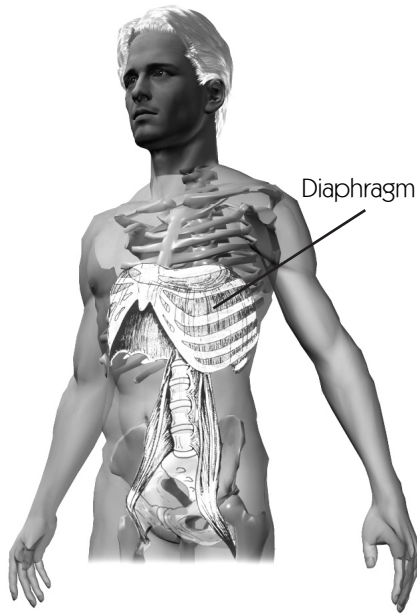


# Diaphragmatic Breath



## When is Breathing Diaphragmatic?

Practice of the Natural Breath invites you to explore the your experience of the ‘Prime Mover’ of the breath, the diaphragm. Proper use of this muscle is the key to relaxed and full breathing. We can’t help but use it; but how well do we use it, and how well do we understand its movements?

The diaphragm divides the two principle cavities of the torso — the abdominal cavity and the thoracic cavity. And although the diaphragm is illustrated as being shaped like a parachute or a ‘mushroom,’ it doesn’t have a determinate shape of its own. It is shaped by the organs it encloses between these two cavities — the stomach and liver from below, and the lungs and heart from above.

The nature of the two cavities is very different. As Leslie Kaminoff points out,<sup>1</sup> the contents of the abdominal cavity below the diaphragm (the abdominal organs, as surrounded and contained by the abdominal and other muscles) can change *shape* during the act of breathing, but the overall size or *volume* of the abdominal organs doesn’t change. The effect of the diaphragm upon the organs of the abdominal cavity below it is simply to move the organs around, much like pushing down on the end of a water balloon: the belly bulges outward when pushed by the downward movement of the diaphragm.

The thoracic cavity above it, is of a rather different nature. Like the abdominal cavity, the chest changes shape as we breathe; but unlike the abdominal cavity, it *also* changes size or *volume*, because of the nature of the lungs. All movements of breathing, whether in the ‘belly’ via the diaphragm or the chest via the ribs, are meant to increase the size or volume of the lungs: that’s what draws the breath into them.

We illustrated this earlier by describing the thoracic cavity as a cylinder which can work in all directions. The diaphragm draws down like a piston, increasing the size or volume of the lungs from below. As the volume of the thoracic cavity increases, the air pressure inside the lungs is lowered, and the air outside rushes into the lungs to restore the balance in pressure between inside and outside. With this specific action of the diaphragm, the belly distends because the contents of the abdominal cavity, since they cannot change in size or volume, are displaced.

It is largely for this reason that **diaphragmatic breathing** has so often been associated with ‘belly breathing,’ or the movement of the belly with the breath. But our **habit of equating the movement of the belly with the action of the diaphragm is quite misleading.** There is far more to the action of the diaphragm than simply its downward, piston-like movement.

