GO SPORTS THERAPY

Breathing for Injury Prevention & Improved Performance

80% of people have breathing dysfunction significant enough to impair functional movement[6].

As a population, we are breathing twice as much as what is physiologically healthy [7].

Faulty breathing behaviors happen unknowingly, during training and rest, set runners up for breathing dysfunction.

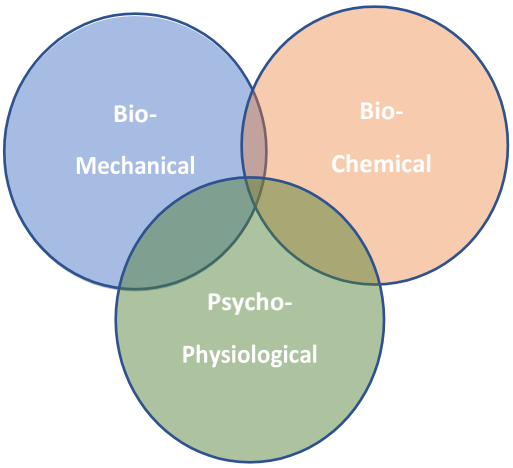
Better breathing helps to restore physical, physiological, and emotional health.

Our breathing patterns are influenced by central and peripheral neural mechanisms, chemoreflex stimulation, biomechanical patterns, emotions, and attention.

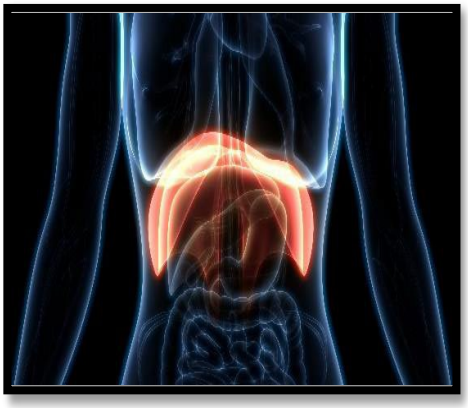
The Breath

Breathing involves our entire being – our mind, body, and spirit. The breath helps drive the beautiful interplay between the mechanical, chemical and the felt sense of being.

- Mechanically, the breath is the dance of the rib cage, abdomen, diaphragm, and postural muscles. The breath helps us maintain good posture, stability, and efficient movement patterns.
- Chemically, the breath helps regulate the pH balance of our blood. This chemical balance influences how oxygen is delivered through the body.
- Well-being, or psycho-physiologically, the breath helps to right-size our fight/flight system, and the system that allow us to feel content and peaceful.



The Basics of Healthy Breath Mechanics:



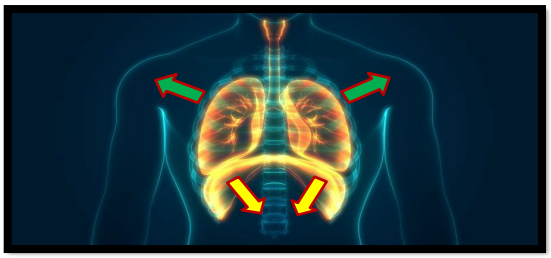
The diaphragm is a large muscle that separates your chest from your abdominal cavity. The diaphragm is accurately known for its role in breathing, but also plays a role in:

- Regulating pressure in the abdomen and thorax to help with posture and whole-spine stability
- Returning blood to the heart
- Moving lymph throughout the body
- Circulating nutrition in the internal organs
- Moving content in the bowels
- Controlling gastric reflux
- Our sense of well-being

The (amazing) Diaphragm

How Does the Diaphragm Work?

https://youtube.com/clip/UgkxTqivNKaS70kU7-81LPW5uomKZihPVMd8?si=XAOhYKquhT-7OofE



Inhale

- The diaphragm starts in a dome position.
- A signal to breathe comes from higher centers (Medulla Oblongata or Frontal Cortex)
- Diaphragm contracts on the central tendon, creating a negative intrathoracic pressure.
- Intercostals contract, elevating the ribs.
- The lungs inflate as a result of the negative intrathoracic pressure.
- Abdominal contents are compressed, including veins and arteries, as a result of the positive intra-abdominal pressure.

