practices to restore 307
  - link to citta 37, 67
  - multiple meanings 53
  - and prāṇāmaya kosha 55–6
  - restoring through breath practices 287–8
  - translation as energy 63
- prāṇā accounting 63–6
- prāṇa shakti 248, 264
- prāṇa vidya 53, 248, 264
- prāṇāmaya 55, 57, 58, 59–62
- prāṇāmaya kosha 55–6
- prāṇavayu 60, 61
  - in Energy Bank Account 64
- prāṇāyāma 48
  - as air diet 63
  - balancing gunas with 37
  - as breath suspension 265–6, 280
  - as center of physiological health 27
  - combining with mantra or humming 230
  - contextualizing 54–5, 68
  - as daily practice of īśvara 39
  - as fourth limb of yoga 41, 45–6, 52
  - as kumbhāka 265–6
  - lineage specific instruction 35
  - links to āsana and meditation 307
  - origins 353–4
  - recommended frequency of practice 86–7
  - as restraint of prana 45
  - role in health 25–6
  - transformation through 31

- prāṇāyāma curriculum
  - biochemistry of respiration 355
  - citta, chakras, and breath 361
  - core, bandhas, and breath 358–60
  - diaphragmatic breathing 347–58
  - emotional brain and breath 350
  - Energy Bank Account 354–5
  - hyperventilation 356
  - nose mouth breathing 356–7
  - overbreathing 356
  - prāṇāyāma as kumbhāka 362
  - prāṇāyāma origins 353–4
  - for program directors 353
  - subtle body 354–5, 361
- pranic leaks, disease as 54
- prasarita paddotanāsana 331
- pratikriya, undulation as 159–60
- Pratiloma ujjayi 263
- pratyāhāra 45, 246, 257
- prefrontal cortex 241
- progesterone effects 297
- program directors, prāṇāyāma curriculum 353
- proprioceptive awareness 202, 242,
  - practices increasing 232
- protection, through prāṇāyāma 57
- protocols 32
- psycho-emotional fluctuations, addressing 352
- pulse oximeter 277, 281
- pūraka 46, 47
- purity 43
- pursed lips exhale 169
- puruṣa 36, 51
- pyramid pose 331
  
- quadratus lumborum 145, 154
  
- raga 41
- rainbow colors, chakras and 251
- rajas 36, 38, 51
- Rakhimov, A. 26
- Rapunzel exercise 166–7, 217, 308, 358
- reactivity 257
- reading aloud 137
- rechaka 46, 47
- rectus abdominis 183
- reduced breathing technique 105, 287
  - author’s experience 343
  - downloadable app 111
  - Subtle Breathing 105, 106–11
- reflex centers, control 81
- relaxation response 223
  - exhalation and 28
  - nasal resistance and 116
- reptilian brain 221
- residual volume (RV) 22, 24–5, 74
  - myths about 350
- respiration
  - biochemistry 71–3
  - movement and 79–80
- respiratory alkalosis 100, 111
  - diagram 101
- respiratory physiology 73
  - blood gas transport 77–8
  - Bohr effect and 78
  - breathing volume and rate 74

- cellular respiration 78–9
- gas exchange 76
- partial pressure 75–6
- respiratory tract 75
- ventilation/perfusion in 73–7
- respiratory rate 73–4
  - in dysfunctional breathing 95
  - in functional breathing 95
  - myths 22, 24
  - of yogis 23
- respiratory therapists 88
- respiratory tract, anatomy 75
- resting pause, after exhale 95
- restorative poses 231
- rheumatoid arthritis 295
- rhinencephalon brain 117, 224
- rib cage positioning 148, 347
- right-nostril breathing 247
- right/left imbalances, anatomical effects 154
- ṛkshana
  - through prāṇāyāma 57
- root chakra, association with smell 117
- root lock 182
- rotator cuff 162
- sacral plexus 250
- sag and sway posture 124
- sahasrāra chakra 257
- samādhi 44
  - breath suspension as preparatory 272
  - diving reflex similarity 272
  - as eighth limb of yoga 45
  - as meditative absorption 26
  - as sattvic mind 40
  - sustaining through bandha practice 182
  - through natural breath cessation 47
- samādhi mind 42
- samāna, and breath retention after exhale 61
- samānavayu 60, 61
  - in Energy Bank Account 64
- Sāṃkhya philosophy 36–7, 51
  - evolution 37
  - five elements and 56–7
- samśāya 66
- samskāra 38
  - hyperventilation 91
  - pervasiveness of breathing 94–5
  - transforming 40, 48
- Sanskrit words 31–2
- saṃtosa 35, 43
- sattva 36, 38, 51
- sattvic breath pattern 44
- satya 42
- śauca 43
- scalenes 143
- scapular swirls 161–3, 210, 257, 307, 308, 319, 358
- scoliosis, anatomical effects 154
- seated mountain pose 189, 202, 208, 309, 319, 320, 330, 332
  - core breathing from 170–2
- second chakra 254, 255
- self-awareness 42, 43
  - Duḥkhaville 231–3
  - enhancing with Subtle Breathing 106
  - with kumbhāka practice 277