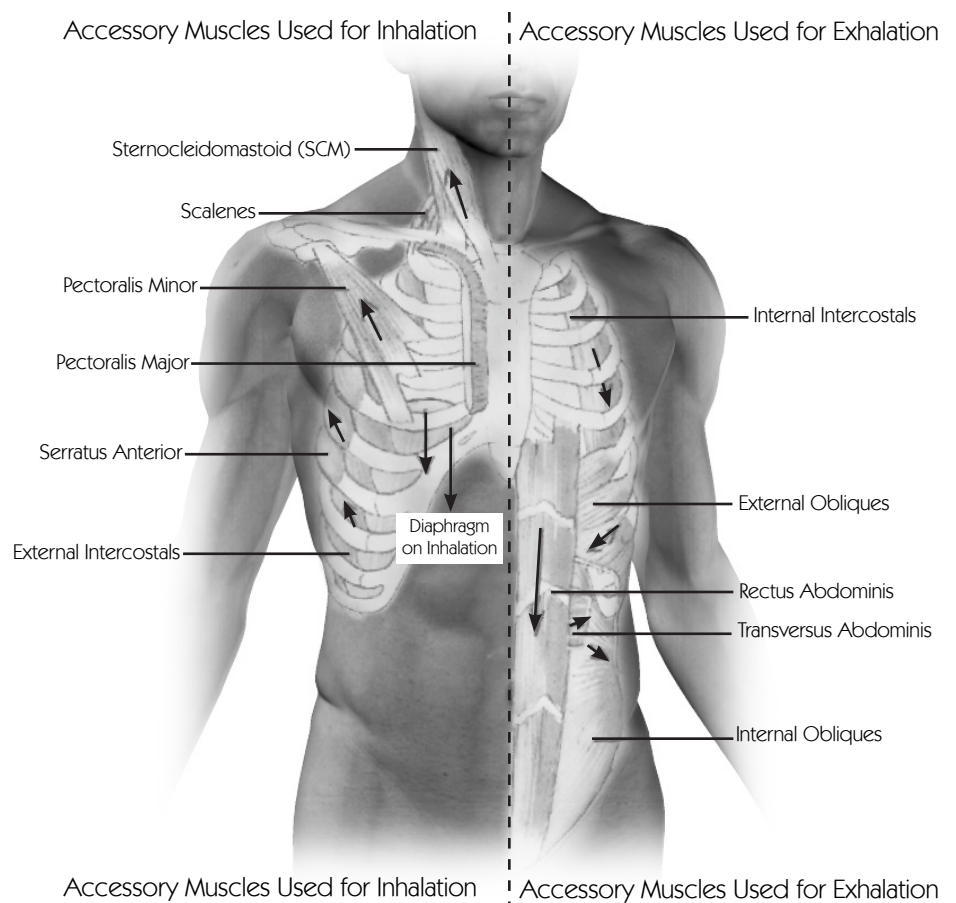
<sup>1</sup> Leslie Kaminoff, ‘What Yoga Therapists Should Know About the Anatomy of Breathing,’ International Journal of Yoga Therapy no. 16 (2006), p. 69

The second kind of expansion of the ‘cylinder’ that we described was the expansion and contraction of the chest. This is usually understood to be done by the muscles of the rib cage and chest, which lift the ribs like bucket handles to expand the chest. The ‘top’ of the cylinder is likewise drawn upward — like another piston at the top of the cylinder — by the muscles of the shoulders and neck (serratus anterior, pectoralis minor, sternocleidomastoid and scalenes, which we use when our breath is especially labored). We referred to this earlier as ‘clavicular’ breathing.

The muscles used in this sideways and upwards expansion of the chest are generally understood to be secondary or accessory muscles for the breath. They are meant to *assist* us in breathing, but they are not designed for the 24-7 work of the breath. Their *overuse* is most often defined as ‘chest breathing,’ which is in turn considered to be a stressful pattern of ‘overbreathing.’

Chest breathing as a form of overbreathing is indeed not good. But is all movement of the chest the same as this kind of chest breathing? The distinction is often based on where we most observe movement with the breath. If the abdomen expands on the inhalation, it is regarded as a ‘diaphragmatic’ breath. If the chest expands — and the abdomen moves little, or even draws inwards — during the inhalation, then some yoga teachers regard this as ‘chest breathing’ and treat it as the very opposite of diaphragmatic breathing — and more ‘belly breathing’ is encouraged.

