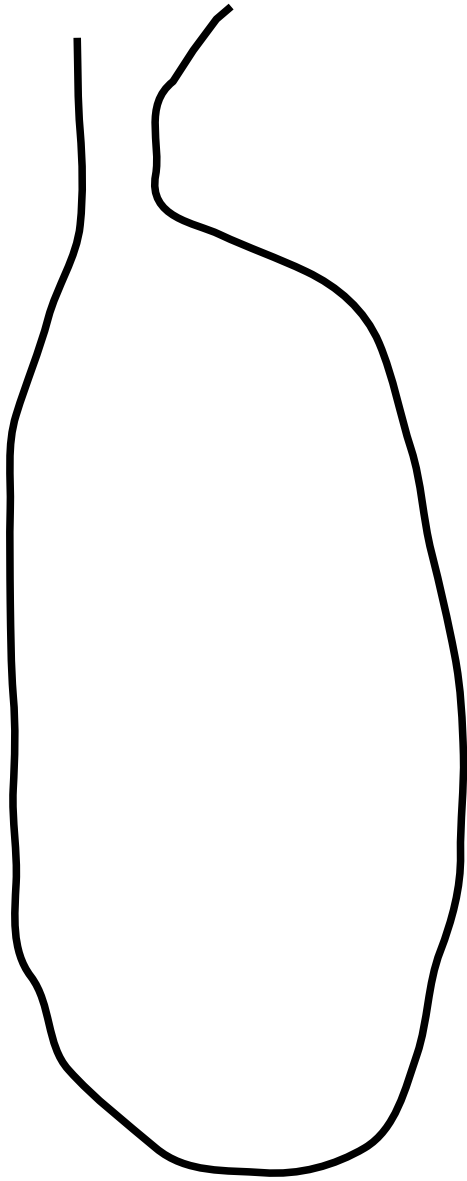


What every swordsman should know about breathing

A badly illustrated guide

by Jaana Wessman
A dabbler in the Arts of Life and Death



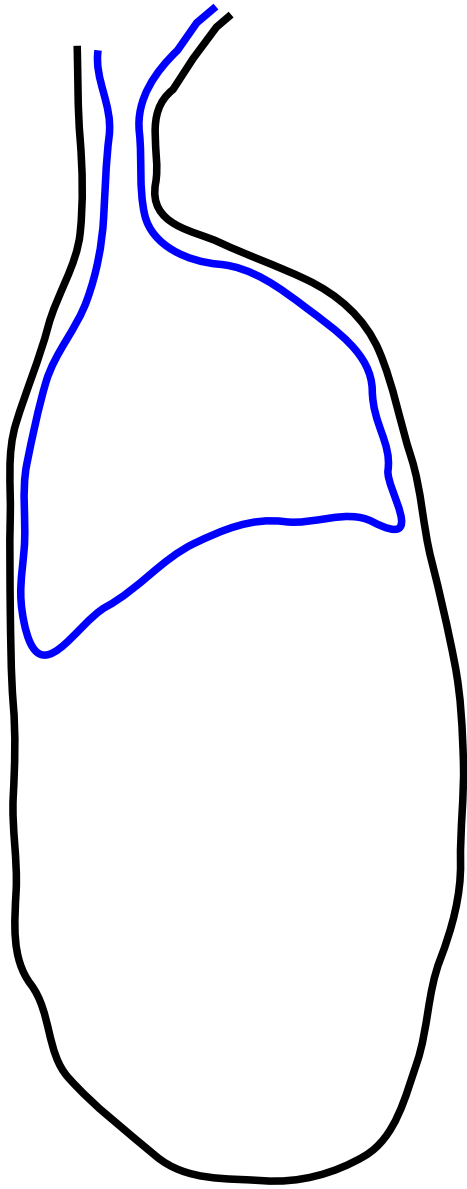
For the purposes of this presentation, your body is a sack with one opening on top.



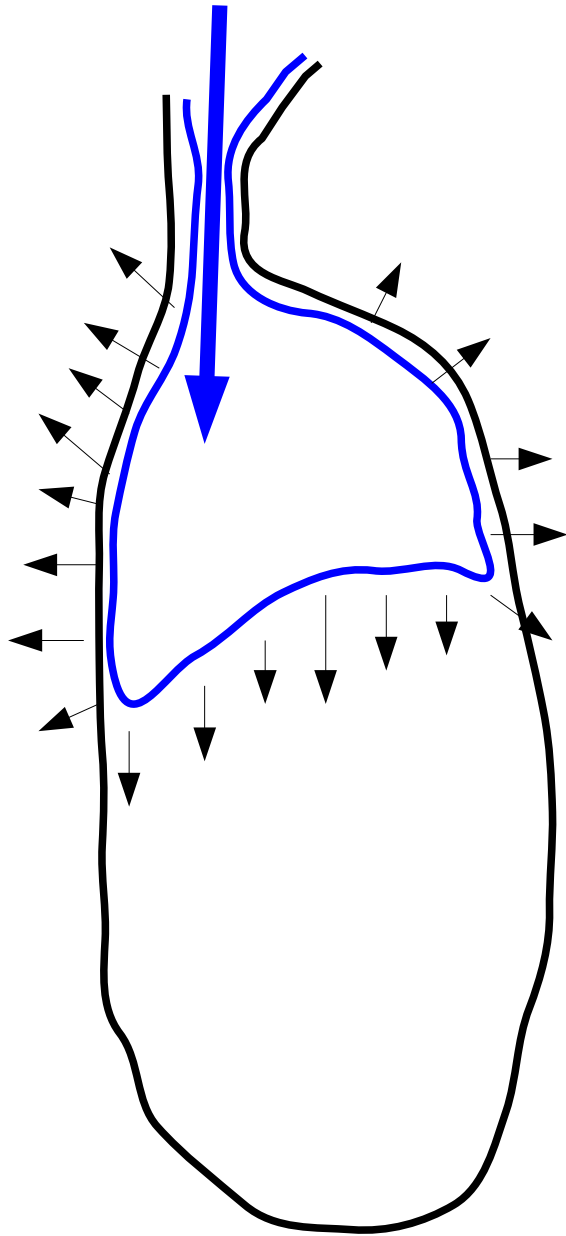
In reality, there's all sorts of flailing bits and holes.



We will ignore all that.



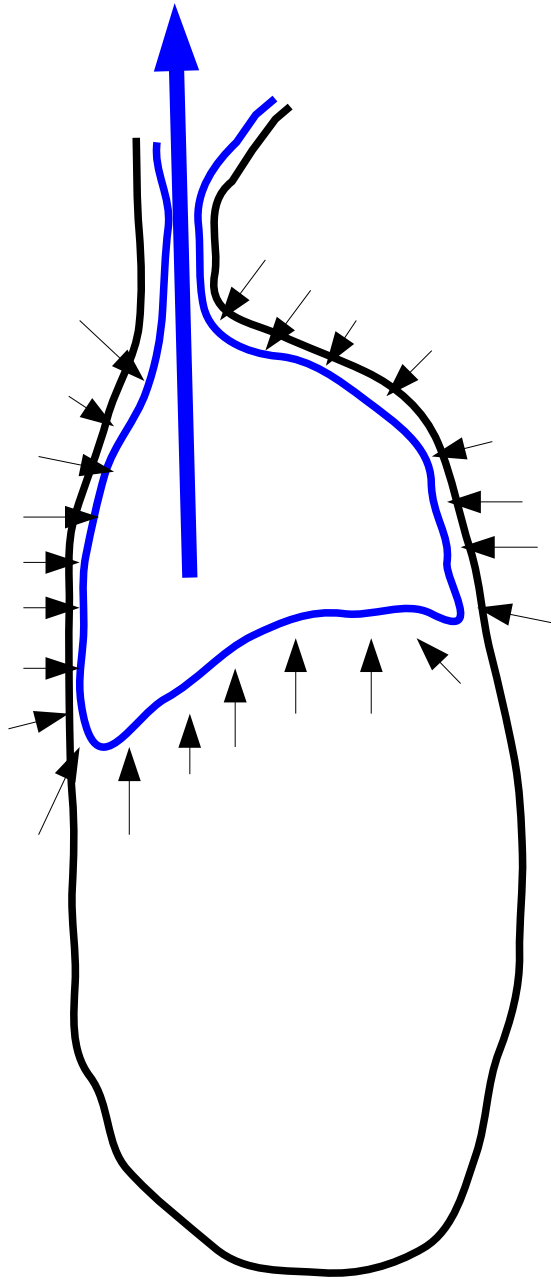
The top half of the sack
consists of
your **LUNGS**:
an air-filled bag that
opens to the top.



When the lungs expand,
AIR flows in.

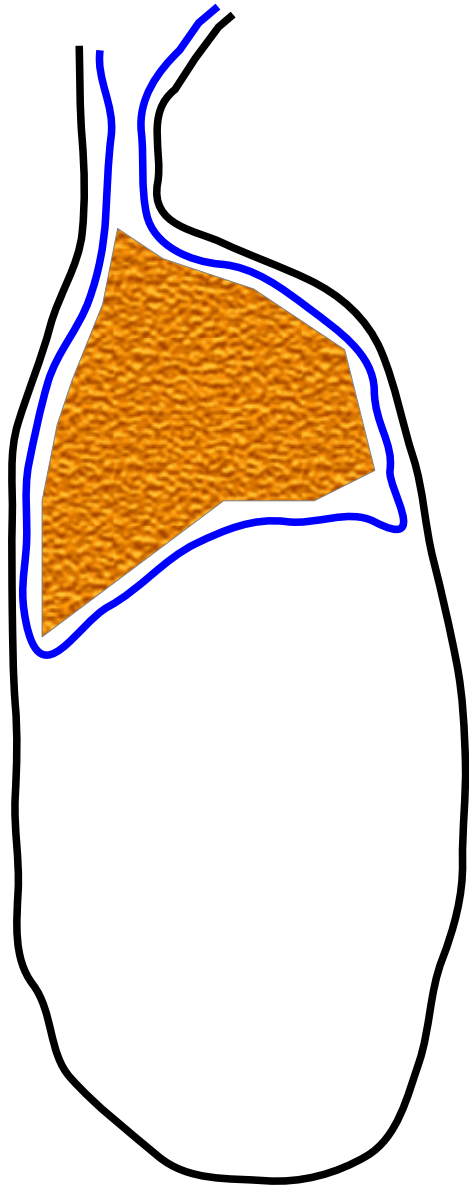
This is because when the lungs expand while there is the same amount of air in them, the air in them gets thinner, and air from the outside now has a higher pressure than air in the inside, and the pressure equalizes by air flowing from the higher pressure environment to the lower pressure one.

