Yoga practice and physiology

Workbook Anatomy Plus

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Yoga practice and physiology

A sensible and regular yoga practice can have a significantly positive effect on the human body.

People who practice yoga regularly over an extended period, often exude an individual vitality, a "glow from within." The body's voice grows clearer and easier to hear. As we begin to take note of unhealthy patterns, we often also start to dismiss them naturally. The "plasticity" of the human being is influenced mainly by genetic preconditions, usage (of the body) and nutrition (also the way the mind absorbs information). Through yoga, we not only promote the proper use of the body, but we also facilitate transportation through the human system (digestion, cell nourishment, mental processing).

Yoga also offers us the means to reduce stress, for instance, by learning to consciously relax (sympathetic/parasympathetic nervous system) or notice tension in the first place. Many ailments are stress-induced. The simple reduction of stress symptoms is already an excellent relief for many yoga students. Understanding the nervous system and how it often directs our behaviour is a crucial experience for many of us. Breathing and the nervous system are closely related. Let's take a closer look at both their physiology.

The breathing system

Higher airways

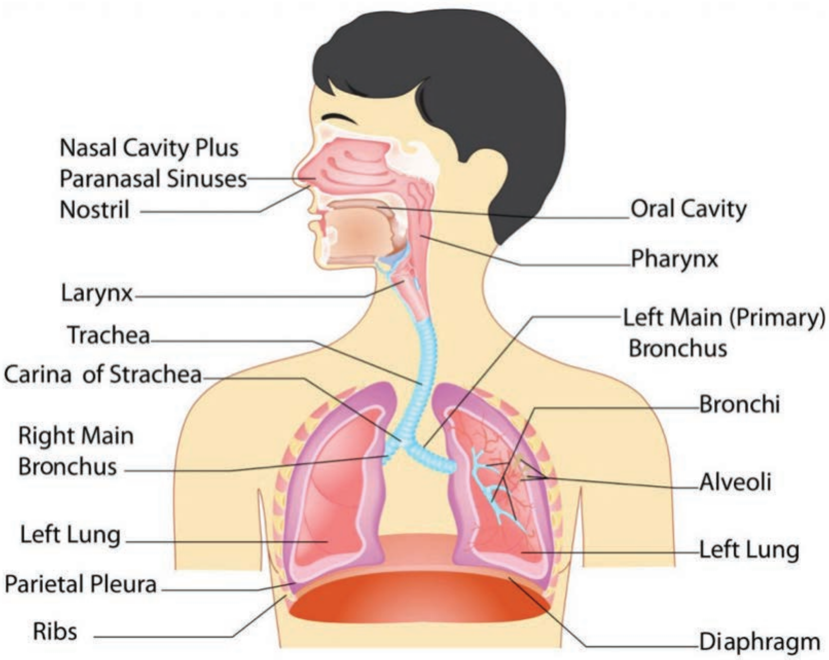
The air we inhale is moistened, filtered and controlled through the nose. The defence cells (tonsils) are located at the back of the throat (pharynx). The function of the glottis is to produce sound; it is also the closure of the breathing space (Jalandara Bandha).

Lower airways

The windpipe (trachea) is divided into a left and a right main bronchus. From here, air reaches the bronchi. Their inside walls are lined with a mucous membrane and with cilia. The latter catch the smallest particles and ejects them back out.

Lungs

The lungs are located in the chest cavity and are divided into the right and left lung. In between them lies the heart. The bottom of the lung space is separated from the abdominal region by the diaphragm.
The lungs are enveloped by a thin skin, called the visceral pleura.
A second skin lines the chest cavity and the rib cage (the costal pleura). Between the lungs and the costal pleura, there is a small gap, the pleura space.



