

MODULE 4: THE SCIENCE OF BREATHING

LESSON 2: THE BIOMECHANICS OF BREATHING (PART 2)

When we work with the breath, it is important to be aware of the dynamics that occur in the two cavities that make up the torso:

1. The thoracic or chest cavity which contain the vital organs of the heart and the lungs
2. The abdominal cavity that contains the digestive organs – stomach, liver, gallbladder, spleen, pancreas, small and large intestines, kidney, bladder, and the reproductive organs.

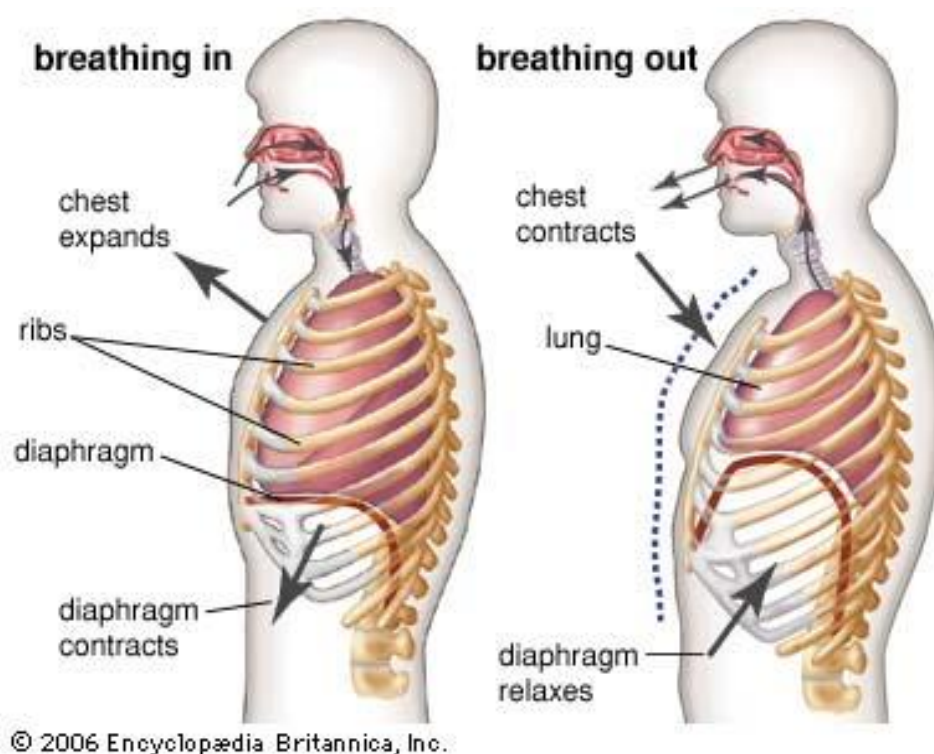
The spine creates the support for both cavities at the back and the diaphragm is the sheet of muscle and fascia that separates these cavities - it forms the floor of the thoracic cavity and the roof of the abdominal cavity. When we breathe, both cavities change shape, and it's important to understand the different ways that they do.

When we breathe in, the lungs inflate like a flexible gas-filled container, and the entire chest cavity changes its shape and volume. As this happens the diaphragm flattens, and the abdomen changes shape like a water balloon, so in the context of breathing, the abdominal cavity changes shape but not volume. However, when we eat or drink something, the volume within the abdominal cavity does increase as the stomach, bowel and bladder fills up and this increase in volume will produce a corresponding decrease in the volume of the chest cavity. That's why it's harder to breathe after a big meal, before a big bowel movement or when pregnant.

In a living, breathing body, thoracic/chest shape change cannot happen without abdominal shape change. That is why the condition of the abdominal region has such an influence on the quality of your breathing and why the quality of your breathing has a powerful effect on the health of your abdominal organs.