We’ve already noted that movement of the mid and upper chest is part of the ‘natural breath’ or a very complete breath, and that overbreathing usually consists of overuse of chest breathing and clavicular breathing. Now we’re taking a moment to focus on the question of whether a false dichotomy is being used when students are being told too easily and too often that they are ‘chest breathers.’ The diaphragm moves in more than one way, and the quality and efficiency of our use of the diaphragm depends upon the interaction of the two cavities of the torso. When we look more closely, we realize that the diaphragm is really the prime mover of breath as it takes place in the chest as well. The difference between ‘good’ and ‘bad’ chest breathing rests upon the balance struck between changes in the two cavities of the body during



Redrawn from illustration in International Journal of Yoga Therapy no. 16 (2006) p. 74

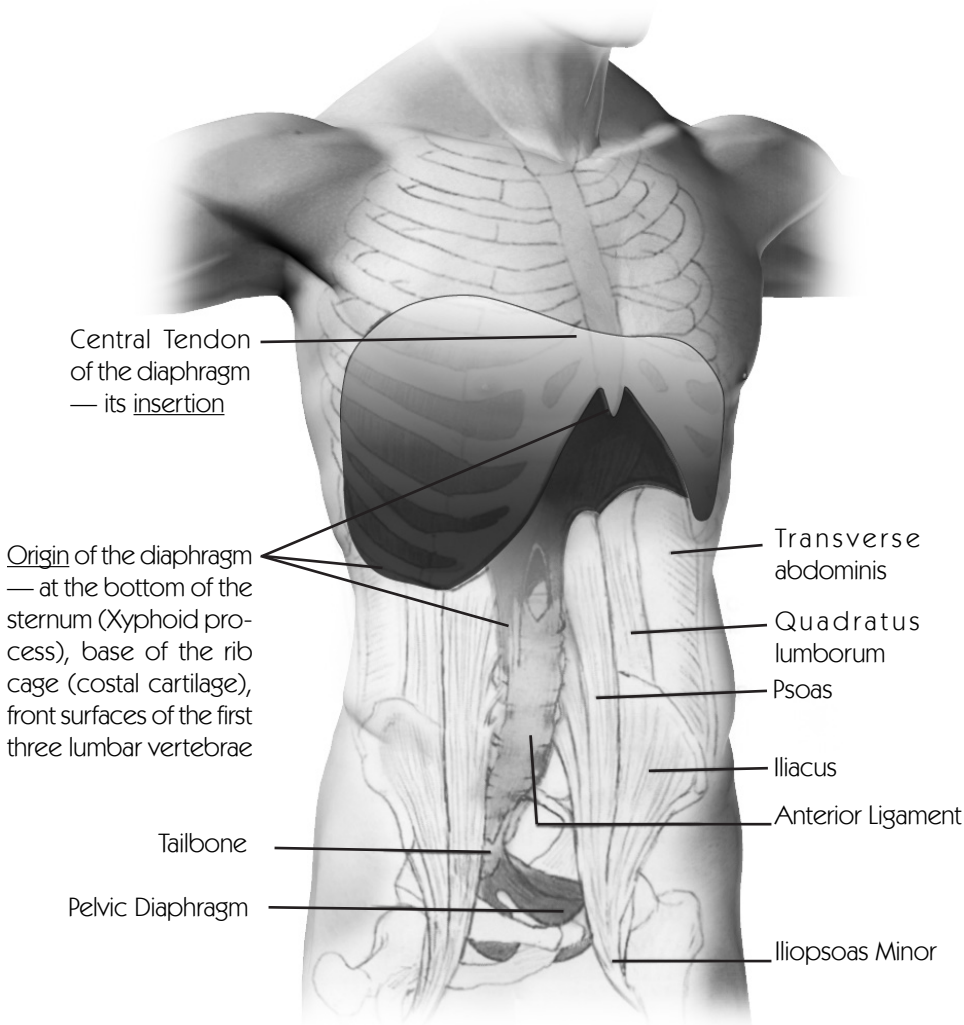
the process of breathing. Awareness of this balance, mediated by the diaphragm, takes us a long way in refining the movement of efficiency of the breath. The balance is the result of the rather unique nature of the diaphragm.

## The Diaphragm as a Muscle

Most muscles connect from bone to bone, and are designed to move bones. The bicep, for instance, has its origin at the upper arm bone and its insertion at the forearm. When the bicep contracts, it pulls origin and insertion toward each other — most often drawing from insertion toward origin, such as when the elbow in a ‘bicep curl.’