Exhale

- The exhale can be a passive release or an active process.
- Diaphragm ascends to its original dome position.
- Intrathoracic pressure increases, compressing air out of the lungs.
- Intra-abdominal pressure decreases, dragging the internal organs up while decompressing the organs.

Diaphragmatic Breathing vs Thoracic Breathing: A Functional Continuum

IMG_0046.MP4

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- A biomechanical pattern of upper chest breathing at rest results in breathing dysfunction, chronic spine stiffness, and pain.
- Upper chest breathing poses a significant threat to breathing efficiency.

Suggested Activities for Good Breathing Mechanics:

Thoracic Spine & Ribs – keep 'em moving

The thoracic spine is the basis of the attachment of the ribs and the crura of the diaphragm. It is vital that the posterior-lateral ribcage expands during inhalation for normal diaphragm function. Good mobility is needed for full inhalation and exhalation.
Qi Gong and Yoga offer effective ways to improve thoracic spine, ribs, and diaphragm mobility. Click on the link to view a 7-minute Qi Gong routine to improve rib and diaphragm motion.

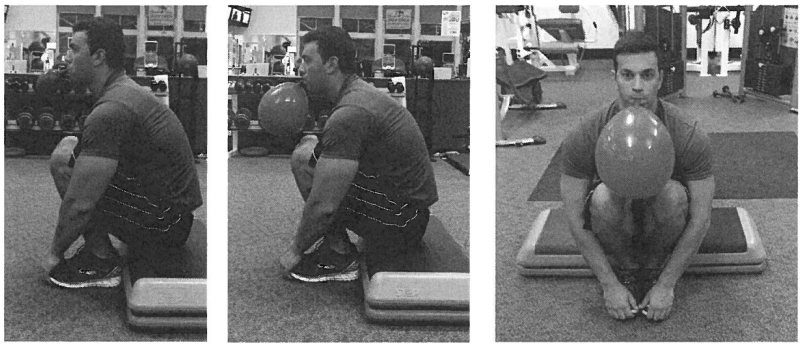
Diaphragmatic Breathing: Breathe low in the body, letting the lower ribs, abdomen, and back expand with a breath in, and return with a breath out. This stimulates the internal organs as well as the nerves controlling the emotional centers. It is also good for posture and movement stability.

Short Seated Balloon Blow:

APPENDIX: PRI Integration for Fitness and Movement.
Sagittal Plane Inhibition

STAIR SHORT SEATED BALLOON

PARAVERTEBRAL INHIBITION RIB IR AND THORACIC RETRACTION



Set Up

Sit on a 6-inch step with your feet together, knees bent and knees together. Round out your back and roll your pelvis back, feeling your "sit bones".

Check

Feel your left sit bone, left heel, and your left abdominals as you exhale into the balloon.

Move

1. Inhale through your nose and feel your rib cage retract back
2. Slowly blow out into the balloon. Pause.
3. Without pinching the neck of the balloon and keeping your tongue on the roof of your mouth, take another breath in through your nose.
4. Slowly blow out again as you stabilize the balloon with your hand. Pause and repeat for 4-5 breaths before taking the balloon out of your mouth.
5. Let the air out of the balloon. Relax and repeat the sequence at least 4 more times.

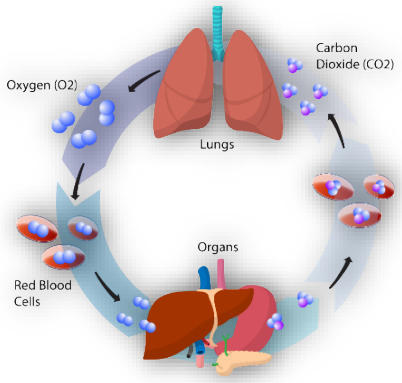
Control

Do not strain with your neck or tighten your cheeks as you blow into the balloon.
Attempt to expand air into the back of the rib cage without elevating your shoulders as you inhale.