The diaphragm

The diaphragm is the primary muscle of breathing and to master your breathing practice, it's helpful to examine this interesting muscle in detail. This dome-shaped muscle separates the chest and abdominal cavities, with the top of the dome reaching the space between the 3rd and 4th ribs and the lowest fibres attach to the front of the third lumbar vertebrae - so basically it extends from nipple to navel.

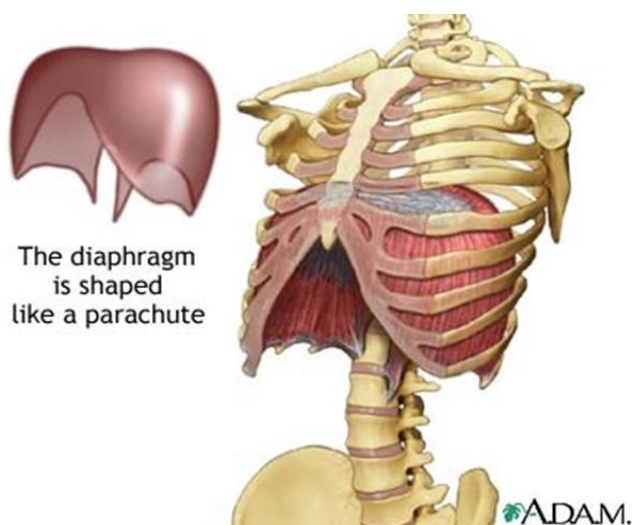


The diaphragm's shape is created by the organs it encloses and supports i.e. the liver pushes the right dome up and the heart pushes the left side down – and this gives it an asymmetrical shape.

Several different structures go through the diaphragm but 3 main openings in the sheet of muscle make space for the aorta, oesophagus and vena cava to pass through.

The lower edge of the diaphragm attaches in 3 places

- The bottom part of the sternum (breastbone)
- The base of the ribcage
- The front of the lower spine.



All the muscular fibres rise upwards from these 3 origins and arrive at the flattened horizontal top of the muscle, the central tendon into which they insert - so basically, the diaphragm inserts into itself - its own central tendon, which is fibrous non-contractile tissue.

The central tendon of the diaphragm is the point of anchorage for the connective tissue that surrounds the organs of the chest and abdomen. These structures can be remembered as the 3 P's

- Pleura - surrounds the lungs
- Pericardium – surrounds the heart
- Peritoneum – surrounds the abdominal organs

It now starts becoming clear that the optimum movement of the diaphragm has a profound effect on the movements of the organs that these cavities contain. With each breath cycle, the movement of the diaphragm massages and tones all the abdominal organs and squeezes the heart, optimising its function. It also squeezes the abdominal lymphatic nodes and vessels that sit under the diaphragm. The lymphatic vessels do not contain valves to direct the lymphatic fluid and depend on the movement of the diaphragm to help channel the fluid.

Because the diaphragm has two parts - the muscular part on the periphery and the central tendon in the centre, the movement happens in 2 phases. If you take in a deep breath, you will find that either the belly bulges out before the chest expands or the chest expands first and then the belly rises afterwards. If the belly bulges out first, this means that the base of the ribcage is stable, and the central tendon is mobile and pushes the contents of the abdomen down. If the central tendon is stabilised and the ribs are free to move, this is a chest breath. If you breathe fully, slowly and deeply both these areas move, but it will happen in two phases.

Try it for yourself - lie flat on your back and place one hand on your belly and the other on your chest. Take a deep breath and see which moves first - your chest or abdomen and then try to reverse it.

The diaphragm's function goes beyond the action of breathing as separating the chest from the abdomen. It also acts as a 'halfway house' of the emotions. In bioenergetics, most emotions find their way to the diaphragm for distribution.

The emotions arrive at the diaphragm from 4 different sources:

- A current event - such as an argument or bad news.
- A stored emotion that has been activated by something that we have seen or heard.
- An emotion that has been absorbed by an external source
- Contrived emotions that are created by our minds through conditioned thinking.

