

# HOW TO MAKE A BREATHING MACHINE

This is a great way to learn how some vital parts of your body work. You can construct your model lungs using materials you can find around the home. The experiment isn't really that difficult, but you need to follow the instructions very carefully if you want your breathing machine to work well—making joints airtight is particularly important. Use glue as well as tape or adhesive putty, if you find this makes things easier.

## WHAT YOU NEED



**1** Cut off the base of the bottle. Keep the cut nice and straight, since it will help you to make an airtight seal on the bottom of the bottle later on. Ask for help if you're not sure you can do this. Save the bottle cap—you're going to need it later.



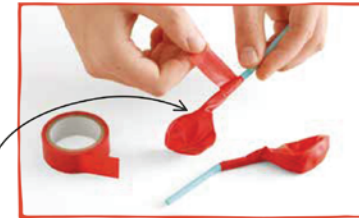
**2** Cut all three straws to just over 4in (10cm). One of the straws will represent the trachea, the name of the breathing tube that joins the back of your throat to the top of your lungs.



**3** Now cut off the ends of both red balloons. In your model, the balloons will represent the lungs. They will take in air and let it out again, inflating and deflating inside the bottle as if breathing in and breathing out.



Make sure you don't squash the straw when you wrap tape around it.



**4** Push the end of one straw about  $\frac{1}{4}$ in (2cm) inside a balloon. Wrap tape firmly around the balloon, making an airtight joint. Now repeat with the other balloon and another straw. These straws represent branching air tubes called bronchi.

**5** Cut a slit  $\frac{1}{4}$ in (2cm) up the middle of one end of the third straw—the trachea—so that it opens up into two equal parts. Do the same at the other end, then turn the straw 90 degrees and cut it again, so this end opens into four equal parts.

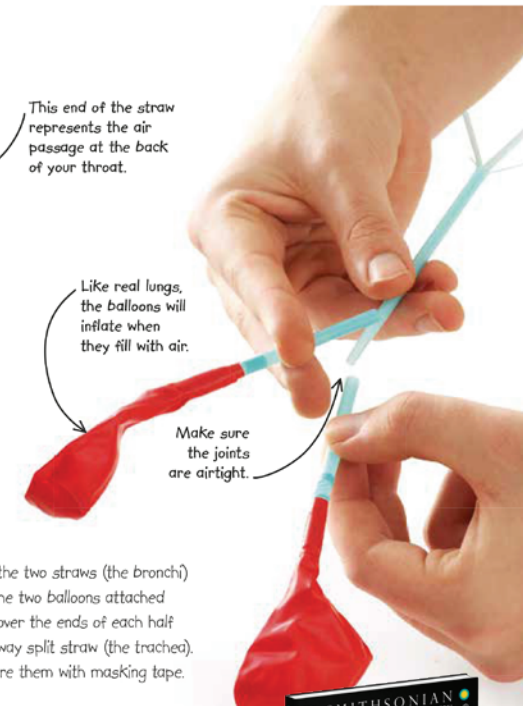
This end of the straw represents the air passage at the back of your throat.

Like real lungs, the balloons will inflate when they fill with air.

Make sure the joints are airtight.

A person breathes in and out about **seven million times every year.**

**6** Push the two straws (the bronchi) with the two balloons attached (the lungs) over the ends of each half of the two-way split straw (the trachea). Finally, secure them with masking tape.





Hold the scissors firmly when pushing and turning the scissors into the cap.

When you have positioned the straw, screw the cap onto the bottle.

**7** Retrieve the bottle cap and cut a hole in the middle of it, just big enough for a straw to fit. Keep your fingers clear of the scissors' point and don't jab the table by mistake! To avoid mishaps, you can push the cap into a lump of adhesive putty.



**8** Now pick up the end of the "trachea straw" that is split into four. Hold the four flaps together and push them right through the hole in the bottle cap. Once the flaps are through the hole, fold them down to lie against the top of the cap.



Keep the tape tightly stretched as you wind it around the cap.

**9** Check that the straw fits snugly in the hole. Then, using tape, make a tight seal around the bottle cap to stop air from leaking into the bottle through tiny gaps.



**10** Cut the third balloon just beyond the end of the neck. This represents a sheet of muscle called the diaphragm. Hint: if you inflate it before you do the cut, it will be easier to stretch in step 11.

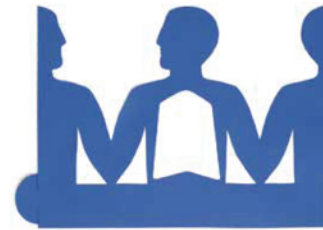


Push the third balloon firmly so that all of the air escapes.

**11** Tie off the end of the balloon, as you would have if you had just blown it up. Stretch it over the end of the bottle and secure it with tape. Make sure the joint is completely airtight.



**12** Your working model is now complete! To make it breathe in, pull the end of the balloon; to breathe out, push it up again. Watch the balloon lungs inflate and deflate.



**13** Draw and cut out a net. You don't have to be an artist; the important thing is to cut a large hole in the middle figure. At the base of the net, cut a tab at one end and a slit at the other.



**14** Wrap the net around your model, and tuck the tab into the slit. Add masking tape to make the tab more secure. Your "breathing" lungs should appear through the middle hole.

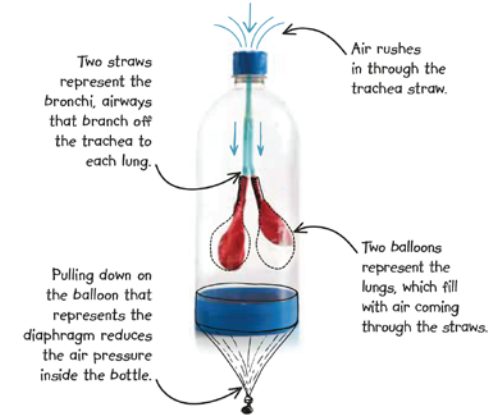


This head and body will really help you explain to others what your model is showing—it will also look great if you put your model on display.

**15** The paper wraparound head and body will really help you explain to others what your model is showing—it will also look great if you put your model on display.

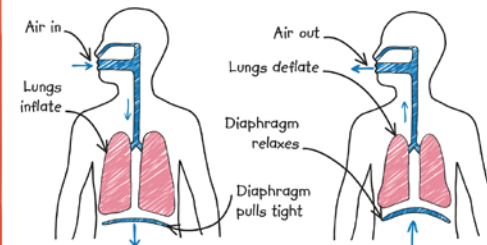
## HOW IT WORKS

Breathing is all about pressure. When you pull down on the balloon, you increase the volume inside the bottle, reducing the air pressure inside. This makes the air from outside the bottle rush through the straw and inflate both balloons. When you push the balloon up, you reduce the volume and increase the pressure inside the bottle, so the air rushes out again.



## REAL WORLD SCIENCE CHEST CAVITY

In this X-ray, you can see the lungs (black) on either side of the spine (white), protected by the ribs (also white). The diaphragm is the large gray structure at the bottom.



As you breathe in, or inhale, your lungs inflate and your diaphragm flattens and pushes downward.

As you breathe out, or exhale, your lungs deflate and your diaphragm is pushed upward.



FROM  
MAKER LAB