- self-healing journey 71
- sense withdrawal 45
- senses 58
- sensory information, neutrality of 245
- serotonin, peristalsis and 250
- seventh chakra 254, 257
- sexual trauma 198
- shallow breathing 24
- Shavāsana 309, 320, 331
- Shīṭali exercise 46, 136
- Shīṭali tongue breath 136
- Shītkari exercise 136
- short breath holds 235, 240, 280, 282, 305, 308, 331
  - with movement 239–40, 360
- shoulder girdle 162
- sighing 105, 299
  - audible 347
  - identifying 346
  - observing tendencies to 288
- silent hugs exercise 173, 279, 308, 358
- silent mantra exercise 236–7, 241, 360
- simple living 42
- single nostril breathing 330
  - with walking 283, 362
- sinking lunge 155
- sinus clearing, with kriyas 279
- sixth chakra 254, 256
- Sjogrens syndrome 290
- skull-shining breath 278
- sleep
  - mouth breathing during 125–6
  - nasal flow during 118
  - reduced need for 92
  - side-lying position 118
  - unilateral breathing during 118
- sleep apnea 112, 346
  - breath volume and rate 97
- sleep disorders 292, 293
  - Buteyko Breathing for 29
  - comorbidities 104–5
- sleep study 125
- slow breathing
  - effects on HRV 82
  - emotional control and 229
- slump-asana 123, 148, 149
- smell reflex 117, 139
  - olfactory bulb and 252
- smooth muscle
  - carbon dioxide as relaxant 349
  - dilation in functional breathing 96
  - dilation with higher carbon dioxide levels 295
  - effects of carbon dioxide 84–5
- snoring 112
  - erectile dysfunction and 125
  - hyperventilation and 104
  - obstructive sleep apnea and 125
- social engagement system (SES) 227
- soldier's heart 93
- spasticity 300
- speech, re-patterning 137
- speech exercises 136, 357
  - alphabet practice 136
  - mantra 137
  - reading aloud 137

- spiritual consumption 64
- spiritual seeking 65
- spleen, stimulation by diving reflex 272
- standing forward fold 214, 308, 330
- standing mountain pose 208, 213, 330, 331
- Stark, J. 26, 29, 97
- steroids, reducing use of 291
- stress
  - carbon dioxide deficits and 230
  - CBT effects 225
  - effect on ZOA 176
  - effects on brain 220–3
  - exercise effects 225
  - fostering learning 224
  - high-road reaction 222, 227, 233
  - low-road reaction 221, 222, 233
  - meditators' response 222–3
  - ZOA effects 151
- stress resilience 233
  - heart rate variability and 224
  - HPA axis and 227
- stress vulnerability 223
- stuckness 39
- styāna 66
- subtle body 53, 243–4
  - chakra model 248–57
  - chakra system 247–8
  - hatha yoga and 246–7
  - nādis 247–8
  - nādis and ANS 247–8
  - vedic review 244
- Subtle Breathing 105, 106–11, 112, 142, 167, 198, 237, 238, 240, 291, 293, 298, 299, 309, 320, 330, 332, 356
  - for anxiety 289
  - benefits for anxiety 294
  - Core Breathing 289–90
  - effects of food/emotions on 219
  - with Hi-Low hand position 107
  - language for teaching 350–2
  - low and slow 109
  - mountain pose with 308
  - nomenclature 350
  - with prop support 107
  - seated with hi-low hand position 308
  - silent nature of 343
  - sitting on floor 108
  - supine with block 307
  - teaching 288
- suffering 36, 51
  - five afflictions and 232
  - ignorance (avidya) and 29–30
- sūkṣma 46–7
- sun breath 263
- supine leg extensions with block, with suspension 319
- supine side-bend, with snow angel arms 331
- supine subtle breathing with block 307
- Supta Baddhakonāsana 202
- survival instinct 41, 233
- sūrya bhedana 263
- suṣumnā 244, 247
  - as central channel 248
- svādhiṣṭhāna chakra 255
- svādhyāya 39, 42, 43, 157
  - breath retraining and 231–3
- Svādhyāya (Self-Awareness) Chakra Practice 257–8