The Biochemical Aspect of Breathing

Biochemical refers to the effect of breathing on blood gas levels and the pH balance of blood – typically related to, but not limited to, the management of CO2.

How we breathe has an immediate effect on the pH of the blood and availability of oxygen.



• Breathe correctly – CO2 is in balance – pH is in balance – hemoglobin (Hg) lets go of oxygen readily – there is vasodilation - cells are happy.

• Over breathing – CO2 drops, pH climbs – Hg hordes Oxygen – we see vasoconstriction - cells become oxygen deprived and unhappy.

Chronically oxygen-deprived cells results in poor rest, repair, sleep, digestion, cardiac function, musculoskeletal tone, and cognitive function. You get the picture. Over breathing robs us of normal function making life harder and less efficient.

Just because there is a normal blood oxygen level (PaO2, or spO2 if measured with a pulse oximeter), it does not necessarily correlate to the right amount of oxygen getting to the tissue(s) in need. It is entirely possible to have normal arterial oxygen levels and have oxygen-challenged (deprived) brain, heart, smooth muscle system, and musculoskeletal tissue. In fact, this seems to be a common problem.

The Problem of Over-breathing

The most common breathing dysfunction is actually "over-breathing," or breathing too much. Research shows that just a few decades ago, humans breathed at an average of 12 breaths per minute (BPM). Today, we're breathing an average of 18 BPM. You would think that breathing more would result in getting more oxygen. In fact, when we over breathe, **it results in a decrease in available oxygen** and may even leave us feeling like we need more air, when in fact we need less.

This might include:
Feeling short of breath, feeling the need to sigh, pain/fatigue, increased muscle tightness, dizziness, headaches, tingling, chest pain, anxiety/panic, change in blood pressure, etc.

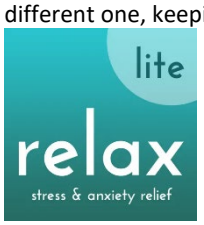
Suggested Activities for good breathing chemistry:

We are about to tell you to **breathe less.** This usually means breathing slower. And before you go off working hard to breathe less, allow us to point out something very important. If you want a positive result by breathing less, it will have to be done in a way that **feels good**. That usually means that small changes over time have the best results. Here are some examples.

1) **Feather Breathing.** Place a finger under the nose imagining the finger is a feather. Minimize the breath to NOT move the feather. It is important to find a way to do this activity with ease. Be careful to not exaggerate the activity or that will come with its own problems. Let it be comfortable. Think of it this way "only breathe the breath you need in this moment."

2) **Slow the Exhale.** Gently slow the first part of the exhale, as if trying to savor this part of the breath. Again, find a way to do this that feels very settling.

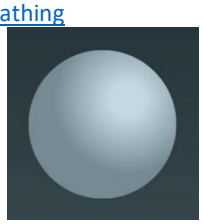
3) **Counting:** Inhale for three seconds, pause, exhale for 4 seconds, pause. If this does not feel like a good ratio, try a different one, keeping the exhale slightly longer than the inhale. Working w Paced Breathing



Relax Lite (free)


Breathing Zone (free)


State (subscription)


Breathing App (free)

The Psychophysiological Aspect of Breathing

Psychophysiological refers to the connection of thoughts and feelings to breathing behavior.