You don't have to know that, but I thought you might want to.

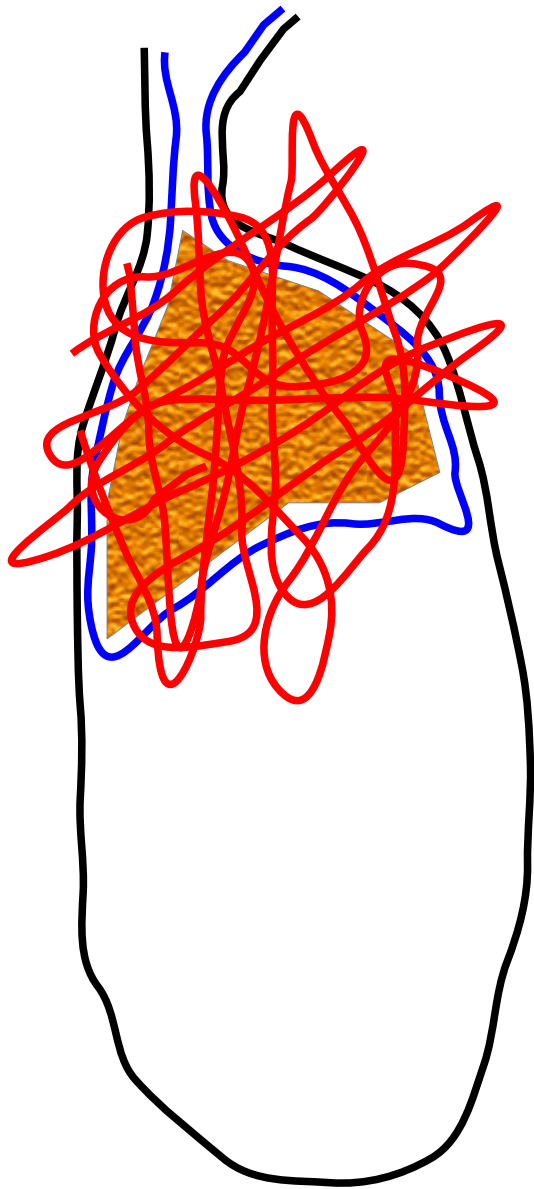


When the lungs compress,
air flows out.

Same thing as previously: Compressing the lungs causes there to be the same amount air in less space, or increasing pressure, making it higher than that of outside (the pressures inside and out were just equalized on the previous inbreath). Air flows from higher to lower pressure again.



Fancy gas exchange
stuff happens here.

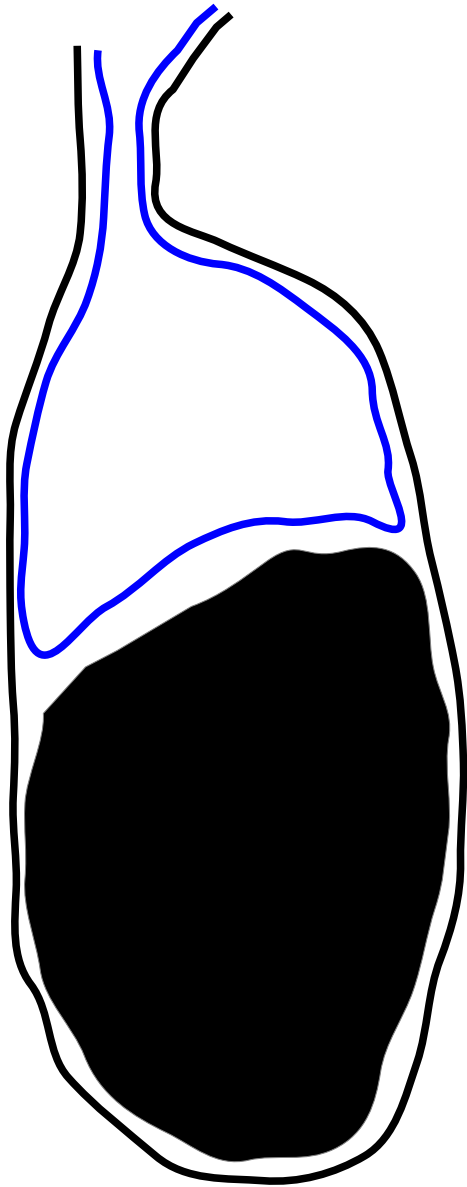


But we can totally ignore it too.

Just remember:
When you work harder,
you need more air flow.

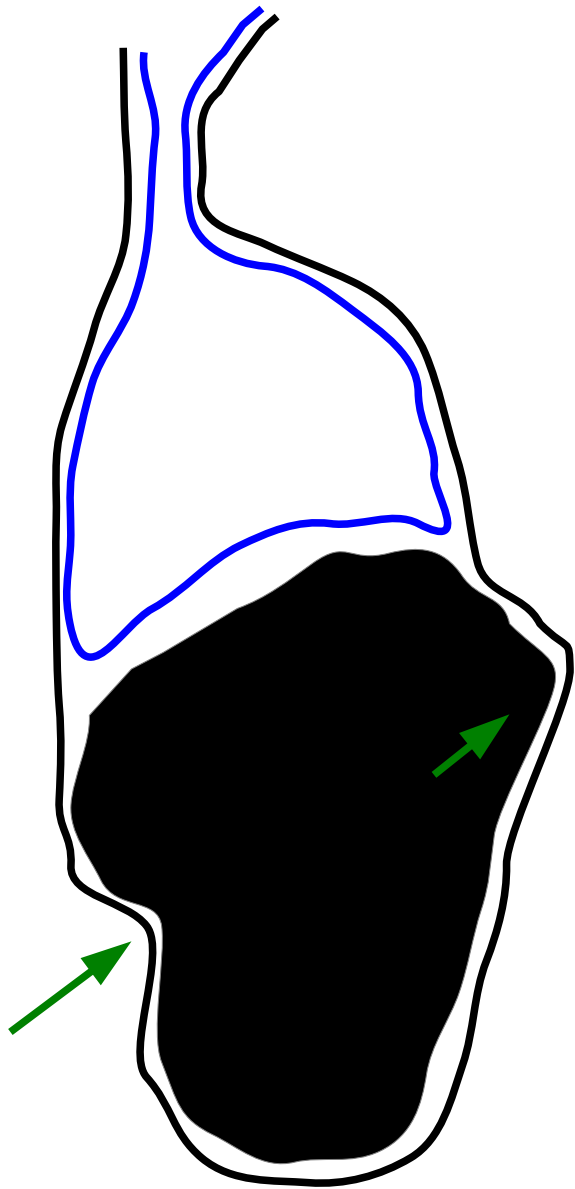
You can achieve more air flow
by two ways: by breathing
faster, and by making each
breath *bigger*.

This presentation explains how you do the latter. To breath faster you just do the same, but faster.



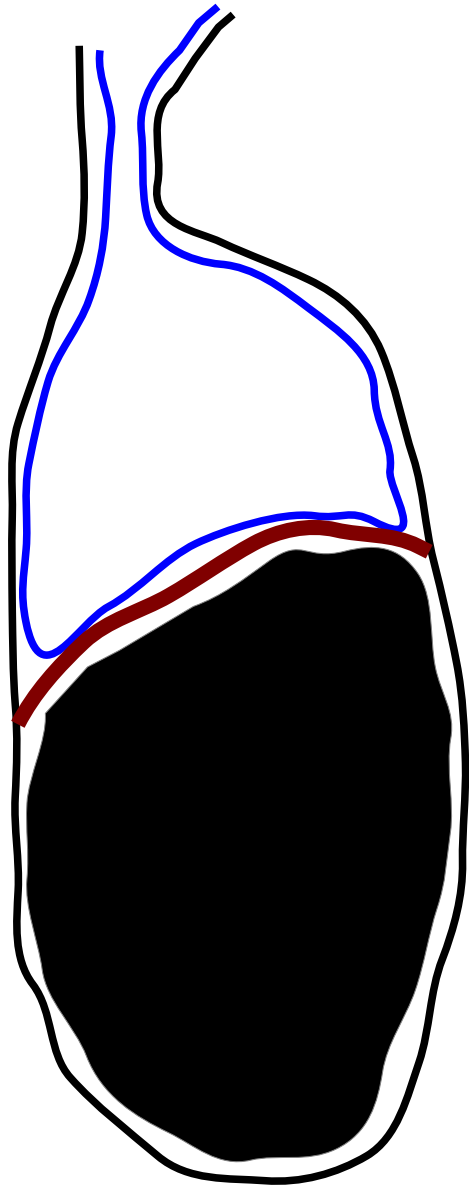
The bottom half of your body
consists of a noncompressible
bag of **GUTS**.