Svādhyāya Breath Journal (SBJ) 49, 50, 69, 234, 241, 258, 263, 276, 281  
breath suspension practice 280  
carbon dioxide levels 219  
CP monitoring 89  
Energy Bank Account and 68  
Subtle Breathing practice 109  
svādhyāya practice exercise 233–4  
Swami Muktibodhananda 26, 36  
Swami Rama 23, 26  
Swami Saraswati 106  
Swami Veda Bharati 45, 91  
swara 106  
sympathetic arousal 111, 149  
from chest breathing 143  
in hyperventilation 94  
with low carbon dioxide levels 100  
sympathetic dominance 116, 223  
sympathetic nervous system (SNS) 80, 82, 221, 226  
piṅgalā and 247  
  
table top position 330  
Tadāsana (Mountain Pose) 123  
finding ZOA from 150–1  
tamas 36, 38, 51  
Tantric tradition 246, 251  
tapas 39, 43  
with breath 50  
tardive dyskinesia, case study 300–1  
teachers, dysfunctional breathing in 97  
teeth misalignment 128, 129  
teeth washing exercise 133  
text neck 185  
thalamus 221, 222  
therapeutic applications 287–8  
anxiety 292–3  
asthma 298–9  
immune system disorders 290–1, 296–8  
multiple sclerosis 300  
postsurgical disability 293–5  
tardive dyskinesia 300–1  
traumatic brain injury 299–300  
Type I diabetes 295–6  
uterine fibroids 296–8  
third chakra 254, 255  
thoracic breathing 347  
three bandhas 181, 218  
three doshas 56  
three primary nādis 247, 248  
thunderbolt pose 319, 330  
tidal volume (TV) 73, 74  
tolerable discomfort 110  
tongue curl 136  
tongue exercises 132, 357  
clucking with closed mouth 135  
Jiva Mūdra 132  
Kechari Mūdra 134–5  
Shīṭali 136  
Shītkari 136  
teeth washing 133  
tongue breath 135–6  
tongue extensions 133–4  
tongue mudras 123  
tongue placement  
in jālandhara bandha 184



- nose breathing and 122–3
- total lung capacity 74
- touch, air element and 60
- transversus abdominis 143, 148, 154, 155–6, 183
  - developing 187–97, 359
  - tricks for engagement 168–9
- traumatic brain injury, case study 299–300
- tremors, reduction with breath holds 300
- truthful communication 42
- tumor growth 297, 298
- Type I diabetes, case study 295–6
  
- udāna/udānavayu 60, 61
  - in Energy Bank Account 65–6
- uḍḍiyāna bandha 181, 183–4, 218
  - during breath suspension 273
- undulation exercises 161, 358
  - to counter agitation 352
  - doodle with your nose 165
  - forward bend position 165–6
  - paint the floor 164–5
  - passing notes 163–4
  - Rapunzel 166–7
  - scapular swirls 161–3
- undulations 160–1, 177, 205, 212
  - exercises 161–7
  - passing notes 214
  - as pratikriya 159–60
  - Rapunzel 214
  - rules 160–1
- unilateral breathing studies 247–8
- Upanishads 267
- upliftment energy 61
- upper back twist 331
- upper respiratory tract 75
- upper trapezius 143
- urination, frequent 112
- uterine fibroids, case study 296–8
- Utkatāsana 308
- Uttanāsana 308, 330
  