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Breathing muscles

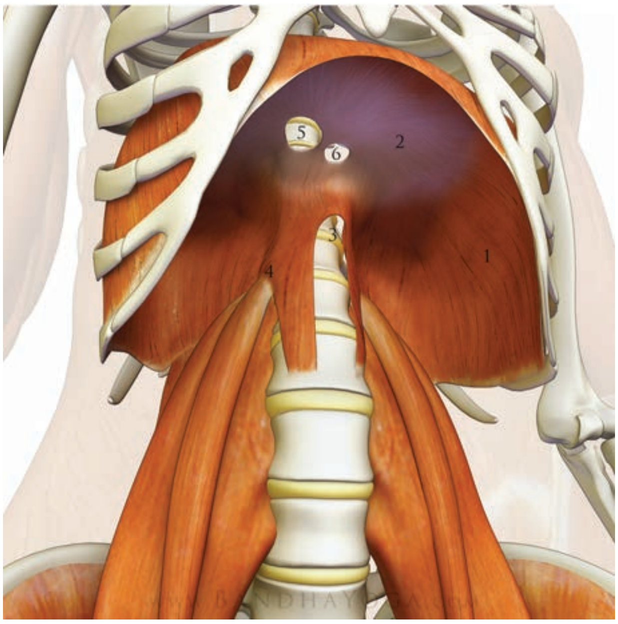
We consider those skeletal muscles as breathing muscles which are able to expand or contract the rib cage and thus cause the inhale and the exhale. The most important breathing muscle is the diaphragm. The other muscles involved vary mostly with the breathing technique (chest breathing or belly breathing). They cause a negative pressure in the pleura space and thus the lungs expand, which again causes air to stream in.

Diaphragm

The diaphragm consists of a central tendon and a dome-shaped muscle. The origin is between rib 7 and 12 in the front and between the first three lumbar vertebrae at the back.

When we inhale, the dome of the diaphragm flattens and presses down on the abdominal organs. As the pleura space is expanded, a negative pressure occurs in the chest cavity and air streams in through the airways.

When we exhale, the diaphragm relaxes and domes up again, the pressure increases in the chest cavity and air streams out. The diaphragm is also the point where the spine, the psoas and the lowest tip of the trapezius meet (they all connect into T12).



Breathing synergists

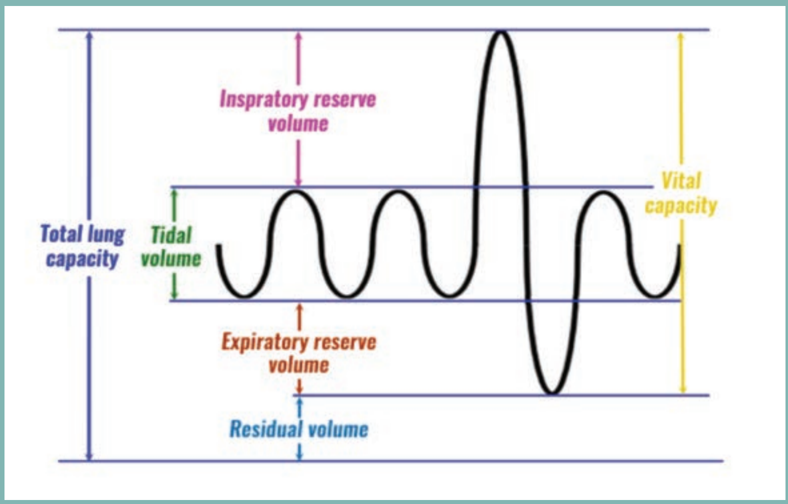
We consider those skeletal muscles as breathing synergists which support the expansion or contraction of the thoracic cavity. The essential breathing synergists for inhalation are Musculi intercostales externi (exterior intercostal muscles), Musculi scaleni (scalene muscles), Musculus serratus anterior (especially the posterior-anterior part) and Musculus sternocleidomastoideus.

The most important breathing synergists for exhalation are Musculi intercostales interni (interior intercostal muscles), Musculus serratus posterior inferior (inferior-posterior part), Musculus transversus thoracis, Abdominal muscles, Musculus latissimus dorsi "coughing muscle" and Musculus quadratus lumborum.

When breathing normally, these muscles only play a role in the inhalation. The inhalation requires an expansion of the rib cage, which is enabled by the inspiratory muscles. The exhalation, on the other hand, is usually a passive mechanism; it occurs merely by relaxing these muscles. The lung tissue consists of elastic fibres, which shrink together as they relax and press air out of the lungs. Only when we cough, actively assist the exhale or in case of lung disease, is the exhale supported by the synergists (expiratory muscles).