(and entrails and gore and blood and other things
you'd rather not think about)

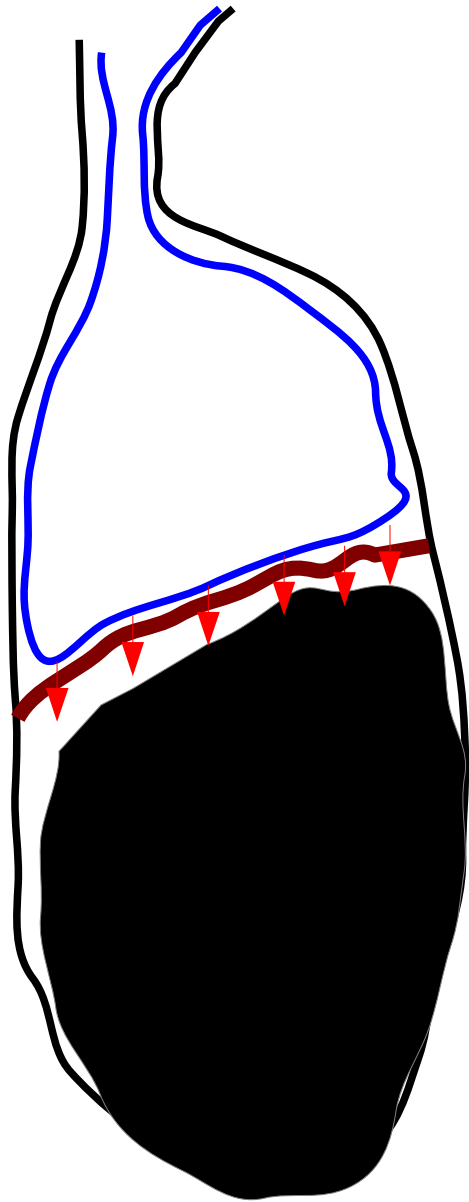


“Non-compressible” means:
When you push it from one side,
it must expand to another,
because it always takes up
the same volume.

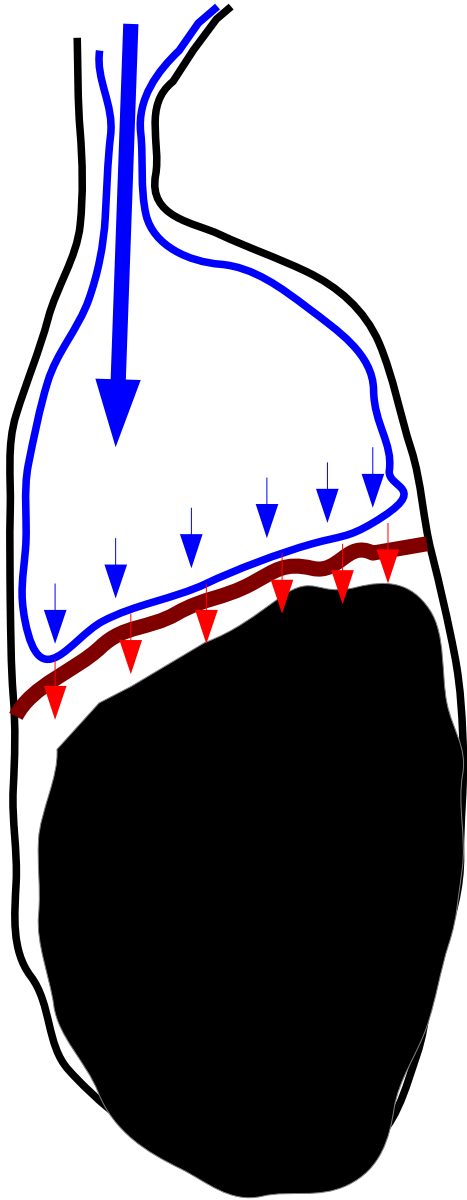
(I promise, this is the most complicated technical bit in this whole presentation. Think of a balloon filled with water: if you press it with your hands, it bulges until it bursts, but it does not become smaller.)



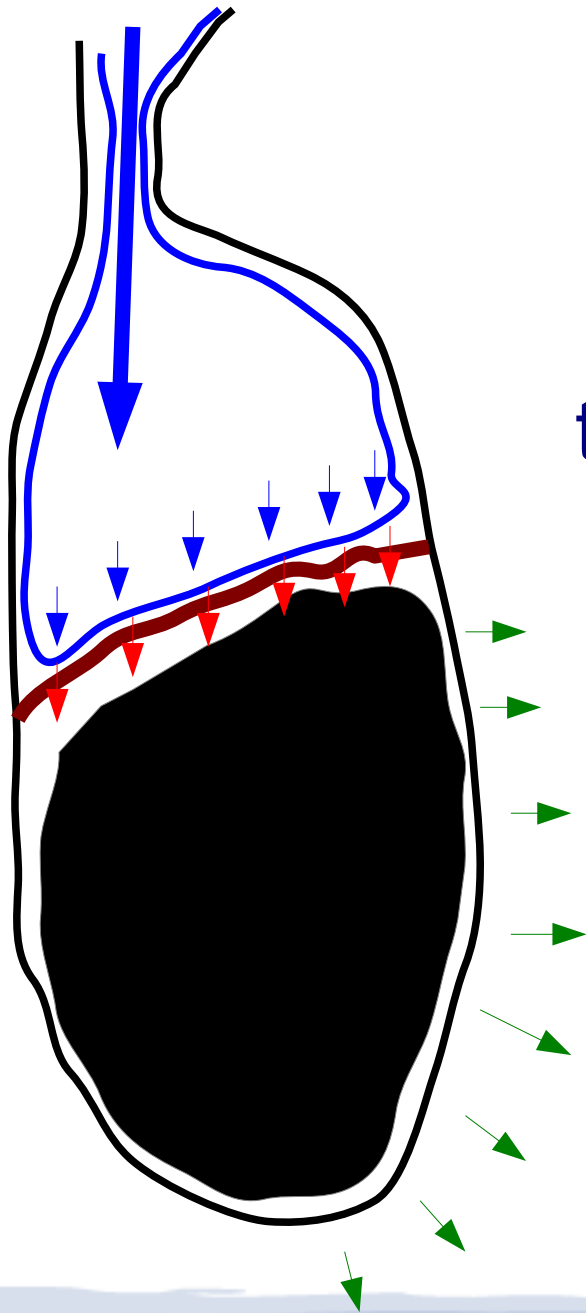
Between your lungs and your guts, there is a dome-shaped sheet of muscle called the **DIAPHRAGM**, which divides your body vertically into two compartments.



When the diaphragm contracts,
it tightens up and flattens,
moving downwards because it is
attached from the sides, pulling
the lungs down and pushing the
guts out of the way.

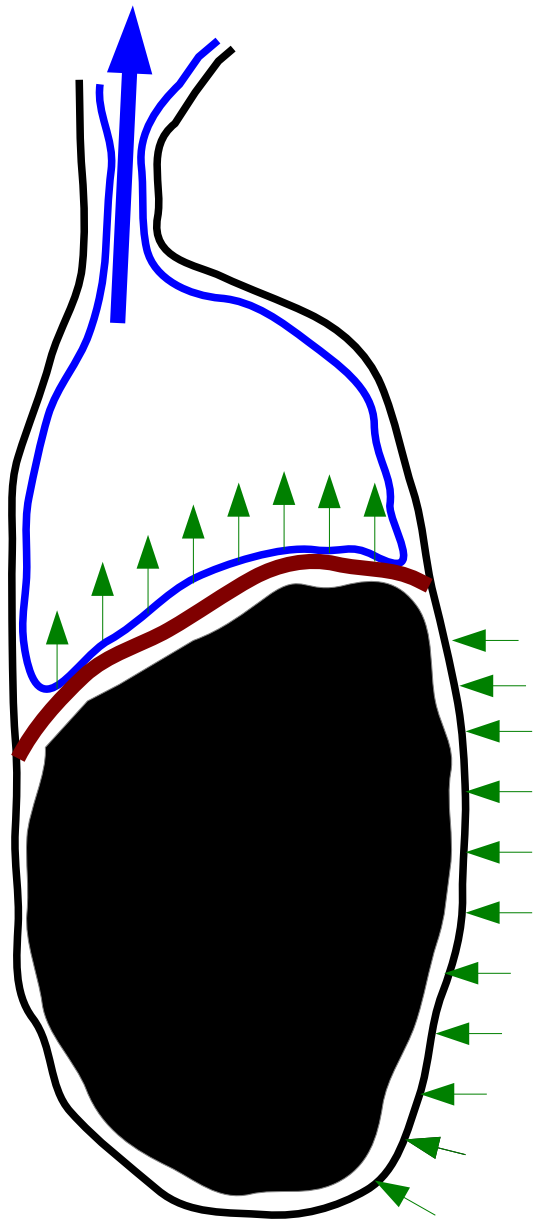


As the lungs are fixed to your ribcage from the top and sides, when pulled down from the bottom, they have to expand, and air flows in.



As the guts are pushed down,
the muscles lining your belly and
sides must relax and stretch to
make way for them.

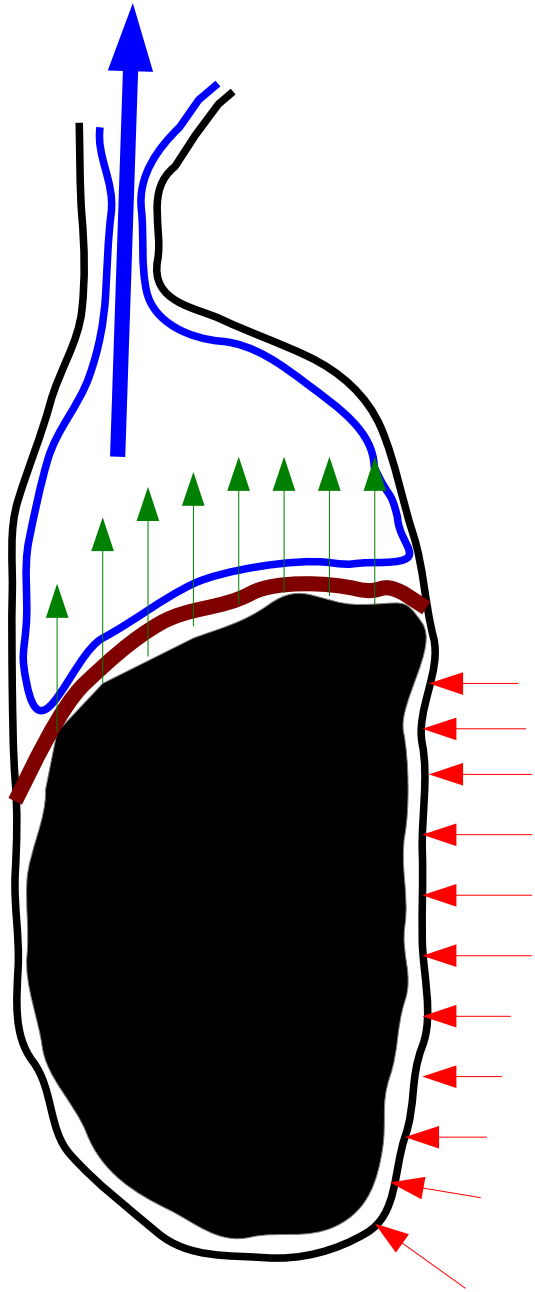
(Remember: The guts cannot be made smaller.)