- vagal brake 223, 233, 239, 241, 350
  - activating with sound 230
  - measuring responsiveness 224
  - stress resilience and 227
- vagal response, to diving reflex 271
- vagal tone 224, 294
- vagus nerve 28, 253
  - breathing and 116–17
  - breathing practices 234–8
  - control by bandhas technique 180
- Van der Kolk, B. 221
- van Lysebeth, A. 53
- vasodilation
  - by nitric oxide 77
  - smooth muscle effects 84–5
- vata dosha 56, 69, 121
  - breath as aspect of 57
  - derangement 122
  - as king 57
  - over-breathing and excess 140
  - reducing 122, 244
- Vedas 36, 267
- ventilation 23, 73–7
  - control by medulla oblongata 80–1

- ventilation/perfusion ratio 77
- ventilatory response, progressive reduction 280
- vidya 30–1, 233
- vijnānamaya 58
- vikṛti
  - fluctuating nature of 57
  - and vulnerability to disease 56–7
- viloma ujjayi 262
- Viniyoga 32
- vinyasa krama 31, 180
- vīrya 48, 52
  - and oxygenation 63
  - promotion by intermittent hypoxia 275
- viśuddhi chakra 256
- visual cortex 222
- vital capacity 74
- vitality 48, 52
- vṛttis
  - as source of suffering 51
  - stilling through yoga 38
  - transforming through mantra 236
- vyādhi 66, 270
- vyānavayu 60, 61
  - in Energy Bank Account 65
- wall sits 189
- warrior 1 331
  - with waitress arms 330
- Warrior I pose 208
- waste 65
- water element 56
- weight loss 291
- Welch, C. 245
- Western lifestyle, depletion by 55
- wheel pose 210, 308, 319
- wheel pose with 2-part exhale 193–5
- wide V/narrow V with PF and TVA engagement 205–7, 319
- wide-legged forward bend 331
- wisdom 58
- yama 42, 52
- yantra 251, 264
- yawning, identifying 346
- yoga
  - author's self-healing journey 71
  - as combination therapy 225
  - neural integration goal 225
  - as oral tradition 267–8
  - reducing suffering through 38
  - transforming saṃskāras through 40
- yoga bandhas 141
- yoga breathing 102
- yoga danda 116
- yoga practitioners, chronic hyperventilation in 93–4
- Yoga Rahasya 31
- yoga teachers
  - breath instruction considerations 157–8
  - cuing for functional breathing 90
  - functional breathing cues 343–52
- yoga therapists, functional breathing cues 343–51
- Yoga Yajñavalkya 31
- Yogi Ramacharaka 101
- yogic mind 38–40
- yogis
  - breath teachings 86–7

combination techniques 230

zone of apposition (ZOA) 148–52, 176, 294, 358

finding 150–1

increasing in exhalation 173

maximization through bandhas 181

reduced in lung hyperinflation 151

restriction 158

rib cage positioning 148

## Join our mailing list

We pride ourselves on sending useful and relevant information to the members of our mailing list. You can unsubscribe at any time.

[www.singingdragon.com/mailling](http://www.singingdragon.com/mailling)



SINGING  
DRAGON

## ACKNOWLEDGEMENTS

It took a village of people to help me write this book. Although the process of writing can be a lonely business, I never felt alone because I had so many colleagues and friends who assisted me in formulating the material, clarifying it, and rectifying my many technical (and grammatical) errors along the way. I bow to each of you with heartfelt gratitude.