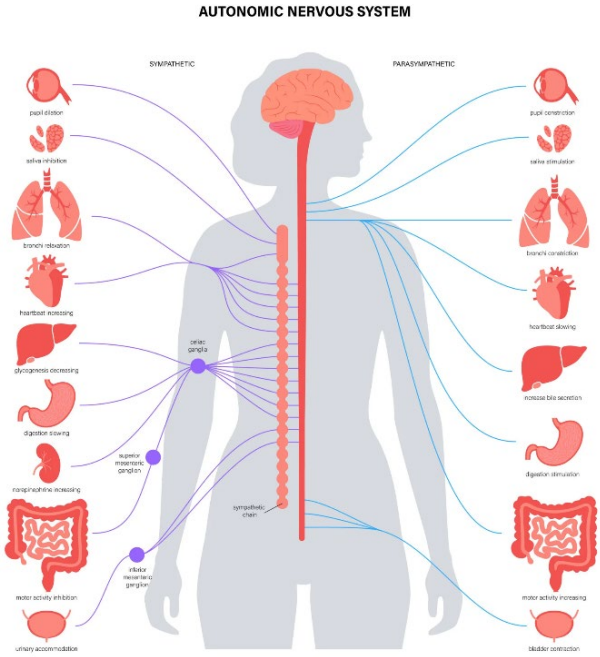
There is a powerful two-way street between thought and physiology – each having the ability to drive the other.

Remember: stress and anxiety are strongly correlated with upper thorax and accessory muscle breathing, even more so than conditions like COPD and asthma [27]. These dysfunctional breathing patterns have significant downstream adverse effects.

Every runner knows the mental benefits of running. Most elite runners also know the negative impact of anxiety on performance. If running alone is used to manage a mental state, eventually the mental state will win. Seeing the relationship between the breath and the mental state provides a stronger tool than running alone.

It's fair to say that breathing well starts and ends in the mind.

Autonomic Nervous System (ANS) Refresh



We've all learned that the sympathetic nervous system (SNS) is associated with flight or flight. The parasympathetic nervous system (PNS) is associated with rest and digestion. That's mostly true, but there are some complexities in the ANS that make it even more applicable to running considerations.

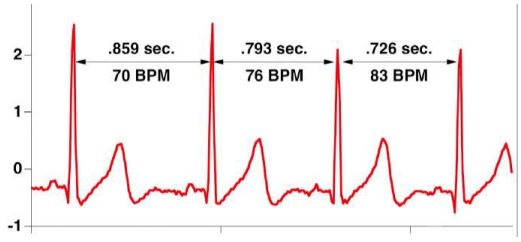
- PNS and SNS can be stimulated and suppressed at the same time, it's not always an either-or relationship. "Flow state" is probably a good example of sympathetic and parasympathetic NS acting in concert. In flow state, there is a sense of ease, focus and peacefulness that occurs along top performance.
- Removing PNS tone causes an increase in sympathetic tone, but the reverse is not true. If we remove a stimulus causing sympathetic tone (stress), we do not automatically get an increase in parasympathetic tone. Whereas in general, if we increase PNS activity, we will get a reduction of SNS activity. This points to the importance of practicing PNS tone. PNS tone is automatic, but it has an overriding influence that can become very powerful.
- The Vagus nerve, the 10th cranial nerve, is 20% efferent (carrying information away from the central nervous system – to the organs) and 80% afferent (carrying information to the central nervous system from the organs). It connects all internal organs and functions to the central nervous system.
- The Vagas nerve is the primary driver of PNS tone. The Vagus nerve runs through the diaphragm. Movement of the diaphragm stimulates the Vagus nerve, thus the PNS. If the diaphragm does not move as it should, sympathetic tone will increase, regardless of what's going on in the outside world. This will have a negative effect on mental and physical performance, as well as internal organ function.
- Some evidence points toward increases in parasympathetic activity specifically with expiration. Dynamic spinal stability may also be better during the expiration. [28-30].

Heart Rate Variability – the connection between breath, heart rate, and performance

- Many runners, athletes, and health enthusiasts currently track heart rate variability (HRV) in some way.
- HRV is a measure of our mental and physical readiness and resiliency. The greater the HRV, the healthier or more ready a system is. The reverse is also true. The smaller the HRV, the more fragile, ill, or headed toward illness a system is.
- Runners want strong HRV for two reasons – both related to each other
    1. For stronger performance output
    2. To be able to rest and recover better

What is HRV?

Heart rate variability is the variation from one heartbeat to the next. This is frequently measured as the distance (time) between "R" waves but can also be the distance between the "P" waves [31, 32].