The diaphragm does not join two bones, and what it ‘does’ is rather unique. The origin of the diaphragm is where it attaches along a rim that begins at the bottom of the sternum, and extends around the base of the rib cage to the front of the lower spine. The only ‘bony’ attachments are at the back of the xyphoid process and the front of the lumbar vertebrae. The rest of what the diaphragm attaches to is flexible tissue: the cartilage and ligaments of the eminently mobile ribs.

The ‘insertion’ of the diaphragm is the top of the flattened ‘dome’ it forms — or more precisely, the dome formed by the way it rests upon organs such as the stomach and liver below it. The very top of the dome is non-contractile tissue. This forms a ‘tendon’ that is not attached to any bone; rather it inserts into itself.<sup>2</sup>

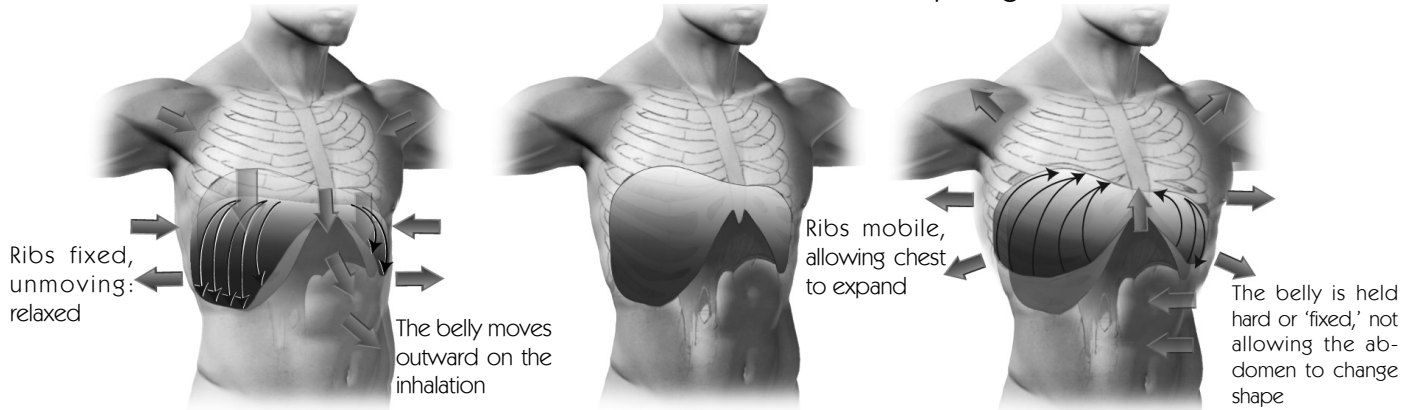


### The Diaphragm: Its Origin and Insertion

Redrawn from illustration in International Journal of Yoga Therapy no. 16 (2006) p. 72

2 Ibid., p. 72

## Two Manifestations of Breath from the Diaphragm



Diaphragmatic Inhalation when the ribs are fixed: the central tendon is pulled downward, and the belly and lower ribs expand. The abdominal cavity changes shape because of displacement by the diaphragm; the diaphragm thus initiates the breath in the 'belly' (and lowest ribs)

Neutral Diaphragm

Diaphragmatic Inhalation when the abdominals are held firm: the central tendon cannot move, so the contraction of the diaphragm pulls upward on the lower ribs, causing the rib cage to begin to expand. Here the diaphragm initiates the breath in the chest.

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## Movements Initiated by the Diaphragm

Like every other muscle, the diaphragm contracts. But what the diaphragm *causes* to move depends upon what is *allowed* to move — either the belly or the chest... or both:

- **If the rib cage does not move** (i.e. the muscles of the rib cage are not used to expand it), then the contraction of the diaphragm **pulls the central tendon downward**, pushing down upon the contents of the abdominal cavity. The result is that **the belly (and the lower ribs) expands** or 'bulges,' moved by the diaphragm. That's not all. The lower ribs are pushed outward by the contraction of the diaphragm also. This is an important point of distinction between 'belly breathing' and genuine diaphragmatic breathing. Diaphragmatic breath is always is 'three-dimensional,' an expansion that encircles the lower ribs, moving them without needing to enlist the intercostal muscles of the ribs. In 'belly breathing,' only the belly distends forward, and the drag it exerts can actually limit diaphragmatic breathing.
- **If the abdomen is held firm** by the abdominal muscles, then the central tendon does not move. Because the abdomen is holding its shape and cannot be squeezed into something smaller, the central tendon has nowhere to go. Instead, as the diaphragm contracts, it **pulls upward on the lower rib cage** (since it can't move downward) and **the lower rib cage expands outward** — usually to an even greater degree than when the belly is allowed to move. If, of course, the abdominals are gripped too hard, the lower ribs won't move, and the breath will be entirely in the mid and upper chest.

It seems reasonable to say from this that the **fullest expression of the diaphragmatic breath** comes when **both belly and chest move** to some degree, and in coordination with each other. Diaphragmatic breathing is not simply synonymous with ‘belly breathing’ or with mere movement of the belly. The relaxed expansion and contraction of the chest — particularly when one is sitting or standing upright — is equally diaphragmatic. A full yogic breath also makes use of the accessory muscles of the chest for a complete yet relaxed breath. This does not make it any less diaphragmatic, but rather a diaphragmatic breath ‘plus’ — which is as it is intended to be. The fullness and pacing of this breath is determined by the body’s needs in the moment: certainly a full breath while one is doing a slow and steady — yet physically challenging — asana practice will be different from the kind of breathing one does in preparation for meditation. The body’s demands in those two cases are quite different!<sup>3</sup>

This insight into the nature of diaphragmatic breath also helps us to better understand the classic **role of the ‘bandhas’** in making the breath more efficient and diaphragmatic. Uddiyana bandha — which we might simply define here as a gentle toning of the lower abdominal muscles just above the pubic bone (and the toning of the pelvic floor or Mulabandha that this action brings) — brings just the kind of muscular toning that serves to gently maintain the shape of the abdominal cavity. This toning is just enough to make the action of the diaphragm in the lower ribs all the more expansive.

Notice that this ‘toning’ of the muscles in Uddiyana bandha refers to the *lower* abdominals. If the abdominals as a whole were held firm (rectus abdominis in particular, which is hard to maintain in any case, though an artificial attempt was made in the age of corsets), then not only would the abdominal cavity be prevented from changing shape to allow for the expansion of the lungs, but the lower ribs as well would be immobilized, inhibiting the action of the diaphragm in every way. Then the breath would indeed have to be handled by the accessory muscles of the mid and upper chest, making for very tiring and inefficient ‘chest breathing’ of the kind that we are warned against.

Uddiyana bandha and the toning of the pelvic diaphragm (Mulabandha) provides the necessary balance between tone and freedom in the abdomen. This allows the diaphragm to cause movement in the belly **and** expansion of the rib cage. The diaphragm can then act with such fine and relaxed coordination that one can smoothly add the assistance of the accessory muscles of the chest for a very ‘full’ yogic breath. The use of the bandhas in this very full style of pranayama comes into play primarily when the body is upright. We will turn to the distinction between this and diaphragmatic breathing in reclining practice after the next section.

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3 If in the process of yogic breathing we are taking in more oxygen and dispelling more carbon dioxide than the body needs at that time and level of physical activity, then we are overbreathing or hyperventilating, and not breathing ‘yogically’ at all. A breath can be very full without causing these problems if the balance is maintained via proper pacing of the rate of the breath, assisted by practicing with the Ujjayi sound, and a relaxed and receptive attitude.

## Oxygen, the Breath and Stress

When it comes to delivering oxygen to the blood efficiently, diaphragmatic breathing does the job best, in large part because of the structure of the lungs themselves. A major portion of the blood sent to the lungs goes to the lower parts, largely because of the influence of gravity. The lower lobes of the lungs are the largest, and the lower parts of the lungs expand the most as well, because of the action of the diaphragm. Thus the breath is brought first to the most blood-rich parts of the lungs.