To my team of primary readers: Staffan Elgelid, Richard Miller, Rachel Lanzerotti, Patti Pitcher, Dr. Baxter Bell, Patrick McKeown, Dr. Lynn Hughes, and Summer Cushman. My heart is so full of appreciation for the generosity you showed in devoting hours to reading this text (some of you multiple times!). Your analysis, critical questions, and encouragement have elevated the quality of the book far beyond where I was able to go on my own. Summer, thank you for helping me shape the Vedic sections when the text was in its infancy. Richard, thank you for the long chats on breath and all the corrections on my use of Sanskrit. Patrick, I am so appreciative for your willingness to triple-check my physiology and provide me with endless articles and resources. Baxter, thank you for requiring more clarification when my language was fuzzy or incomplete. Lynn, thank you for teaching me about Porges' polyvagal theory, the HPA axis, and neuroplasticity; thank you double for helping me write about these complex concepts in a readable fashion. Rachel and Patti, I appreciate your nit-picky honesty which enabled me to hone my writing with the reader in mind. Sarah Birger, I am very grateful for your editorial expertise, and willingness to be my clean-up crew at the last minute. Staffan Elgelid, what a gift to have you as my first reader! Your swift and positive responses, your knowledgeable eye, and humor—as I opened up these pages for critique—filled in the cracks of my doubt when I was most vulnerable. I am in your debt. Thank you all for helping me face my comma-challenges. Apparently, I needed a full intervention team on that!

To my Essential Yoga Therapy family: students, colleagues, mentors, and faculty for my various training programs. Specifically, I'd like to acknowledge Jill Massengill, Dr. Lynn Hughes, Lulu Peele, Anita Boser, Rachel Lanzerotti, Summer Cushman, Julie McNeil, Claudia Cardin, Carol Klammer, and the many students and clients who have trusted me as I dropped deep into this rabbit hole of the breath. I appreciate your willingness to try out these new techniques. Thank you for allowing me to practice with you (and on you) and for letting me know what worked and what didn't. Your faith in me has been my *sthira* and my *sukha*. I extend special gratitude to the clients who were willing to share their breath experience for the book. You will inspire many with your healing journey, just as you have inspired me.

To my Buteyko family from the Buteyko Breathing Educators Association (BBEA), thank you for teaching me so much in the past three years! Your knowledge of the breath and respiratory health has made me a better yoga therapist! Most special shout-out to Pippa Kiraly who initiated my personal transformation with Buteyko. Patrick McKeown, I am

forever grateful for all that I have learned from you as a breath educator. Your manner of teaching with the utmost yogic sensitivity and generosity has made being your student a blessing. Your conviction that this book needed to be written, and your interest in the intersection between Buteyko and the Vedic teachings, provided me with the fortitude to step into the world with this material.

To my International Association of Yoga Therapists (IAYT) family, especially my heart sisters Aggie Stewart, Sue Tebbs, Molly McManus, and my heart brother, Leigh Blashki: thank you for believing in me. Your support from the beginning has meant the world to me. Matra Majmundar, thank you for all your wise counsel on the breath and for Halo Breathing. Aggie—thank you sister-writer for keeping me company while cloistered in our separate book caves. Thanks to John Kepner for providing me with a platform to explore these novel ideas within our professional community.

To the many authors and researchers who are cited in this book—I am humbled by your knowledge and hope I have represented your work with the honor it deserves. To breath researchers Rosalba Courtney and Luciano Bernardi, thank you for the amazing work you are doing in this field—the world needs you! I appreciate that you each took personal time to respond to my many questions as I toddled into the pool of the breath that you navigate so fluidly.

To my many yoga teachers over the years, thank you for the wisdom you imparted upon me and for igniting my passion for yoga. With deep gratitude I acknowledge Gary Kraftsow, Sonia Nelson, Nischala Joy Devi, Dr. Richard Miller, T.K.V. Desikachar, Raminand Patel, and Dr. Judith Hanson Lasater. You all are with me each day as I practice and teach.