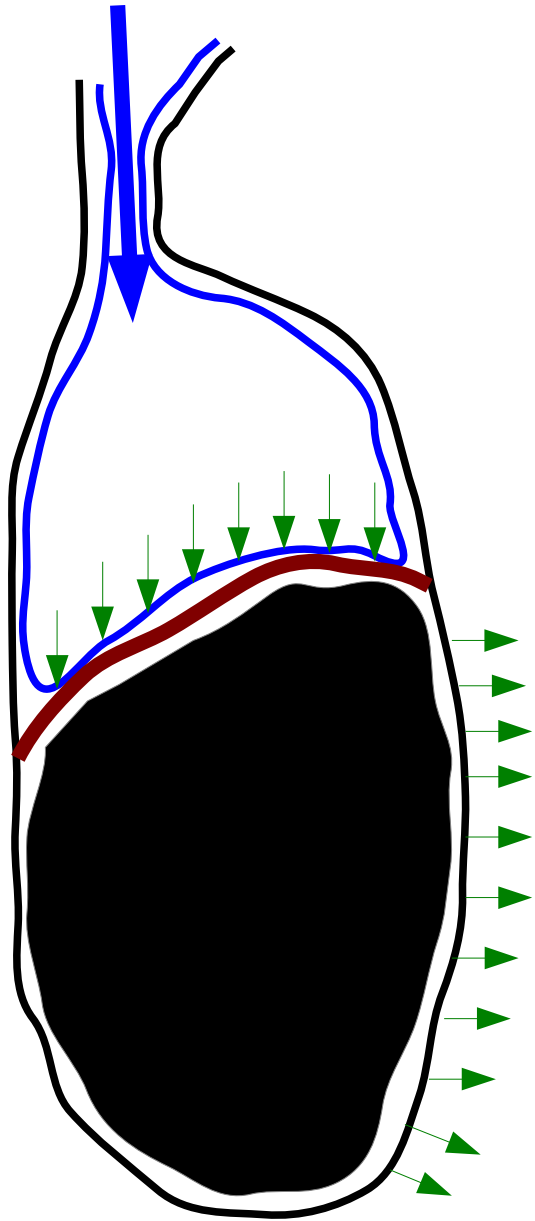
When the diaphragm relaxes, it is pushed back up by the guts returning to their normal position. Air flows out.

(Note: This part of breathing out is all passive. No work involved – gravity and the abs returning from the stretch do it all for you.)

Just sit back and relax.)

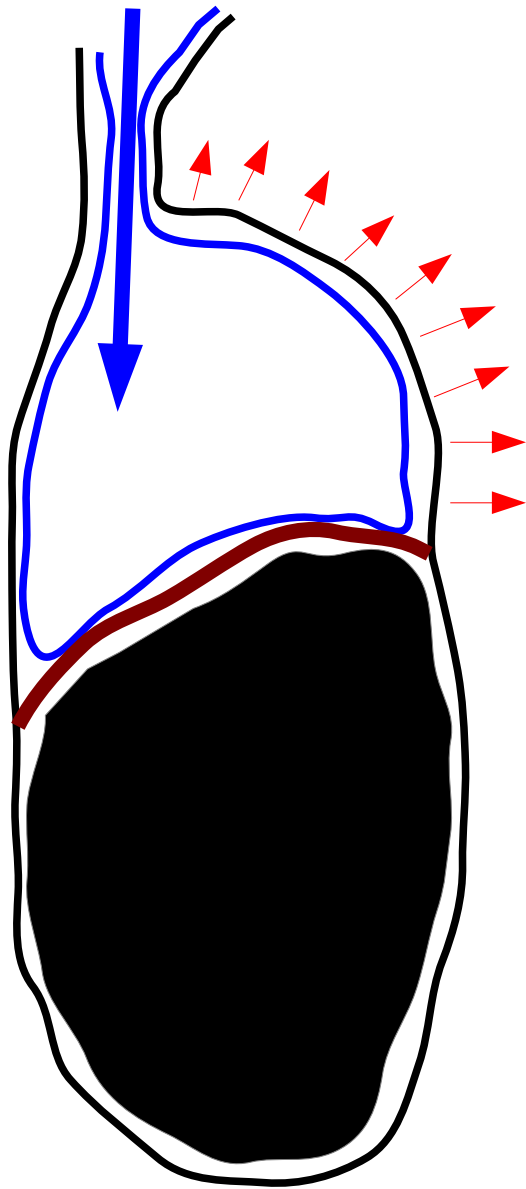


If you tighten your **ABDOMINAL MUSCLES**, you can push the guts even further in. The diaphragm is pushed up by the noncompressible guts, the lungs have even less room, and even more air flows out.



And when you relax your abdominals again, the guts return to their normal position, diaphragm returns to its middle position, lungs expand, air flows in... And you are ready to begin all over again.

(Confused? Don't worry, we'll go through it all once more real soon now...
Just one more thing.)

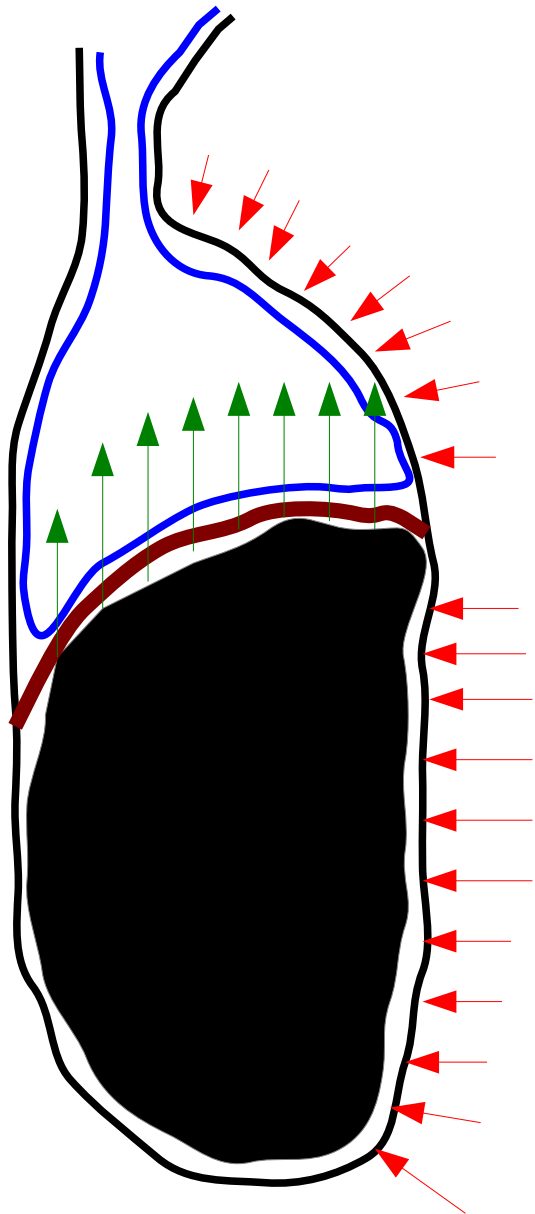


In addition to the diaphragm and the abdominal muscles, you have a third muscle system for breathing. You can use the muscles of your **RIBCAGE** to pull the ribs up and out, expanding the lungs.

(Air flows in.)

(Actually there is a fourth system for real emergencies too. But we'll ignore it. You should not be using it anyhow, and if you ever have to, you cannot stop yourself.)

Now let's put this whole thing together.



To try this out yourself, lie down on your back, or sit in a relaxed position.

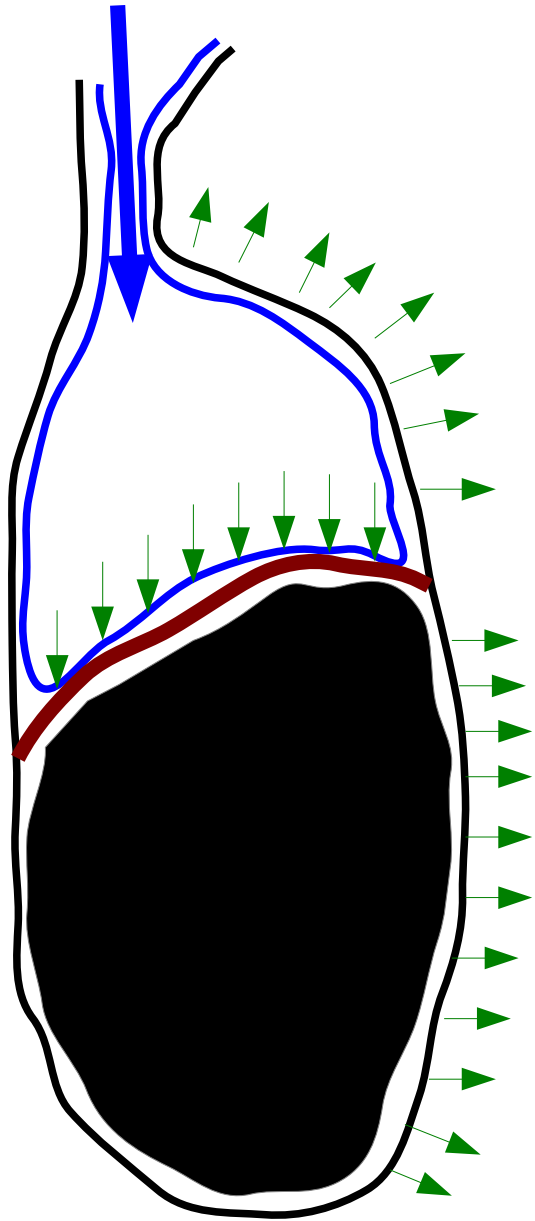
Breath out as far as you can, trying to empty your lungs completely.