Breathing volume

The average breathing volume in resting condition is usually around 0.5 litre. However, the inhalation or exhalation can also hold (or release) much higher amounts of air.
The maximum airflow rate is called vital capacity. The vital capacity also depends on age, stature, fitness level and physical condition. It can very well reach approx. 6.5 litres, but it will decrease significantly with age.
We take an average of 14 to 16 breaths per minute (breathing frequency). Different receptors in the body send a signal indicating oxygen or carbon dioxide levels in the bloodstream to the brain stem. As these levels are gauged, signals are transmitted to the breathing muscles.



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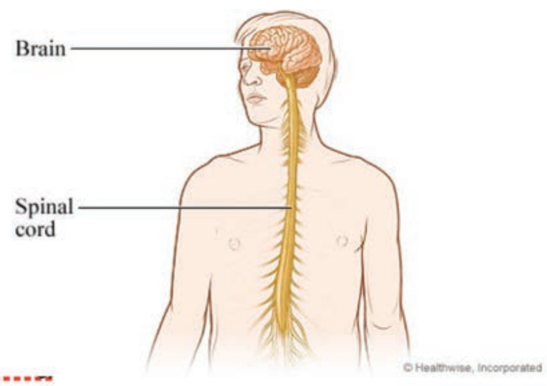
Nervous system

Yoga has a considerable effect on our nervous system, regardless of whether we practice Asana or Pranayama, of whether we lie in Savasana or sit in meditation. The nervous system is the internal and external communication system of the body and conveys all sorts of arousals (emotion) and perceptions (sensations). The eight-fold path of Patanjali leads us from the outside to the inside, from movement to stillness. No yoga class is complete without Savasana. As we move through the Asana, so we rest in Savasana. Focus and awareness, the fundamental aspects of the yoga practice, affect through and simultaneously on the nervous system.

Central nervous system (CNS)
The CNS consists of our brain and the spinal cord.

Brain

The brain consists of the brain stem and the cerebellum (they make up what we refer to as the reptilian brain/oldest part of the brain) as well as the diencephalon and the cerebrum.
The cerebrum makes up the most substantial part of the brain in human beings and is the uppermost region of the central nervous system.
The diencephalon is located deep in the brain underneath the cerebrum, and it is the link between the nervous system and the endocrine system. It includes the thalamus and hypothalamus.
The cerebellum receives information from the sensory systems, the spinal cord, and other parts of the brain and then regulates motor movements. The cerebellum coordinates voluntary actions such as posture, balance, coordination, and speech, resulting in smooth and balanced muscular activity.
The brain stem controls the flow of messages between the brain and the rest of the body, and it also controls essential body functions such as breathing, swallowing, heart rate, blood pressure, consciousness, and whether one is awake or sleepy.



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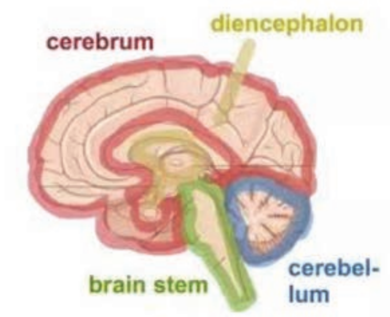

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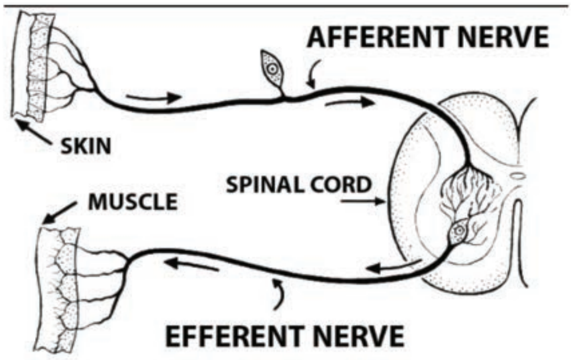
Peripheral nervous system (PNS)

The PNS consists of 12 cranial nerves and all the spinal nerves. The cranial nerves emerge directly from the brain in contrast to spinal nerves that emerge from segments of the spinal cord. Humans have twelve pairs of cranial nerves. The vagus nerve is the 10th cranial nerve and is exceptional. It is the only nerve that has sensory and motors communications with several organs. Cranial nerves typically relay information to and from the region of the head and neck.