We generally report heart rates as an average per minute (bpm). Consider the heart rate of 60 bpm. This is generally considered to be healthy. But not so fast. There are healthy and unhealthy ways to be at 60 beats per minute. One person with very little beat-to-beat variation, or HRV, will struggle to recover from intense training, and maybe more prone to illness or disease. However, a person with larger HRV will enjoy greater system vitality and resiliency – in most cases.

What drives HRV? The Baroreceptor System and a breathing rate called Respiratory Sinus Arrhythmia

Baroreceptors, located in the carotid bodies help regulate blood pressure. While it could be said that a body loves HRV, it does not love fluctuations in blood pressure. Baroreceptors influence the heart rate to help regulate blood pressure. For example, if blood pressure increases, baroreceptors signal the heart to slow down. A drop in BP and baroreceptors will signal the heart to speed up.

Again, HRV is good. Blood pressure variations are not. The baroreceptors use the HR to help control blood pressure in the moment.

What does breathing have to do with HRV?

Pressure regulation. We've already mentioned that the diaphragm helps regulate intrathoracic and intra-abdominal pressure. When we exhale, there is an increase in intrathoracic pressure as the diaphragm returns to its dome-like position - especially in the beginning phase of the breath out. As intrathoracic pressure increases (exhale) so does pressure increase on the heart – resulting in a temporary blood pressure increase. This pressure rise causes the baroreceptors to slow the heart rate – to normalize the blood pressure. This happens especially if we slow the first part of the exhale.

Now think of the reverse. During a breath in (inhale), there is a drop in intra thoracic pressure. Baroreceptors respond by causing the heart to speed up – thus maintaining blood pressure.

In this, breathing is a prime driver to baroreceptor activity and HRV. This phenomenon is called respiratory sinus arrythmia – which is a strange name, because it's actually rhythmic.

Respiratory Sinus Arrhythmia. Under normal circumstances, an inhale speeds up the heart (110-140 bpm), and with an exhale, heart rate should slow down (30-50 bpm).

Resonate breathing frequency. Respiratory sinus arrhythmia and HRV are greatest at a specific breathing frequency or rate. In general, this is between 4.5 and 7 breaths per minute. This seems to be set at birth and does not change based on health or fitness level. It's safe to say that most of us will be right around 6 breaths per minute.

A small word of caution: Breathing at 6 breaths per minute with a pacer does not guarantee good breathing or good HRV. It's possible to over breathe if tidal volume is increased disproportionately – which frequently happens. In this case, the pH imbalance caused by over breathing will override the benefits of resonate breathing frequency. So, the trick, if not using technology to monitor CO2 levels (capnography), is to encourage "comfortably low volume" breathing at 6 breaths per minute. See the Paced Breathing Apps above.

How to improve HRV

Simply put, do things that rev you up, and practice things that slow you down. **Both** are important. Do this with a mindset of curiosity, humor, satisfaction, and affection to boost the effect.
Specifically, researchers support:

- Cardiovascular exercise with nose breathing
- Interval training
- Strength training
- Meditation or Hold positive thoughts:
  - Hold feelings of gratitude and affection
  - Feel a solid, confident rooting to nature
- "Resonate breathing frequency" breathing
- Maintaining optimal ETCO2
- Eat well
- Rest well
- Connect to circadian rhythms

What gets in the way of good HRV.

- Poor sleep
- Illness, or starting to get sick
- Alcohol and most drugs
- Eating too close to bedtime
- Over training or under resting
- Chronic over breathing
- Unhelpful mental stories
- Falling out of synch with circadian cycles

Nijmegen Questionnaire

The **Nijmegen Questionnaire** (pronounced [ˈnīˌmāg(ə)n]) was introduced as a screening tool to detect patients with hyperventilation related complaints that could benefit from breathing regulation through capnography biofeedback [34, 35].