(You cannot. But it will feel like you did.)

Note how this tightens your abdominals and contracts your ribcage.

Ready to go now!

(Confused by the arrows? Nevermind, they'll become clear later.)



Now relax your muscles, all of them

(as much as you can without falling out of your chair anyway).

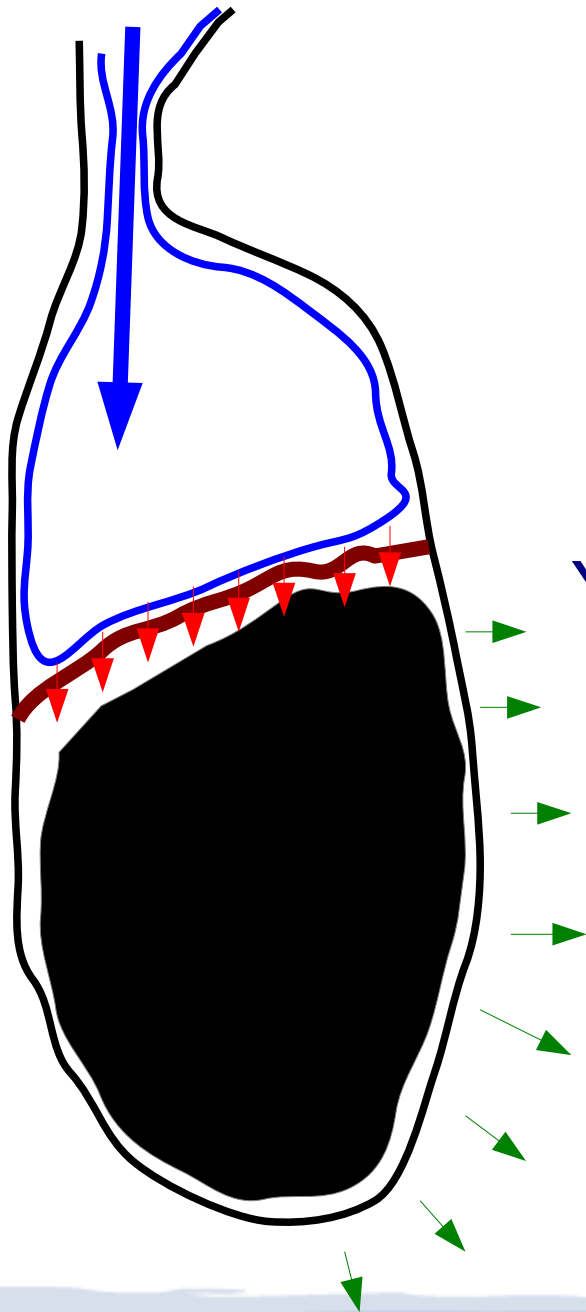
Your stomach and ribcage move outwards.

Your diaphragm falls down, but is still relaxed.

The lungs expand.

Note how air flows in, even though you do not do anything.

This is the *passive* phase of breathing *in*.

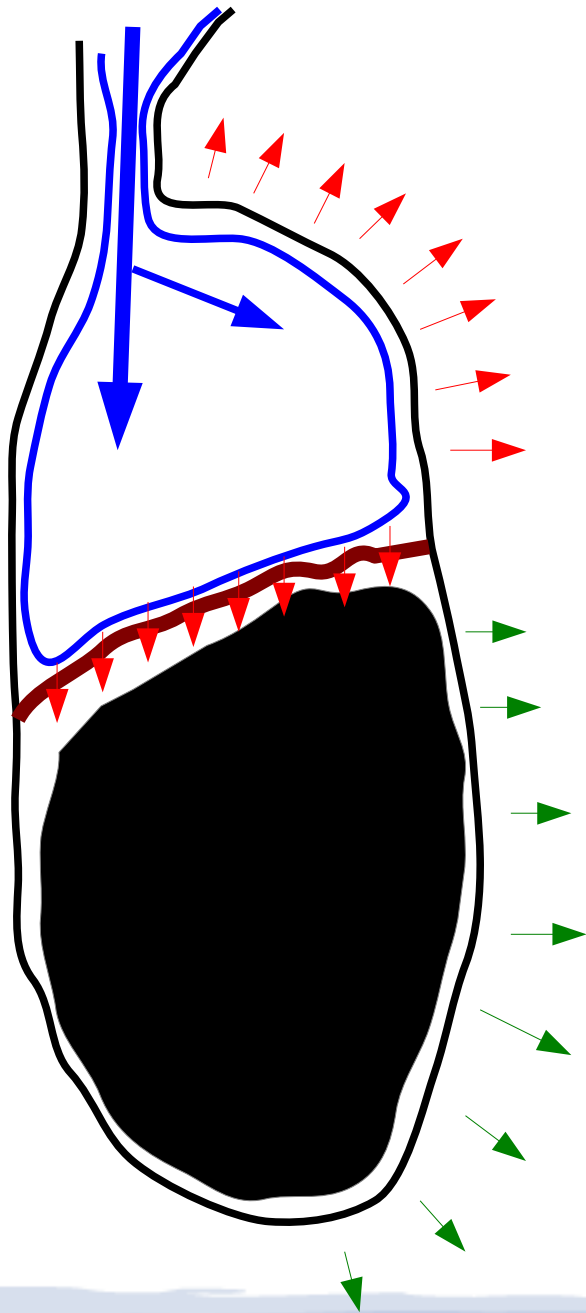


Now, breathe in as far as you can without feeling like you are forcing it.

Your belly moves further outwards, but your ribcage should remain relatively still.

Your diaphragm is now tightened and is pushing your guts downwards.

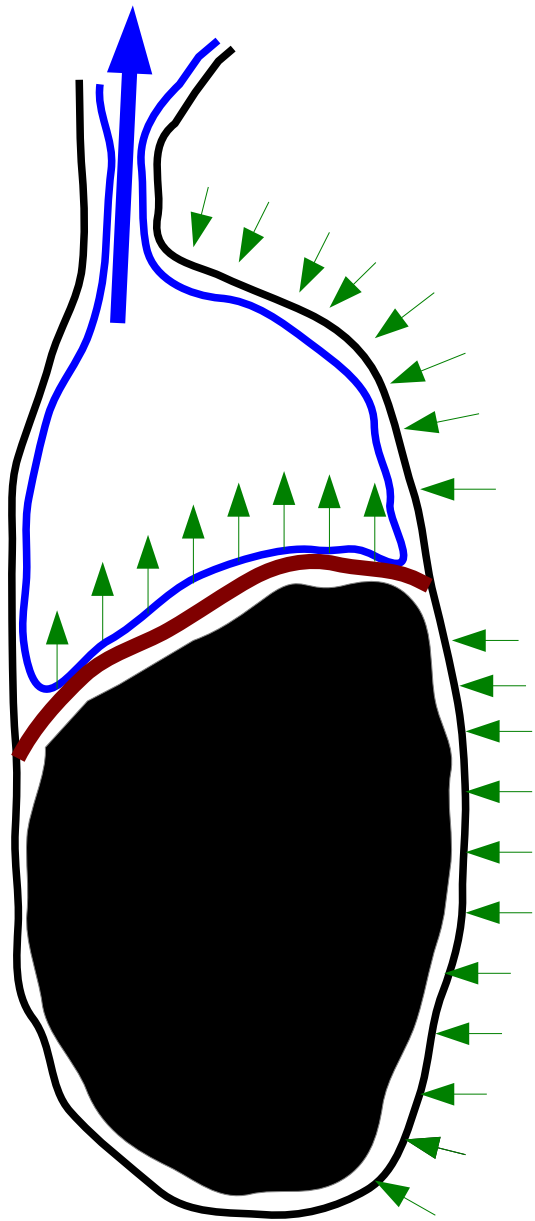
This is the first part of the *active* phase of breathing *in*.



Next, draw as deep a breath in as you can.

You should feel your ribcage expanding as you engage the third system of breathing muscles.

This is the second part of the *active* phase of breathing *in*.



Relax everything.