From the diaphragm, the emotions can go in 4 directions:

- Up to the chest and head where they are experienced immediately as expressed emotions, for example - our pet dies and we have the immediate expression of grief.
- They can go down to the intestines to be eliminated from the body. This is the healthiest way to go with any emotion other than the acute emotions which are often better expressed outwardly.

- They can be held in the diaphragm for a while but not let go either up or down. At this stage, the liver decides to take the emotion and store it in the connective tissue for release later. This now becomes an active stored emotion and one of the main triggers in disease.
- Rarely, emotions do not move from the diaphragm especially in a person who finds it difficult to let go. These emotions end up in the connective tissue of the diaphragm muscle and compromise the function of the diaphragm.

It is becoming more evident how important the movement the diaphragm is on so many levels!

Accessory muscles of respiration

Although the diaphragm is the principle muscle of breathing, there are other muscles that are engaged in changing the shape of the chest and abdominal cavity. These are called the accessory muscles of respiration and once all the musculature of the body is coordinated and integrated with the action of the diaphragm, breathing will be effective and efficient.

The intercostal muscles

As the name suggests, these are the muscles that lie between the ribs. The external intercostals – there are eleven pairs between each rib and when they contract, they pull the ribs towards one another and elevate the ribcage. The internal intercostals lie deeper than the externals and lie at a right angle to them. When they contract, they draw the ribs together and depress the ribcage.

Abdominal and thoracic accessory muscles

The abdominal cavity and its musculature can be imagined as a water balloon surrounded by elastic fibres running in all directions. The shortening and lengthening of these fibres in coordination with the contractions of the diaphragm produce the many shape changes that can occur with respiration.

Other Accessory muscles

Chest, neck and back muscles can also expand the rib cage, but they are far more inefficient than the diaphragm and external intercostal muscles at doing this.

Considering the degree of muscular tension that occurs in using the accessory muscles in breathing, the net payoff in oxygenation makes it a poor energetic investment. In other words, it is a low effort to energy ratio. That is why improved breathing results in decreased tension in the accessory mechanism, which allows the diaphragm, with its shape-changing ability, to operate as efficiently as possible.

Diaphragmatic breathing

Diaphragmatic breathing is taught in most yoga schools. And most martial artists learn belly breathing if they want to derive the most... or if they want to reach any level of skill... diaphragmatic breathing is very important.

It is also important to any athlete, or in any athletic endeavour; for singers and performers it is very important. Any activity that requires balance, groundedness, calmness or a sort of serene power... [those are times when you need to breathe]. Belly breathing is a good place to start. And to reach any level of mastery in any of those areas, you pretty much have to get belly breathing down. So, belly breathing is quite simple. You can watch a baby and see how active their belly is when they breathe.

It seems as we grow, and as we get older, we get more and more 'uptight'. This is reflected in the level of the breathing: that is, the centre of the breathing seems to move higher up into the chest.

But you can also notice it in very subtle ways in just about everyone. You can notice that in people by the activity in their shoulders and their neck as they breathe. Good belly breathing requires absolutely no involvement of the muscles up around the chest and the shoulders, neck, or the upper back. Those muscles are simply not required for breathing.

When there's a great demand for breath, and you can see this in runners and athletes especially recovering after they have run a distance, or you see it in emphysema patients, and people with COPD, and asthma, and so on: struggling to breathe. You can see that the accessory muscles are involved in the breathing. These accessory muscles, which include muscles around the shoulders and the upper back and the chest, come into play in breathing when extra demand is put on the breathing. But they are not normally used for breathing. In emergency cases they will come into play to support. Using those muscles requires quite a bit of skill and coordination, and without the foundation of good diaphragmatic breathing it is very likely that the breath, the breathing mechanism, will get quite uncoordinated. What happens is one muscle begins to fight against the other and the breathing gets all jammed up. Another thing that happens is that the natural sense of the flow of breath is lost. And when we deliberately begin to force ourselves to breathe or to breathe deeper or quicker, we artificially begin to manipulate the breathing mechanism, and we cause it to get even further out of balance.