Motor and sensory pathways

The nervous system has to enable communication in two directions: On one hand, it communicates impulses for movement from the brain to the operative organs (efferent nerve), such as "extend the arm." Motor pathways are in charge of such tasks.
On the other hand, the nervous system has to report sense-perception stimuli from the whole body back to the brain (afferent nerve), such as "the floor is warm."



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Autonomic nervous system (ANS) & Polyvagal theory
In close cooperation with the hormone system, the autonomic nervous system controls almost all the vital body functions.
It has its pathways and consists of what initially we used to explain as two parts with opposite principles of operation: the sympathetic (fight-flight-freeze) and the parasympathetic (rest & digest) nervous system. Taking the Vagus response into account, let's look at it from three principles of operation way. The ANS aims to keep us alive. So what your neuroception does is is to differentiate if a situation is safe or dangerous.

This process happens unconsciously and automatic. Whatever your system decides on; save or dangerous? Your bodily reactions will occur based on it, and that is how we end up experiencing the world. It will affect how we breathe, act, hear, talk smell. Based on the traffic light model: green-orange-red. A healthy system quickly moves back and forward between green and orange.

Green = safe 😀	Orange= danger 😐	Red= life threatening 😲
Heart rate slows down	Heart rate speeds up	Immobilisation
Digestions ⬆️	Pain tolerance ⬆️	Death feigning
Facial muscles ⬆️	Flat facial affect	Shut down
Vocals & eye contact ⬆️	Ear; different frequencies can be heard	(This is what happens in traumatic events and is involuntary similar to a reptile freeze respones).

About the vagus nerve

The word "vagus" means "wanderer" in Latin, which accurately represents how the nerve wanders all over the body and reaches various organs. But what you need to pay special attention to is the "tone" of your vagus nerve. Vagal tone is an internal biological process that represents the activity of the vagus nerve. Increasing your vagal tone activates the parasympathetic nervous system, and having a higher vagal tone means that your body can relax faster after stress. In 2010, researchers discovered a positive feedback loop between high vagal tone, positive emotions, and good physical health. In other words, the more you increase your vagal tone, the more your physical and mental health will improve, and vice versa.

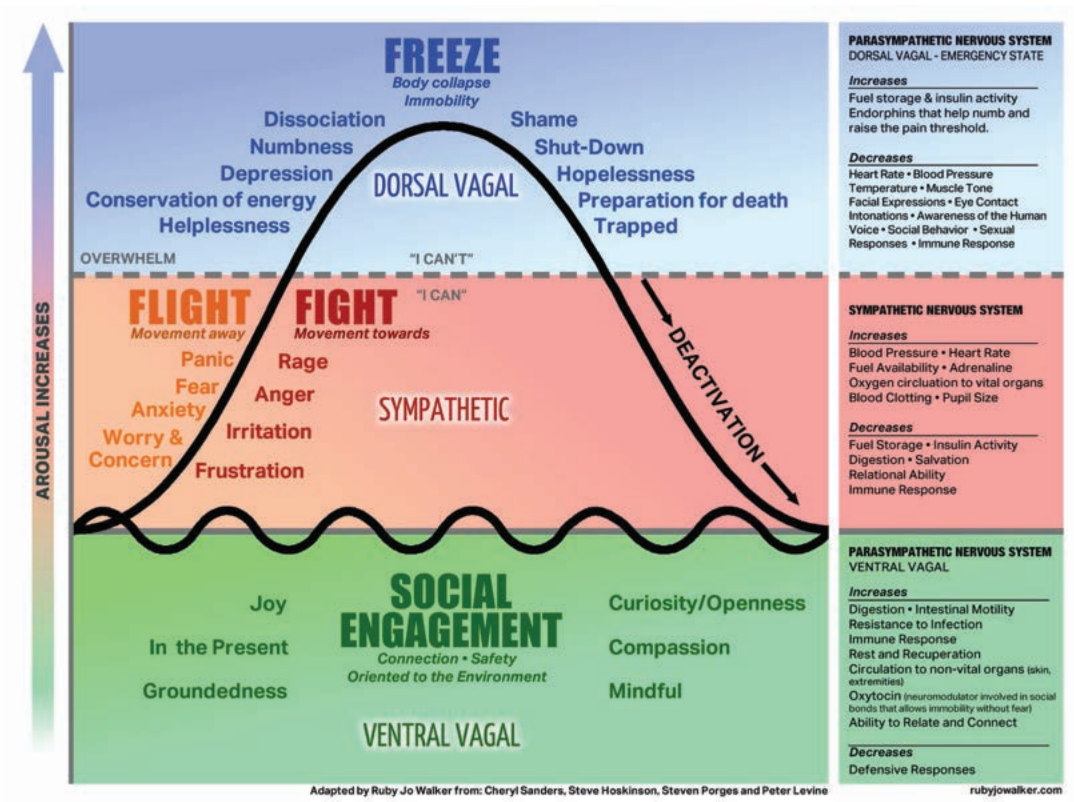
What's interesting is that studies have even shown that vagal tone is passed on from mother to child. Mothers who are depressed, anxious and angry during their pregnancy have lower vagal activity. And once they give birth to their child, the newborn also has low vagal activity and low dopamine and serotonin levels.