There are times when the body physically needs more oxygen because of physical demands placed upon it, and the use of the accessory muscles of the rib cage are designed to increase the volume of the chest more and more, bringing more breath into the lungs to meet the need for more oxygen.

And then there are times when we *anticipate* physical stress and begin to breathe harder, using the chest muscles. The problem is that this situation of persistent mental and emotional stress has become more the rule of daily life than the exception. The body is on constant alert via the sympathetic nervous system, but the physical exertion — and the need for accelerated breathing — never comes. As a result, we've both pumped in more oxygen and pumped out carbon dioxide in this process of hyperventilation, and a vital chemical balance in the body has been seriously upset.

Here begins the vicious cycle that is so familiar to hyperventilators. The harder we breathe, the more oxygen-starved we feel, and we can't 'catch' our breath. This is not for lack of oxygen, but because so much carbon dioxide has been forced out in the process of overbreathing. The presence of carbon dioxide in our blood allows the hemoglobins to transport oxygen to the body's tissues. If too much carbon dioxide is 'blown off' by hyperventilation, the blood becomes alkaline, and the hemoglobin can't release the oxygen molecules, which are chemically 'stuck' to it. The blood is carrying around plenty of oxygen: the problem is that the body can't get any of it!

Carbon dioxide also provides the chemical message in the blood that leads us to take our next breath. At the end of the exhalation, there is a natural, restful pause before we breathe in again. During that pause, carbon dioxide builds up in the blood at the same time that oxygen is being released into the tissues. When it reaches a certain level, the respiratory center of the brain sends a signal through the phrenic nerve to the diaphragm to take another breath.<sup>4</sup> In the normal course of breathing, the entire process of respiration is driven by carbon dioxide, from the first neurochemical impulse that initiates the inhalation, to the chemical balancing act in the blood that delivers oxygen to the body.<sup>5</sup> All of this happens without our having to think about or consciously direct the process, and the whole process works astoundingly well, with carbon dioxide playing a central role from beginning to end.

That, of course, describes the natural process of the breath, in which the conscious mind, with its slurry of desire, emotion and expectation, is not factored in. But what

4 Ibid., p. 76

5 Ibid., p. 76

happens when we overbreathe? Usually an excess of carbon dioxide in the blood tells us to take another breath in, and the process is quite relaxed. But when carbon dioxide drops *below* a certain level, the message from the body — which is now not receiving the oxygen it needs — is that we are suffocating! And so the breath is driven by the body's panic, and we breathe harder, making the situation worse instead of better. A subtle chemical imbalance soon becomes a full-blown panic attack. The age-old cure for panic attacks — to breathe into a paper bag — has a very good biochemical basis: it's meant to increase the levels of carbon dioxide by re-breathing the same air, until the proper balance is restored.<sup>6</sup>

When it comes to stressful breathing patterns, or patterns of 'overbreathing, certainly the vicious cycle of the biochemistry of hyperventilation plays the part of gasoline thrown on the fire. Mental anticipation and anxiety, however, is the match that lights the fire. The biggest challenge in establishing healthy breathing patterns — especially in the conscious practice of pranayama — is the mind, with its desires, conditioning, and love of exerting control in all things. The mind, far more than the body, introduces the greatest interference to the natural breath. Witness any beginner's pranayama class: even in a relaxation in which students are told to simply watch the breath, many become uncomfortable and confused about the breath, feeling that they no longer know how to breathe, even though they were doing a reasonably good job of it when they arrived for class! Such can be the influence of the mind, when attention is turned toward the breath.

## The Purpose of Pranayama Revisited

Given that the natural process of the breath works best when there is the least interference, what is the **purpose** of pranayama as a conscious practice, especially when 'consciousness' of the breath introduces the interference of the mind?

Is it, as is sometimes taught, to better oxygenate the blood? As we've just seen, oxygenation usually not the problem, and the harder we try to do so, the worse we make our situation. *More* oxygen can *become* a problem, especially when we overbreathe.