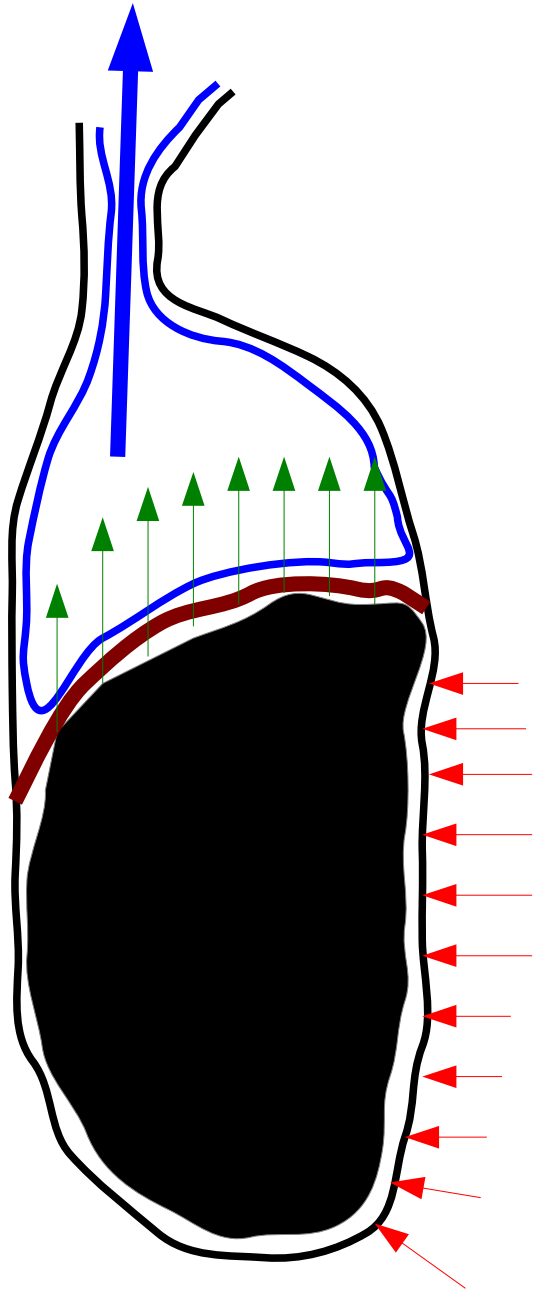
Note air flowing out.

Note belly moving in.

Note ribcage compressing.

No work involved.

This is the *passive* phase of breathing *out*.

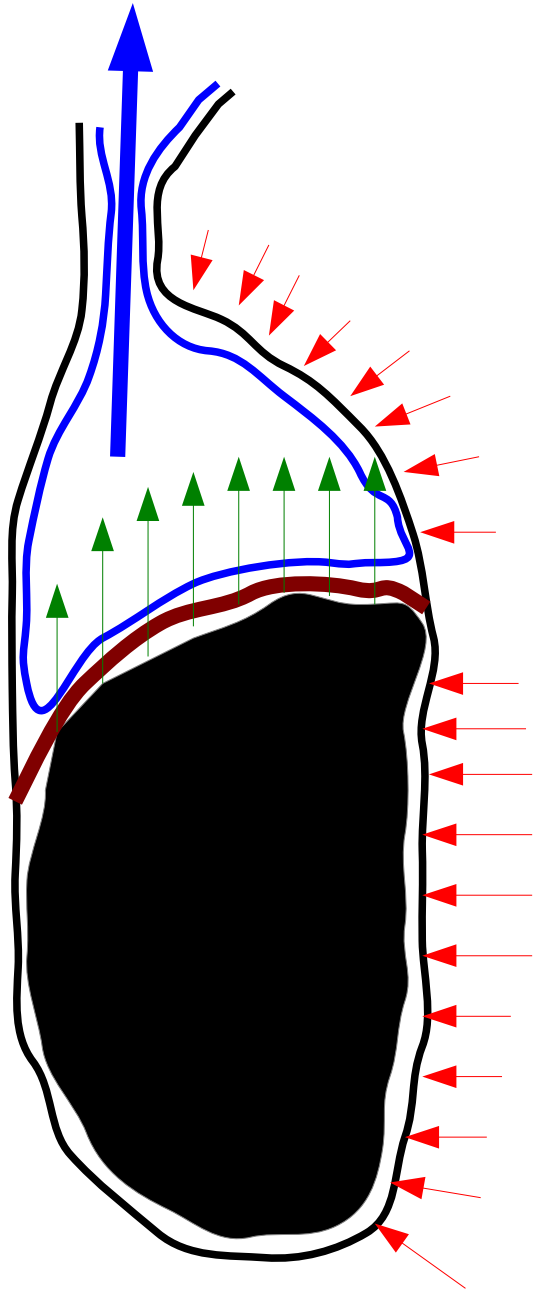


Push in with your abdominal muscles.

Note air flowing out.

Your diaphragm is relaxed and your guts are pushing it into your lungs, making them smaller, and forcing air out.

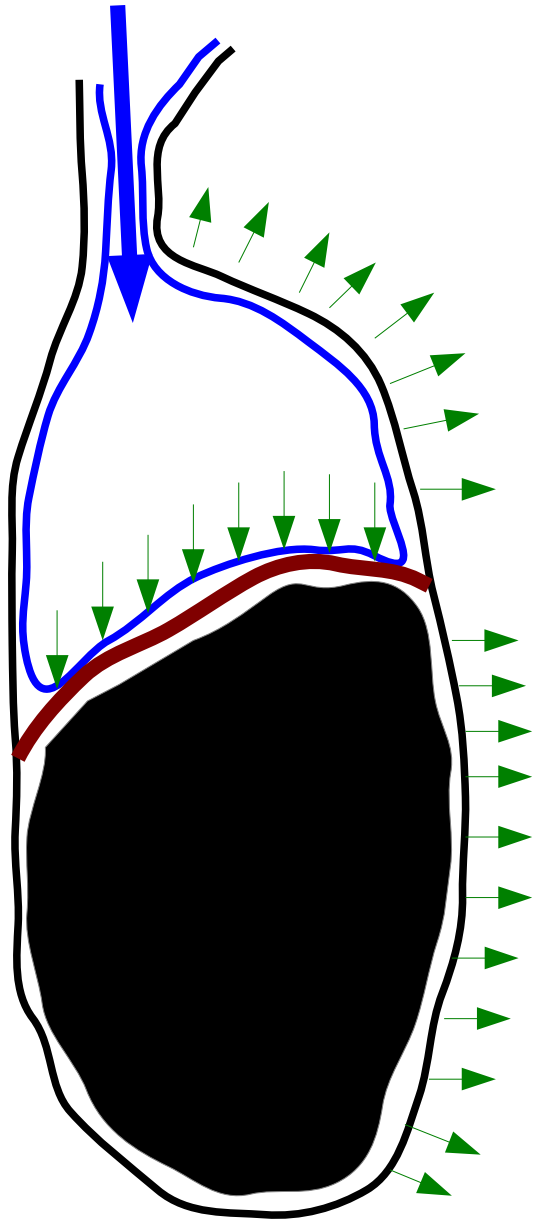
This is the first part of the *active* phase of breathing *out*.



Breathe out as far as you can, again emptying your lungs "completely".

Note that what air was left is mostly pushed out by your ribcage contracting.

This is the *second* part of the active phase of breathing *out*.



And relax again.

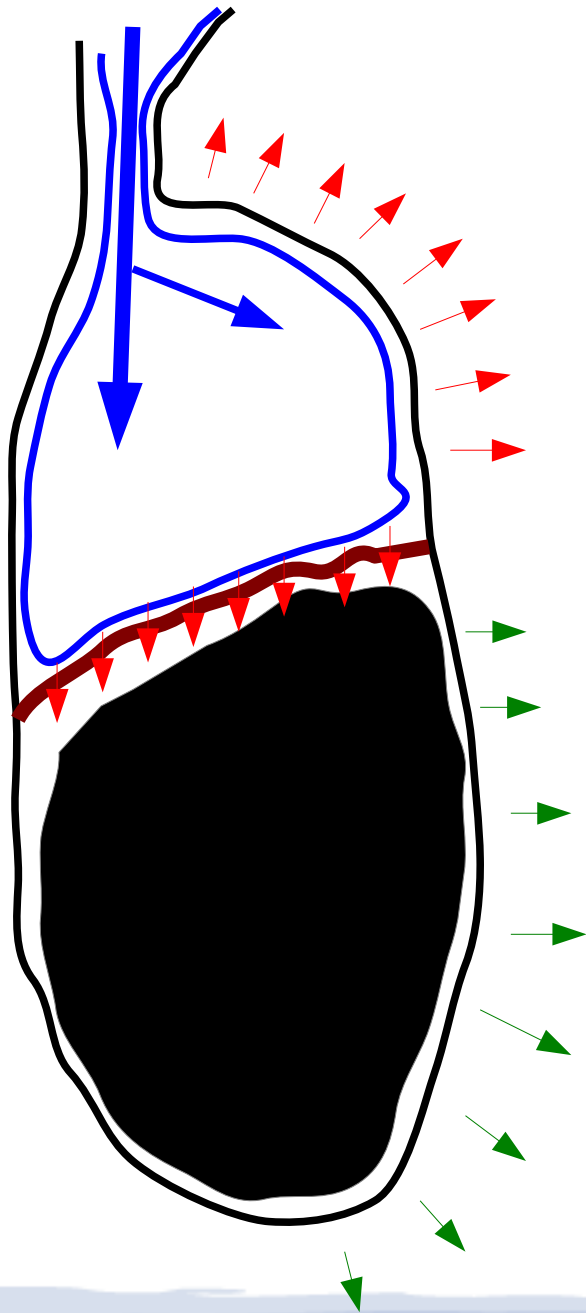
Passive phase of breathing in.

Yes, we have been here already.

You can do another round if you like.

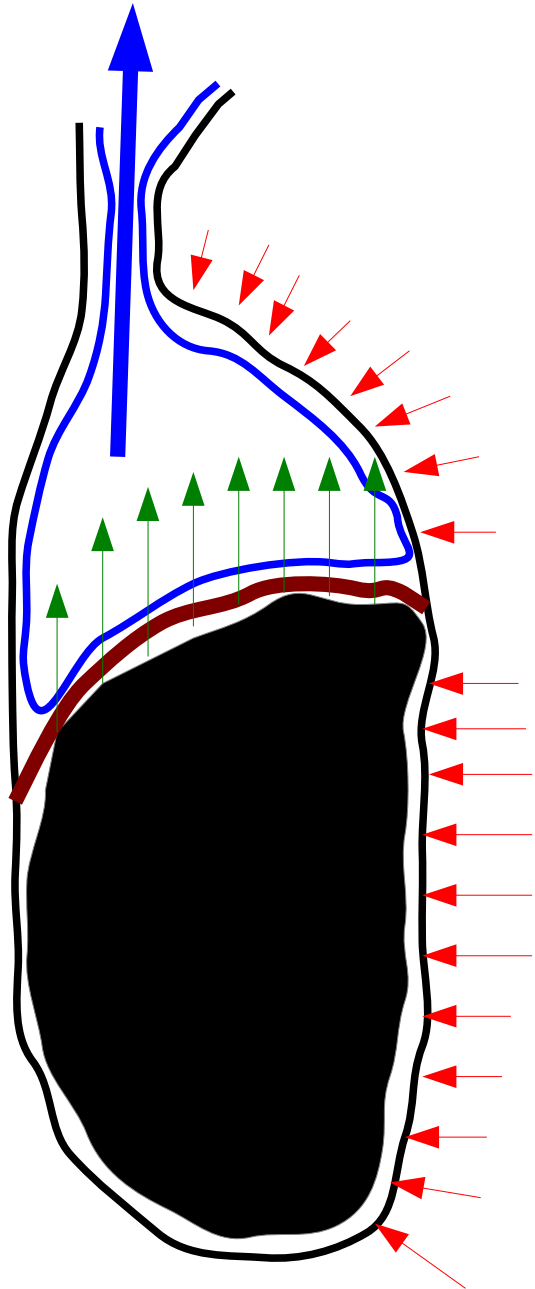
Once you are bored, let's move on to the interesting stuff.