This tool meets basic reliability and validity requirements to have value in a clinical setting, both for the identification of a behavioral component to breathing dysfunction and for measuring progress or outcomes. [36]

Initial research indicated scores greater than **23** points are indicative of breathing dysfunction that will do well with practices that decrease minute ventilation and improve breathing efficiency. More recent evidence points to a score of **19**.

NOSE BREATHING BABY!

Nose breathing facilitates better breathing mechanics, though it does not guarantee them. There is a better chance for diaphragm recruitment, and it helps to maintain proper airway size. For people who mouth breathe, especially during exercise, transitioning to nose breathing will include runny nose, burning nasal passages, watering eyes, and the feeling that they're struggling to get air. The upside is that the feelings are associated with an increase in adrenaline and cortisol, that helps to act as an antihistamine. The pressure of forcing air through the nose helps to improve mid-face development, which is often stunted, even in adults. See the complete list of reasons to nose breath later in this course.

It's time to hit it head on – and summarize it according to three dimensions of breathing.

Biomechanical

- Slows the breath
- Improves lung inflation and deflation
- Improves diaphragm recruitment [44]
- Postural alignment [45-47]
- Spine stability
- Filters the air
- Promotes optimal structural integrity of the nasal passage lining [48]
- Helps the mid-face develop correctly [48]

Biochemical

- **Humidifies air**. When we inhale through the nose, air travels through the nostrils and nasal passages where moisture is added.
- Maintains **hydration**. When we breathe out through the nose, we retain vital moisture.
- Regulates **temperature.** As air is humidified to just the right moisture level, air is also warmed to body temperature so that O2/CO2 exchange is made easier in the lungs.
- Produces and carries **nitric oxide** into the lungs. Nitric Oxide (NO) is a tiny gas particle that, among many other things, helps hemoglobin bind (grab and hold) oxygen. It is a vasodilator, antioxidant, anti-viral, anti-bacterial, anti-fungal agent. You want more NO.

Psychophysiological

- **Emotional regulator.** Breathing through the nose helps to slow the breath and improve diaphragm function. This increases activity in the Vagus nerve, which helps our autonomic nervous system deliver the feeling of being calm, confident, and happy.

Don't be a mouth breather. Mouth breathing allows unfiltered air to enter the lungs, undermines the optimal pressure gradient needed for good posture and lung function and fails to regulate temperature and moisture, thus compromising gas exchange, the immune system and posture.

Our Most Effective Recommendation: Tape Your Mouth Shut

How we breathe during the day and night reflect each other. Most of us can nose breathe during the day when we think of it. The problem is that we often do not think about it, and most of us mouth breathe more than we realize. Changing to nose breathing during the parts of the day when we are not thinking about it (including sleep) may require some assistance. One simple and effective way to improve nose breathing is to **tape the lips closed** during sleep.

Key Considerations

It may feel strange if you are not used to nose-only breathing. Feel inspired if it feels strange – that probably means that you are on to something. Give yourself time to adjust. Most people tolerate the tape for 1-3 hours at first. By the third day or night, most have no problems making it through the night. Most people eventually report that they feel more rested in the morning. Socially, it is weird to tape your mouth shut. We get it. Think of it this way - it is temporary. Give yourself 3-6 months of doing this and see if your body does it on its own (don't be discouraged if it takes longer). Remember, if everyone around you knew what you know, more people would be taping their mouths closed.

Be careful of getting chapped lips from taping. To avoid this, place the tape in the back of your hand or wrist for a few minutes to decrease the stickiness of the tape – before placing the tape over your lips.

Tape Options: There are many acceptable products on the market. Here a few of our favorites.

- Nexcare Gentle Paper First Aid Tape
- Dynamic Tape, or Kinesio tape click here for a demonstration on how to cut the tape
- 3M® micropore tape
- Somnifix®
- Myotape

Note: Do not use duct tape or packing tape (in case you were wondering).

One of the great joys of living on this earth: the expansive sensation of a free, easy, boundless breath that engages the whole of ourselves and connects us with all of life.

Dennis Lewis - Free Your Breath, Free Your Life

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