To the *Restoring Prāṇa* team: Thank you Kirsteen Wright for your beautiful illustrations, which rendered complex concepts comprehensible. Thank you, Roy DeLeon for your illustrative additions and original art work. Bob Clancy, thank you for your photographic expertise, humor and long hours of editing. Gayle Miyake, Jill Massengill, and Cami LeBlanc, thank you so much for modeling for the book and making our photo shoot a play-date. To the amazing Gina Manso whose eagle eyes and attention to detail literally made this project tangible for me. I am so grateful for the hours you spent resourcing citations, permissions, formatting, and glossary writing. I would have been lost without you. Summer Cushman, thank you for the lovely poem that sets the tone of the book, the Sanskrit glossary, and the many ways you've supported me with your enthusiasm and grammatical expertise. Special thanks to my editor, Claire Wilson from Singing Dragon Publishers, who has only said, "Yes," to every ask I've made. Thank you for believing in me and in this project. To Victoria Peters and the editing staff, thank you for accommodating my eleventh-hour edits and assisting me in the polishing process.

To my own family: Rose and Rianne, I feel your love and support of me and my work every day. Dad, thank you for always being interested, and for instilling in me the belief that I can do anything. Peter, I am so very grateful for your patience while I've been in my "book cave." Thank you for being willing to read, to listen to me ramble on and on about the breath, and CO<sub>2</sub>, mouth breathing, and prāṇāyāma... Your support this past year and the space you provided me was a true expression of love.

PRĀṆĀYĀMA MANTRA

*i receive the inhale  
i release the exhale  
i pause in between breaths  
i lovingly accept the inhale  
i gently let go of the exhale  
i pause to enjoy the moment between breaths  
i quietly receive the in breath  
i quietly release the out breath  
i pause in the stillness between breaths  
the inhale comes  
the exhale goes  
the pause happens  
i receive the inhale  
i release the exhale  
i pause to rest  
space moves within  
space moves without  
i rest in the infinite space  
i receive the element of space  
i release the element of space  
i rest in the infinite space within and without*

Summer Cushman, M-Div., C-IAYT

*This book is dedicated to my granddaughter Amirra Skye.*

*May your breath always be light.*

*May your Steps be many.*

*May you experience vīrya all the days of your life.*



Prāṇāyāma mantra on page 9 quoted with permission from Summer Cushman's online course Yoga for Transformation, a password-protected part of [www.summercushman.com](http://www.summercushman.com).  
Extracts from Swami Saraswati (2010) *Prāṇa and Prāṇāyāma* and Swami Muktibodhananda (1998) *Hatha Yoga Pradipika* —*Light on Hatha Yoga: Including the Original Sanskrit Text of the Hatha Yoga Pradipika with English Translation* reproduced by courtesy of Bihar School of Yoga, Munger, India.

---

First published in 2020  
by Singing Dragon  
an imprint of Jessica Kingsley Publishers  
73 Collier Street  
London N1 9BE, UK  
and  
400 Market Street, Suite 400  
Philadelphia, PA 19106, USA

[www.singingdragon.com](http://www.singingdragon.com)

Copyright © Robin L. Rothenberg 2020  
Foreword copyright © Richard Miller 2020  
Illustrations copyright © Kirsteen Wright 2020  
Photography copyright © Bob Clancy 2020  
Figure 4.2 copyright © Roy DeLeon 2008, 2020

All rights reserved. No part of this publication may be reproduced in any material form (including photocopying, storing in any medium by electronic means or transmitting) without the written permission of the copyright owner except in accordance with the provisions of the law or under terms of a licence issued in the UK by the Copyright Licensing Agency Ltd. [www.cla.co.uk](http://www.cla.co.uk) or in overseas territories by the relevant reproduction rights organization, for details see [www.ifro.org](http://www.ifro.org). Applications for the copyright owner's written permission to reproduce any part of this publication should be addressed to the publisher.

Warning: The doing of an unauthorized act in relation to a copyright work may result in both a civil claim for damages and criminal prosecution.

#### **Library of Congress Cataloging in Publication Data**

Names: Rothenberg, Robin L., author.

Title: Restoring prana : a guide to pranayama and healing through the breath for yoga therapists, teachers and healthcare practitioners / Robin L. Rothenberg ; illustrated by Kirsteen Wright.

Description: London ; Philadelphia : Jessica Kingsley Publishers, 2019. | Includes bibliographical references.

Identifiers: LCCN 2018056458 | ISBN 9781848194014

Subjects: LCSH: Pranayama.