Leslie Kaminoff, who emphasizes the need to understand the anatomy and physiology of breathing in order to dispel misconceptions about pranayama, defines the purpose of pranayama in this way:

“...in yoga we train ourselves to breathe deeply, and in a variety of unusual patterns, but this is only for the purpose of exploring the full potential of our breathing mechanisms, and to uncover and dismantle habits that obstruct normal function. In other words, the end goal of practicing pranayama (unusual breathing patterns) in a Yoga therapy breathing intervention is to achieve “normal” breathing. Normal breathing, in the physiological sense, means that our everyday, moment-to-moment respiratory activity is consistent with our metabolic requirements.”<sup>7</sup>

6 Ibid., p. 76

7 Ibid., p. 75

Indeed, tantric philosophers of yoga as well as the later Vedantins, such as the author(s) of the Yoga Vasistha, agree that the highest pranayama is the natural, uninhibited breath. The purity of the breath is embodied by the ‘So’Ham’ mantra, the natural mantra of the breath.

Yet they might take issue with Mr. Kaminoff’s definition of pranayama as ‘unusual breathing patterns’ and urge instead that the practice be defined by its **purpose**. And they link the purpose of yogic breathing back to the purposes of yoga. Thus they might define pranayama as a conscious form or practice of breathing that leads to the natural stilling of the prana, and thus to the natural stilling of the mind.

Mr. Kaminoff’s definition focuses — as do many contemporary accounts of pranayama — more narrowly on the therapeutic value of pranayama practice, especially as an ‘intervention’ in the case of unhealthy patterns of breathing. His emphasis on the biochemistry and physiology of breathing is very necessary and helpful in correcting misunderstandings in the teaching of pranayama, so that pranayama practice does not inadvertently *increase* stress rather than overcome it. Seen in the light of metabolic processes, he points out that

“from this perspective, the notion of taking deep, slow breaths at all times is revealed to be a recipe for metabolic mayhem. Similarly, the oft-repeated dictum that Yogic breathing is supposed to maximize oxygen intake and carbon dioxide elimination is just as flawed. If we were truly able to accomplish this feat, then all Yogic breathing would, by definition, be hyperventilation — that is, the physiological state in which the blood contains too much oxygen and not enough carbon dioxide...Hyperventilation refers to the chemical condition of the blood, not to a particular pattern of rapid or shallow breathing.”<sup>8</sup>

This last point regarding the meaning of hyperventilation is a very helpful one, and is in large part the reason for our use of the term ‘overbreathing’ when talking about breathing patterns, as distinct from ‘hyperventilation.’ Nor would anyone be right in recommending that we take ‘deep, slow breaths **at all times**.’ But what about during relaxation and meditation? Is this too a ‘recipe for metabolic mayhem?’ And what should we understand to be the purpose of this breathing?

In an eminently contemporary turn of phraseology, he suggests that “more accurate teaching language would refer to normalizing levels of oxygen and carbon dioxide in the body. However, as many students do not find discussions of biochemistry particularly inspiring or relaxing, I suggest that Yoga teachers use the terms *prana* and *apana* when referring to these concepts.”<sup>9</sup>

Here Mr. Kaminoff effectively reducing these age-old Sanskrit terms, and least in the therapeutic context of yoga, to a more biochemical definition. Prana and apana are

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8 Ibid., p. 76

9 Ibid., p. 76



*The heart is of the nature of pure consciousness. It is both inside and outside, and it is neither inside nor outside. That is the principal heart. In it is reflected everything which is in the universe and it is the treasurehouse of all wealth. Consciousness alone is the heart of all beings, not the piece of flesh which people call the heart!*

*Hence, if the mind, freed of all conditioning, is gathered into pure consciousness [the heart], the movement of prana is restrained.*

*The Concise Yoga Vasistha  
(p. 239)*

simply more palatable terms designed to help us teach a more enlightened understanding of the purposes of pranayama — which focuses more on blood chemistry than on mental states and conditioning.