For a good understanding of this 'coordinated breathing' you can consider the work of Carl Stough, who has a method called SIMBIC: the Stough Method of Breathing Coordination. He has done over 30 years of work on the mechanics of breathing.

You must 'get' diaphragmatic breathing if you are going to get anywhere in breath therapy. It is a real foundation skill.

Exercise:

You can begin this practice by laying down flat on your back and putting your hands right over your belly button. And as you breathe in... with the inhale... you should feel movement under your hands... As you pull the breath in, your belly should rise.

What is happening is, as you breathe in, the diaphragm moves down, popping the belly out. The diaphragm separates... it's the ceiling of the abdomen and the floor of the chest. As you breathe in, the diaphragm flattens and moves downward, displacing the organs in the abdomen and causing the abdomen, the belly, to pop out. So, as you breathe in, the belly pops out. As you breathe out, the belly flattens.

Take in a breath. Your hands are on the belly. And it is as if you are breathing into your hands and moving your hands with the inhale. Don't use your belly muscles. Send the breath low into your belly. And feel your belly expanding. As you exhale, your belly flattens. It is as if your lungs are in your belly. And as you breathe in, your belly expands. And as you breathe out, your belly empties or flattens.

A good image is given in Nancy Zi's book, *The Art of Breathing*. She talks about a bellows, that old piece of equipment used to fan the fire. It's got two handles on it, a little spout at the end and you pump it [like an accordion], and you fan the flames in a fire. Well, you can imagine that the bellows... the handles of the bellows... are down, one is at your belly button and the other is at your spine.

As you exhale, the bellybutton moves toward the spine. As you inhale, the bellybutton moves away from the spine and your belly pops out. So, practice that. Breathing in, the belly pops out. Breathing out, the navel, the belly button moves towards the spine, the belly flattens. And, if you exhale completely, as you blow the breath out, as you exhale, the belly button gets closer and closer to the spine. The belly flattens more and more until you are completely empty. Then when you inhale your belly begins to pop out.

It is very much like you fill a glass. If you fill a glass with water, it fills from the bottom up. The same thing with breathing, the first bit of breath that enters you should go very deep, all the way down ...low, into the belly. So, you begin to fill the lungs from the bottom up.

As you breathe in the diaphragm moves down and the belly pops up. As you breathe out, the belly flattens, the diaphragm moves up. This is the natural cycle of diaphragmatic breathing. Very important to learn, very important to practice and it should become a natural, automatic reflex. It should be the normal way that the breath flows. If you don't have this habit, begin to practice so it becomes natural and becomes a habit. It doesn't require effort. It requires awareness and practice.

It is also useful to lie on your back and put a heavy book on your stomach, and as you breathe in, you lift the book with the inhale. As you breathe out the belly seems to empty, and the book gets lower and flattens your belly.

You can also play with the small of your back and your sides around your waist. You can put your hands on your waist, for example, sort of standing arms akimbo, one hand on each side of your waist. And as you breathe in you feel the expansion happening around your waist, as if your belly is filling with air. This expansion should take place front to back, side to side, and you feel the expansion in all directions. Make the belly a very lively place as you inhale and exhale.

So, the idea here is to relax and soften the belly. Allow the breath to move into the belly, and enliven and awaken that place, so the belly responds easily, effortlessly, as the breath comes in. There is no interference, there is no rigidity in the belly, and there is no holding of the abdomen to prevent those lower spaces in the lungs from filling.

So, now we have diaphragmatic breathing, very simple, very basic fundamental breathing exercises, upon which all the other breathing exercises are built, without which you won't have balance, you won't have coordination, and you will make very little progress in the end.