Classification: LCC RA781.7 .R678 2019 | DDC 613/.192--dc23 LC record available at <https://lccn.loc.gov/2018056458>

#### **British Library Cataloguing in Publication Data**

A CIP catalogue record for this book is available from the British Library

ISBN 978 1 84819 401 4  
eISBN 978 0 85701 357 6

*of related interest*

**Breathe Well and Live Well with COPD**

**A 28-Day Breathing Exercise Plan**

*Janet Brindley*

ISBN 978 1 84819 164 8

eISBN 978 0 85701 132 9

**Yoga Therapy for Fear**

**Treating Anxiety, Depression and Rage with the Vagus Nerve and Other Techniques**

*Beth Spindler*

ISBN 978 1 84819 374 1

eISBN 978 0 85701 331 6

**Yoga Therapy for Digestive Health**

*Charlotte Watts*

ISBN 978 1 84819 354 3

eISBN 978 0 85701 312 5

**Principles and Themes in Yoga Therapy**

**An Introduction to Integrative Mind/Body Yoga Therapeutics**

*James Foulkes*

*Foreword by Mikhail Kogan, MD*

*Illustrated by Simon Barkworth*

ISBN 978 1 84819 248 5

eISBN 978 0 85701 194 7

**Yoga Teaching Handbook**

**A Practical Guide for Yoga Teachers and Trainees**

*Edited by Sian O'Neill*

ISBN 978 1 84819 355 0

eISBN 978 0 85701 313 2

*“Restoring Prāṇa is a pioneering work, looking at the function and effects of breathing from latest scientific and ancient yogic resources. Well written, thoroughly researched, and referenced by the author’s own practice experiences, this book provides navigating light into breath, breathing patterns and prāṇāyāma, and its effects on our health. Robin oscillates with ease between psycho-physiological effects of breathing and ancient texts on prāṇāyāma, dispelling the popular myths alive in yogic studios today. The author reveals this knowledge as accessible to all of us regular folk: modern-day yogis, teachers, students, and therapy clients alike. I especially appreciate the summary of each chapter followed by recommendation of specific breathing techniques to practice. A very needed book for all yoga teachers and yoga therapists.”*

*—Lee Majewski, MA, DYE, C-IAYT*

*“In this fascinating book, yoga therapist Robin Rothenberg pulls back what she calls a ‘curtain of mysticism’ that shrouds prāṇāyāma and offers a comprehensive guide to respiratory physiology and the practice of breath control. Prompted by a health crisis, she embarked on an in-depth study of breathing—pouring over ancient yogic texts and modern scientific journals—and reveals how breath retraining transformed her life. She details the breathing practices and postures that helped relieve her asthma, apnea, and chronic cough—and shed 15 pounds—and challenges the commonly taught emphasis on ‘big breathing’ and ‘expansive inhalation and exhalation’. Courageous and compelling, *Restoring Prāṇa* offers essential information for yoga teachers, yoga therapists, and healthcare practitioners who want to skillfully help students and clients enhance their health and vitality.”*

*—Carol Krucoff, C-IAYT, E-RYT, author of Yoga Sparks: 108  
Easy Practices for Stress Relief in a Minute or Less*

*“Yoga teachers and therapists will find an unequalled and enthusiastic education in prāṇāyāma that evolves how we learn, understand, and teach the breath. From philosophical roots and physiological context to practical explorations, this book gives us Robin’s deep wisdom and experience with every element of breath. It transforms our ability to educate and improve the countless conditions influenced by how we, and our students, breathe.”*

*—Rachel Lanzerotti, MSW, C-IAYT,  
The RE/ST Method™ for Pain Recovery*

*“I have never met anyone with so much curiosity and drive to grow as Robin Rothenberg. Her journey into the breath from a new perspective contradicted decades of yoga training. By integrating the Vedic teachings with Western science, Robin validates reduced breathing and its impact on the entire human organism (body, mind, and spirit). As a psychiatrist, I found this book incredibly satisfying and useful. *Restoring Prāṇa* will help you understand the essential role of functional breathing on health and provide a framework to use the tools for retraining with confidence. There is no better teacher to guide you on this adventure than Robin.”*

*—Lynn Hughes, D.O. RYT-500 Board Certified Psychiatrist*