So,
what's the business about swordsmen
in the title of this presentation?



Here is the picture of the *active* phase of breathing *in* again.

Note that while you *actively* breathe in, you abdominal muscles must nevertheless *relax*.



And when you *actively* breathe *out*...
your *diaphragm* must relax.

This means that if you tense up all of
your body unnecessarily, you can
breathe *neither in nor out* effectively.

And it means that when you breathe
hard, both inhaling and exhaling are
active and passive.

(Try to tense your abdominals and diaphragm at the same time.
Recognize the feeling? Yes, it's what you do in the bathroom. Not
appropriate while you fence. Unless you are a really *crappy* fencer.)

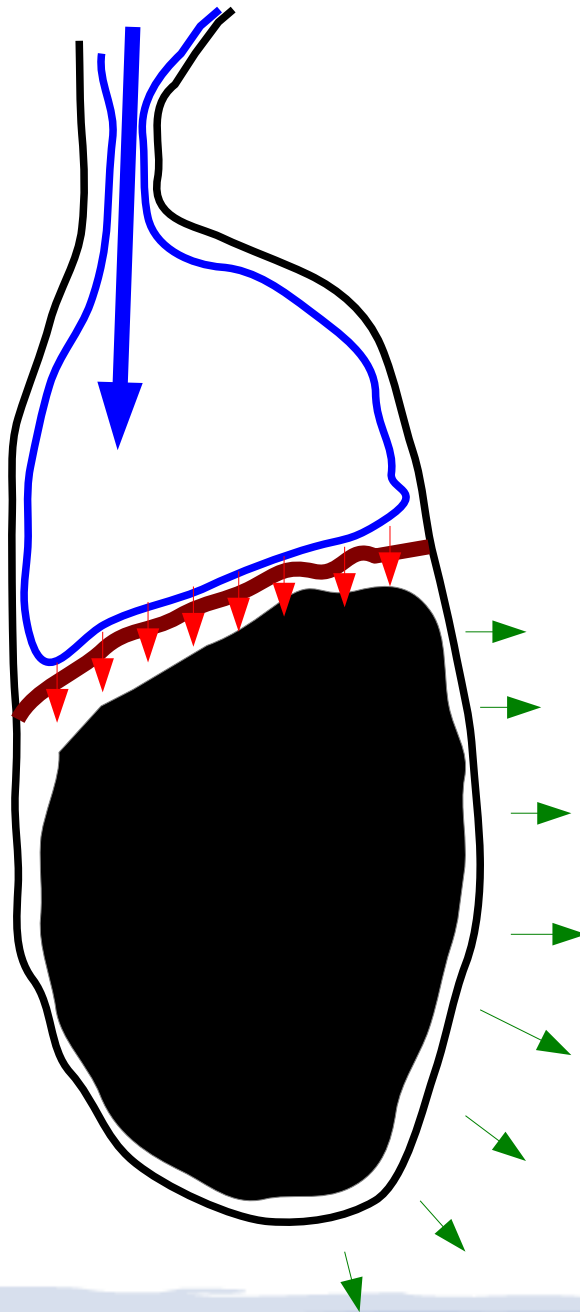
The diaphragm is a very specialized and effective muscle. Pretty much all it does is breathing.

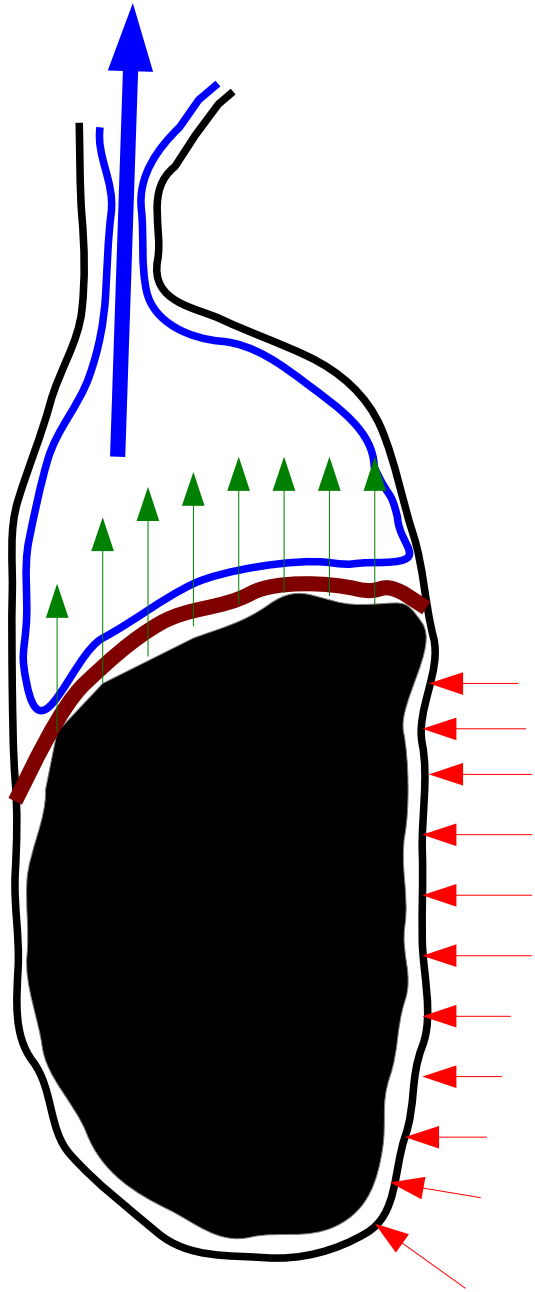
And it can keep on doing that for pretty much forever.

Whenever it is enough, you should breathe with your diaphragm. The active part of your breathing is then the *inbreath*; rest is passive.

By relaxing your sides and stomach as much as possible (without compromising your form) you make room for the guts.

This allows freedom of movement in other parts of the body, and uses very little energy.



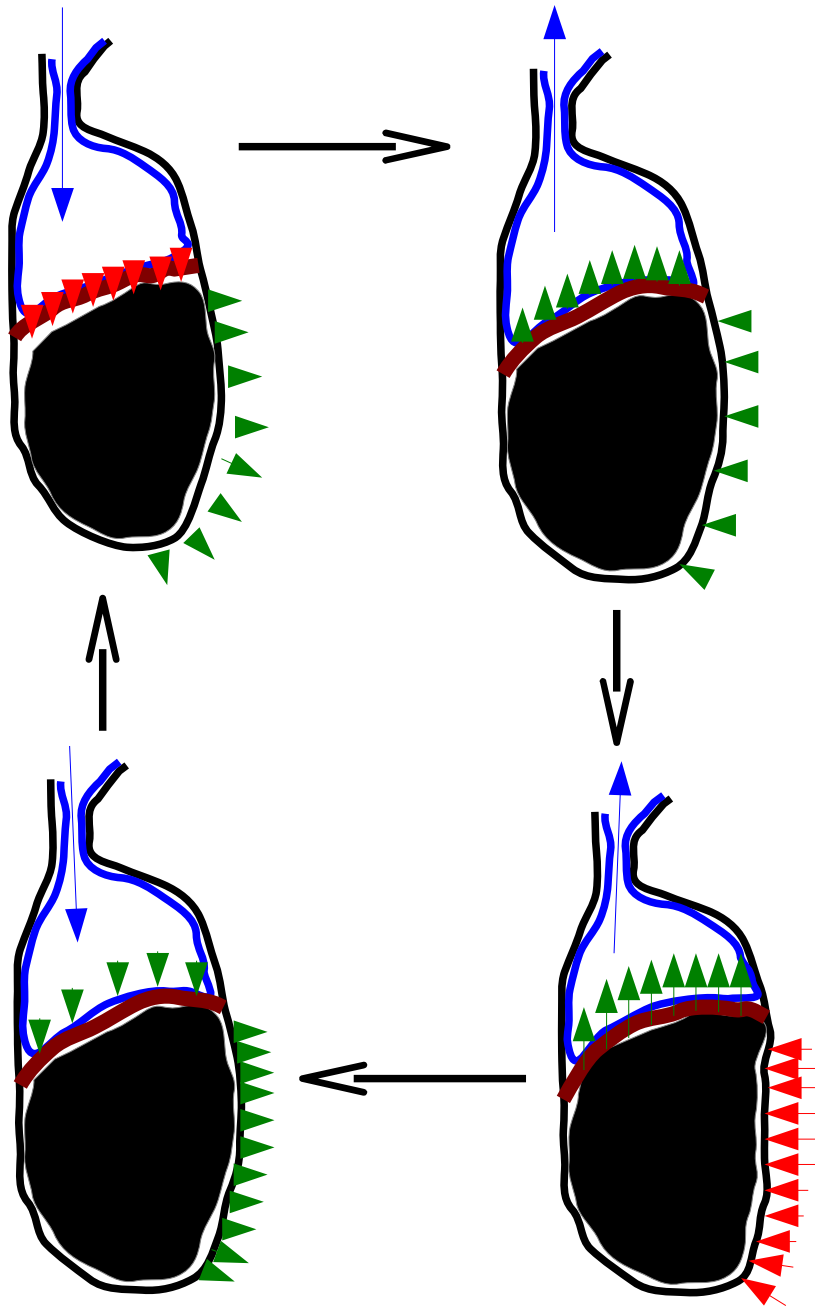


However, when working hard, the movement of the diaphragm alone is not enough to generate enough air flow.