But here is where the age-old practitioners of pranayama would take issue. We risk forgetting that pranayama — even in a more narrowly defined therapeutic context — has to do with the relationship of the breath to the mind, not just the metabolic processes of breathing. Certainly the biochemistry of our blood can affect our breathing processes and thus our state of mind; but haven't we seen how much more profoundly our state of mind can affect the breath, and thus the body? And it is the mind, not just the biochemistry of hyperventilation, that perpetuates the vicious cycle of overbreathing. Pranayama as a conscious practice of breathing is an opportunity to become aware of mental conditioning and the breathing patterns with which they are associated, and gives us the tools for dissolving that conditioning. In this context, the terms 'prana' and 'apana' take on much more expanded and significant meaning. Both 'mind' and 'prana' need to be more deeply understood, and experientially so. This is where practice enters in.

In the Yoga Vasistha we find this account of pranayama:

“Prana is indistinguishably united with the mind. In fact, the consciousness that tends toward thinking, on account of the movement of prana, is known as the mind. Movement of thought in the mind arises from the movement of prana; and movement of prana arises because of the movement of thought in consciousness. They thus form a cycle of mutual dependence, like waves and movement of currents in water.

The wise ones declare that the mind is caused by the movement of prana; and hence by the restraint of the prana, the mind becomes quiescent.

...The movement of prana is arrested by the effortless practice of breathing, without strain... The practice of exhalation, when the prana roams in space without touching the limbs of the body, of inhalation, leading to the peaceful movement of prana, and of retention, bringing it all to a standstill for a long time, all lead to the arrest of the movement of prana... These yoga methods bring about the desired results if they are practiced without violence or force.”<sup>10</sup>

The key point in this account is the phrase, “without force.” The practices of the breath we will cover, beginning with diaphragmatic and Ujjayi breath, are meant to return us in various ways to the naturalness of the breath by practicing them consciously, yet *without force* or interference from the ego. The very effort of this effortless-effort is to dissolve the conditioning of the mind that leads to dysfunctional patterns.

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10 The Concise Yoga Vasistha, Swami Venkateshananda, p. 239

When it comes to the depth and pacing of the breath, along with the patterns of pranayama introduced as practices, we surely do explore the full potential of our breathing mechanisms, and dismantle counterproductive habits — especially the physical ones. That is the first step of practice.

But in moving beyond that, we begin to explore our experience of the movement of the prana, which is the subtler energy that moves both the physical breath and the mind. Are the terms ‘prana’ and ‘apana’ simply arcane terms for the biochemical triggers (having to do with carbon dioxide levels in the blood) which signal the diaphragm — via the respiratory center in the brain — to take another breath in or out? Or is there more to ‘prana’ than fits into the physiology of breathing?

This is something to be explored in our experience of the movements of inbreath and outbreath, and of the spaces of stillness in between: “the practice of exhalation, when the prana roams in space without touching the limbs of the body; of inhalation, leading to the peaceful movement of prana, and of retention, bringing it all to a standstill for a long time, all leads to the arrest of the movement of prana.”<sup>11</sup>

We align ourselves with the subtlety of this energy when the process is unforced. In practice, the mind and physical breath become more and more entrained to this energy, the more every moment of the breathing process becomes an experience of stillness (even in movement). We even experience spontaneous cessations of the movement of the breath (*kumbhak* or natural retention of the breath) for long periods of time. In this cessation, we experience the natural stilling of the mind and the urges that drive it.

This cessation too has to be unforced, and the experience of it can be subtle and fleeting, since the mind is quick to try to jump in, grasp and control or extend it. But in those moments, which increase as we learn to be receptive and open in our pranayama rather than goal-oriented and grasping, we experience the pure essence and significance of pranayama, which is to experience our merging with a conscious energy deeper than the processes of both mind and body. In that experience, we loosen the bonds of the mental attitudes and conditionings by which we ordinarily set ourselves apart from that experience, and apart from our own higher Self. The essence of that experience is the fully conscious surrender to that higher Self.

The first step toward that experience is to return to the diaphragmatic breath, awakening ourselves to the fullness and naturalness of this experience. And so it is to this that we now turn.

Excerpt from the newly revised fourth edition of *Refining the Breath* by Doug Keller

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11 Ibid., p. 239  
DOUG KELLER 2007