



In episode 112, “[How to Breathe Correctly for Optimal Health, Mood, Learning & Performance](#),” I discuss how deliberate respiration (breathing) represents a unique and powerful bridge between the subconscious and conscious mind — and how specific breathing protocols allow us to shift the state of our brain and body in powerful ways. In this newsletter, I explain how to **use specific breathing patterns** to influence your brain-body state and thereby **positively shift your mood, physical capacity, and focus — and improve sleep**. Indeed, even brief, deliberate breathing protocols, if done correctly, can positively impact all these around the clock — not just during the breathwork practice.

Why We Breathe

Breathing allows the body to draw in oxygen (O_2) and discard carbon dioxide (CO_2), or more accurately to *balance* ratios of $O_2:CO_2$ in our brain and body. When we inhale, oxygen fills and passes from millions of tiny sacs (“alveoli”) in our lungs, into our bloodstream. Once in the blood, a carrier molecule, hemoglobin, helps deliver the oxygen to the cells of the brain and body. While carbon dioxide is a cellular waste product, it is also essential for proper oxygenation of our cells. **Carbon dioxide** changes hemoglobin’s shape to help **liberate bound oxygen** into the surrounding cells and tissues.

Carbon dioxide levels also relate to our body’s **pH (level of acidity)**. During exercise, body pH drops slightly, and that results in **increased oxygen offloading** to exercising muscles. When exhaling, carbon dioxide is removed from the bloodstream, passing from the to the alveoli into of lungs and then, with the exhale exiting the body via the mouth or nose.

At rest, the brain has the most metabolically active cells in the body and thus requires significant levels of oxygen. Improper $O_2:CO_2$ ratios can put the body in a **hypoxic** state (lack of oxygen) and **negatively affect cognition and physical function**. In order to constantly monitor levels of oxygen and carbon dioxide within the body, parallel [mechanical](#) and [chemical](#) pathways vigilantly regulate breathing patterns.

Optimize Breathing

Healthy at-rest breathing patterns bring about 6 liters of air into the lungs per minute, which is accomplished by taking **~12 shallow-to-moderate breaths per minute**. However, most people “overbreathe,” averaging 15-to-18 breaths per minute. **Overbreathing** causes excessive exhalation, thereby reducing carbon dioxide (this is termed “hypocapnia”) and decreasing oxygen delivery to the brain and other tissues. When the brain does not receive adequate oxygen, it becomes [hyper-excitabile](#), causing **difficulty focusing** and **anxiety**.

To **reduce overbreathing when doing non-exercise activities**, try: 1) Taking small pauses between breaths and 2) Using nasal breathing (as opposed to mouth breathing), because the relatively higher resistance of the nostrils automatically extends the duration of exhales.

In addition to slowing breathing rate, **nasal breathing** at rest and during sleep has benefits compared to mouth breathing. Note: mouth breathing has its place when exercising.* (More below.)

- The increased resistance of nasal breathing allows for **maximum lung inflation** each breath to **increase oxygen delivery** to the body.
- The nasal passages **warm the incoming air**, which is healthier for the lungs.
- Nitric oxide (gas) is produced in nasal passages and causes smooth muscle relaxation. Nasal breathing improves blood vessel dilation to **efficiently remove waste, deliver nutrients** and help **relieve sinus congestion**.
- Nasal breathing improves [facial aesthetics](#), such as elevation of the eyebrows and cheekbones, sharpening of the jaw, and improvement of the tooth and jaw structure.

While many people over-breathe during the day, many have the opposite problem at night. **Sleep apnea** occurs when breaths are too shallow or infrequent, causing temporary hypoxia and frequent waking throughout the night. This condition is more frequent in individuals carrying excess weight, but even lean people can under-breathe in their sleep and can lead to many issues:

- Symptoms: sleepiness, snoring, morning headache, irritability, inattention
- Potential Risks: increases the risk of cardiovascular disease and stroke, exacerbates dementia, impacts cognitive function, decreased libido
- Treatment Options: 1) CPAP machine, 2) sleep with [medical tape](#) on the mouth to force nasal breathing, 3) practice nasal breathing during exercise and throughout daytime to train proper breathing

Test Your Breathing

To reduce overbreathing, practice controlling the **diaphragm** (an important muscle for breathing located below the lungs). One way to do that is to **deliberately expand your stomach “out” when inhaling and let it return “in” while exhaling**.

Also, take the **carbon dioxide tolerance test** — a tool developed by human performance expert **Brian Mackenzie** — to measure your ability to control the diaphragm and discard rate of CO₂. It's easy and free.