Your abdominals are a fairly strong and big set of muscles. By engaging them to *actively* breathe out you can increase the flow quite a lot. And then you *passively* breathe in by relaxing the abs.

But for maximum benefit, you should still *actively* use your diaphragm to breathe in, too.

Even though abdominals are sometimes called your "stomach" muscles, they actually extend all around your body. So use your sides too.



So ideally, this is how you breathe when you work hard:

Active in →

Passive out →

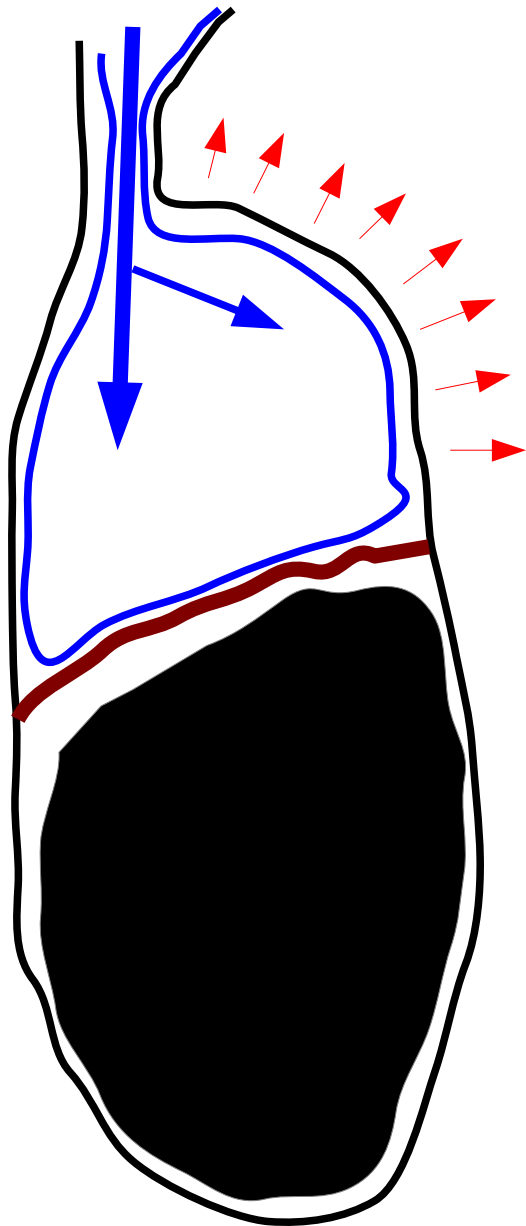
Active out →

Passive in →

Active in →

Passive out ...

Except stop having those pauses in between of each phase that thinking about this makes you no doubt have. Let the phases blend into each other. And yes, it's really really hard to control the abdominals like that while also using them to move around while someone tries to stick a sword into you. It's not just you.



So, what about those ribcage muscles?

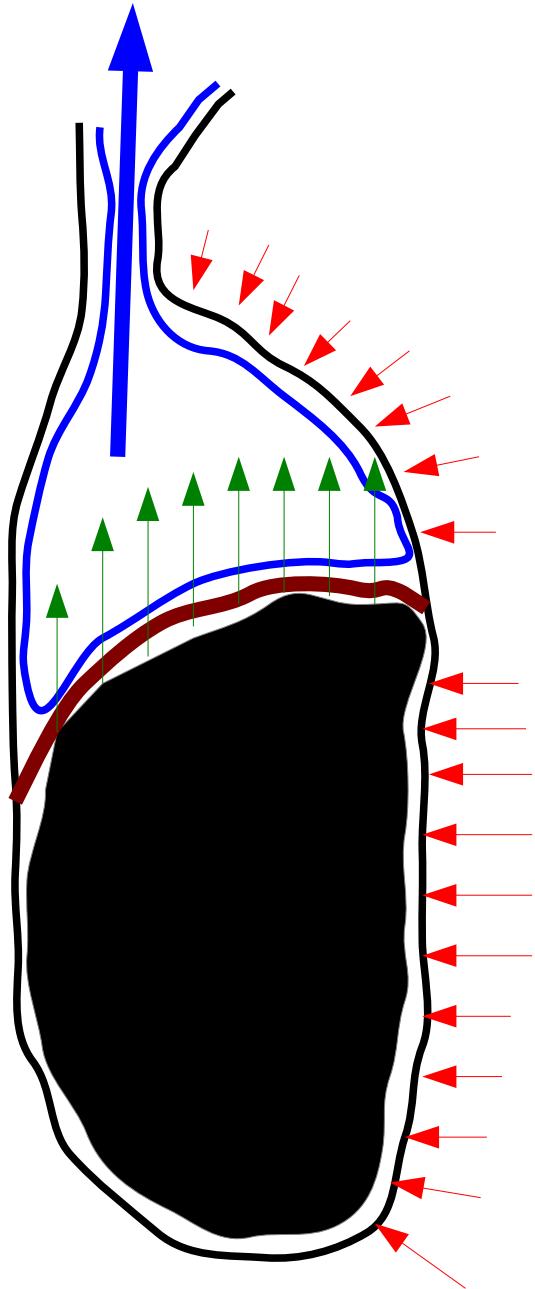
The thing is, they are sort of weak, as in, they use a lot of energy to generate relatively little airflow.

In addition, tensing them tends to tense your upper body in general, which sucks for fencing.

So ideally, you'd not use them at all.

Obviously, oftentimes you just *need* that little bit of extra. And then it gets less ideal, but you use them anyhow.

Because it is better than fainting.



But when that happens, you still need to keep the other systems engaged too,

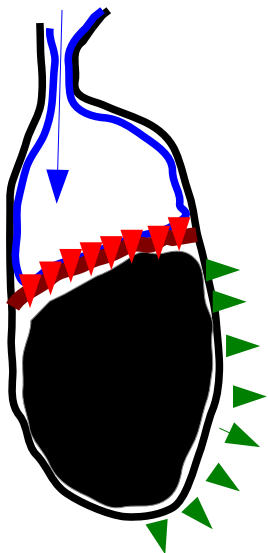
because if you try to breathe with *just* the weakest of your breathing systems when you *really* need air,

things are going to go south really, really fast. And you'll collapse, out of breath.

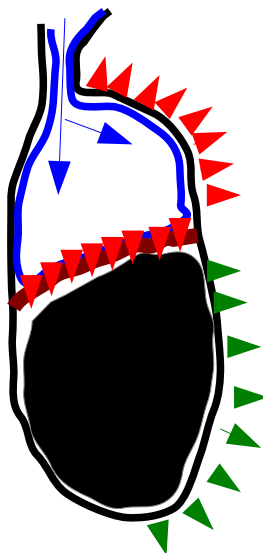
And if that happens while you are in a swordfight, you'll die.

Or more realistically, lose a bout with blunts in a rather embarrassing way.

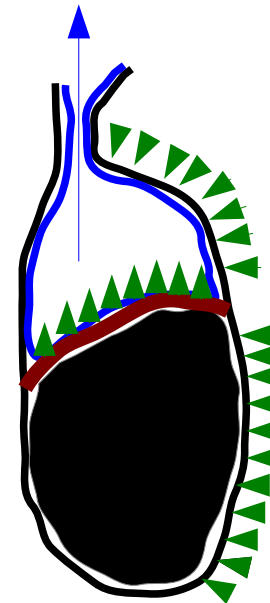
Active in, part one



Active in, part two

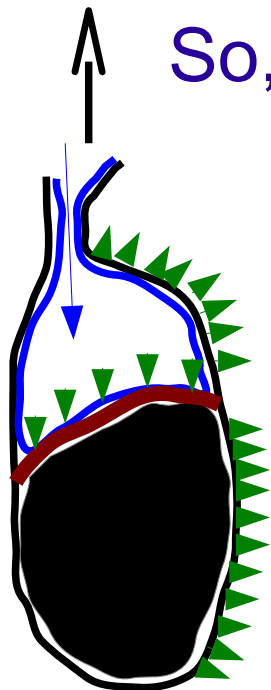


Passive out

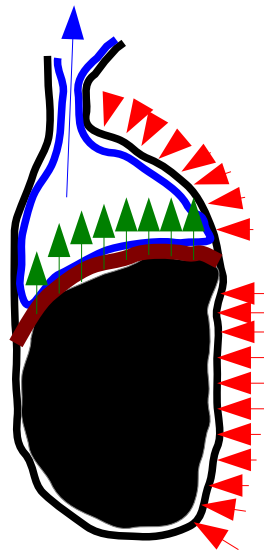


So, here's how you breathe in action.

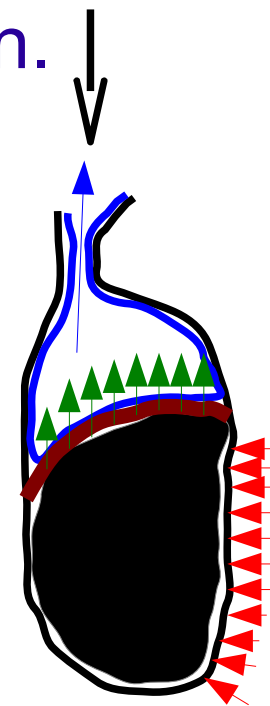
What fun. I could do it all day.



Passive in



Active out, part two



Active out, part one

The End.

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