Your vagal tone can be measured by tracking specific biological processes such as your heart rate, your breathing rate, and your heart rate variability (HRV). If your HRV is high, your vagal tone is also high.

Polyvagal theory

The Polyvagal theory (gr. 'polus', "'many'" + 'vagal', "'vagus nerve'") is a theory that backs up the idea that the Vagus nerve is interconnected to influences that flow from the body toward the brain.
As the vagus tone can be high or low, each activates a different circuit.

The polyvagal perspective demonstrates the importance of the autonomic nervous system relating to therapy. Helping clients re-pattern their nervous systems, build capacities for regulation, and create autonomic pathways of safety and connection.



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"By developing an understanding of the workings of your vagus nerve, you may find it possible to work with your nervous system rather than feel trapped when it works against you."
— Dr. Arielle Schwartz, Clinical Psychologist

How can we affect the vagal tone ?

Perhaps you are already familiar that deep breathing and prolonged exhale, as we practice it in Yogic breathing techniques and singing or chanting results in an increase of the vagal tone. Let's specify a few more known ways to stimulate the vagus nerve:

Deep, slow breathing as well as prolonging your exhalation: Has been shown to reduce anxiety and increase the parasympathetic system by activating the vagus nerve. Most people take about 10 to 14 breaths each minute. Taking approximately six breaths over a minute is a great way to relieve stress. You should breathe in deeply from your diaphragm. When you do this, your stomach should expand outward. Your exhale should be long and slow. This is key to stimulating the vagus nerve and reaching a state of relaxation.
Singing, Humming, Chanting: The vagus nerve is connected to your vocal cords and the muscles at the back of your throat. Singing, humming, chanting and gargling can activate these muscles and stimulate your vagus nerve. And this has been shown to increase heart-rate variability and vagal tone.

Omega-3-fatty-acids: Omega-3 fatty acids are essential fats that your body cannot produce itself. They are found primarily in fish and are necessary for the normal electrical functioning of your brain and nervous system. They've been shown to help people overcome addiction, repair a "leaky brain", and even reverse cognitive decline.

Socialising & Laughing: socialising and laughing can reduce your body's main stress hormone. And now I've now that they are likely doing this by stimulating the vagus nerve. Researchers have discovered that reflecting on positive social connections improves vagal tone and increases positive emotions. Laughter has been shown to increase heart-rate variability and enhance mood. And vagus nerve stimulation often leads to laughter as a side effect, suggesting that they are connected and influence one another.

Feeling safe is crucial and optimises the entire human experience. We mirror the nervous system state in one another. Feeling safe is a necessary prerequisite for healthy social relationships. We are a social species. Connectedness is vital to activate the “green system”. Never feeling safe is unfortunate, especially for young children whose nervous systems are still developing. As Yoga Teachers, we must create a safe classroom feeling and welcome students into the community. Using environmental and social cues to make their “neuroception” sense safety helps.

Trauma is physiological, not psychological. This is an important act to remember when working with humans. The Polyvagal theory brings in a whole new perspective on psychiatric issues and how they are related to the ANS.

Resources:
Stephen W. Porges: The Polyvagal Theory. The transformative Power of feeling safe.
Youtube Talk: The Polyvagal Theory: The new science of trauma & safety
Paper: https://sass.uottawa.ca/sites/sass.uottawa.ca/files/how_to_stimulate_your_vagus_nerve_for_better_mental_health_1.pdf