- Breathe normally for 4-5 breaths, then inhale 1x deeply through your nose, until your lungs are completely full.
- Then, start a timer and measure how long it takes for you to **slowly** exhale all of the air. Make the exhale as slow as possible.
- Stop the timer when you can no longer exhale any more air and note how long the exhale was. Stop the timer when your lungs are empty; **it's not about measuring how long you can hold your breath!** Then breathe normally.

From your results ([see this table](#)), practice 2-3 minutes of box breathing, 1-2x per week, to improve your diaphragmatic control and learn to increase your CO₂ discard rate. This will translate to less overbreathing when at rest, and you'll likely see improved performance during exercise — and reduced anxiety as well.

Box breathing is a pattern of: inhale-hold-exhale-hold, done repeatedly for a given period of time. (Think of each duration as a side of a four-sided box. See a [visual here](#)).

How long should the duration of each inhale-hold-exhale-hold be? It should be based on your timed exhale duration in the carbon dioxide tolerance test; [reference this table](#) for the duration to practice box breathing.

Again, practice 2-3 minutes of box breathing, 1-2x per week.

Repeat the tolerance test after 1-2 weeks of practice to see if you can increase the duration of holding on each “side.” Progress ultimately leads to less frequent breaths and healthier breathing patterns.

Breathing for Stress Reduction

Use a science-based strategy for stress relief with the [physiological sigh](#).

The Physiological Sigh

- Take 2 consecutive inhales through the nose: one big inhale, followed by another inhale (with no exhale in between!), to maximally inflate your lungs.
- Then exhale all your air until you are lungs-empty, via your mouth.

This **rapidly shifts your autonomic nervous system** from a state of elevated arousal and agitation toward a state of feeling more calm. It is — to my knowledge, the fastest way to calm down in real time. Even just 1-3 [physiological sighs](#) can allow us to stay in or return to a calmer state.

There is also value to practicing physiological sighs. In collaboration with Dr. David Spiegel of Stanford School of Medicine, my laboratory [published a clinical trial](#) showing that cyclic physiological sighs, practiced daily for 5 minutes, **reduce overall stress, promote relaxation, improve sleep, lower resting heart rate and enhance mood.**

Breathing for Alertness & Focus

Use [cyclic hyperventilation](#) to **increase alertness** and **enhance focus**.

Repeated forceful, deep inhales followed by exhales = hyperventilation. This causes the release of adrenaline in the brain and body and thus increases alertness and our capacity for focus.

Cyclic Hyperventilation*

(also see two notes below)

- Take a deep inhale through the nose, immediately followed by a deep exhale (active or passive) through the mouth.
- Repeat the above 25x, then fully exhale until lungs are empty and hold for 15-30 seconds.
- Then, repeat for up to 5 minutes.

Expect to feel a little tingly or agitated right after completing the exercise. However, over the next few minutes, adrenaline will increase to improve your focus and attention greatly.

While cyclic hyperventilation increases stress in the short term, repeated training allows you to practice staying calm while feeling agitated and leads to a **higher stress threshold**.

*Please use caution practicing this technique if you are prone to panic attacks or have high anxiety. **And never, ever perform cyclic hyperventilation near or in any body of water or while driving.** There is a possibility of passing out, which can lead to “shallow water blackout,” which can result in drowning, or car accidents, especially when combined with extended breath holds. Be safe!

Breathing and Heart Rate Variability

The science of heart rate variability has long been used in sports, military and clinical practice. There is a **direct connection** between **breathing and** heart rate, allowing you to deliberately reduce your heart rate (e.g., perhaps prior to sleep, an interview, public speaking, etc.) or increase heart rate (e.g., prior to engaging in athletic performance). It is rooted in something called **respiratory sinus arrhythmia**, which sounds bad but is actually a hard-wired and normal feature of our body. It has complex circuitry related to the vagus nerve that links the brain and body, including heart, lungs and brainstem, but it can be summarized simply:

To increase your heart rate: deliberately inhale longer and more deeply/vigorously than you exhale. To decrease your heart rate: exhale longer and more vigorously than you inhale. Here are [some examples](#) of this in common breathwork practices. You'll see why they produce the effects they do. It's about whether the breathwork emphasizes the duration and/or vigor of exhales (e.g., physiological sighs) or the duration and/or vigor of inhales (e.g., cyclic hyperventilation), or if they are balanced (e.g., box breathing).

*In fact, just understanding this inhale-to-increase-heart-rate and exhale-to-decrease-heart-rate phenomenon can allow you to adjust your state of mind and body any time, deliberately, as needed, without the need to do dedicated "breathwork."

Deliberate breathing is a powerful tool to control your brain-body state. You now have the knowledge and protocols to incorporate breathwork in real time and/or as a dedicated practice. Whether you do it daily or only once in a while, I'm certain you'll find it to be a potent tool, as it effects so many neural circuits, neurochemicals and hormone systems in the brain and body.

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