C5.1 Our lungs

You want to see how long you can hold your breath. Here you go – you start the stopwatch and hold your breath. At the beginning, things go quite well, but it becomes harder and harder. After 25 seconds, you absolutely want to take another breath. You hold out for another second, then another!
Then you can't do it any longer and you take a breath.

Why do you have to breathe and why can you hold your breath only for a limited time?

Write down your ideas and guesses:

_____

_____

_____

You need the following for the experiment:

- ☐ Electrical tape
- ☐ 1 plastic bottle, 1.5 liters
- ☐ 1 piece of modeling clay
- ☐ 2 red balloons
- ☐ 1 pair of scissors
- ☐ 1 piece of thin tubing, approx. 10 cm long
- ☐ Transparent packing tape
- ☐ 1 Y-shaped tubing connection
- ☐ 1 zipper storage bag, 20 x 30 cm

Figure 1: Required materials.

In the figure you see the human respiratory organs. The most important organs are the two lungs, also called lobes.
Using your finger, trace the path of the air on the figure: The air is inhaled through the nose or mouth, it reaches the lungs, and it is exhaled again through the mouth or nose.

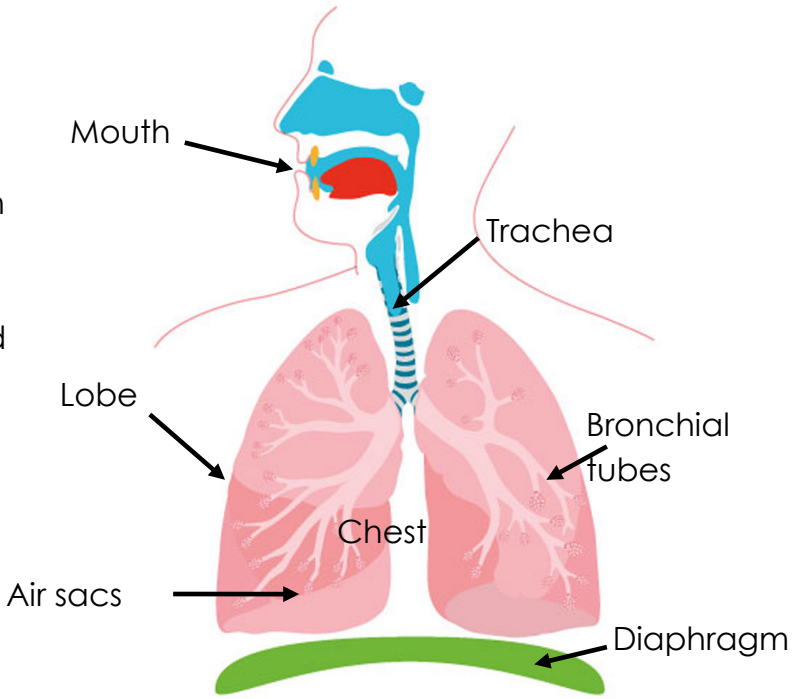

Figure 2: The human respiratory organs.

How to set up the experiment:

Lay out all the materials as shown in the photo.
Tip: First blow up all the balloons and then let the air out again. This will make them easier to expand and your experiment will work much better right away.

1. Cut the bottom off the empty plastic bottle and remove the cap from the bottle opening.
2. Attach a red balloon to the two branches of the Y-shaped tubing connection.
   Tip: Use adhesive tape to attach the balloons so that they cannot fall off.
3. Attach the tubing to the remaining free end of the Y-shaped piece.

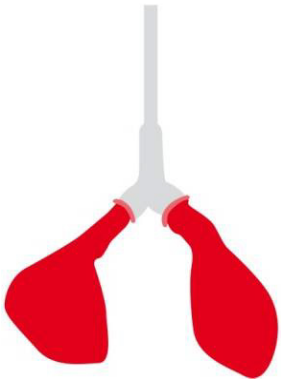

Figure 3:
Y-shaped tubing connection with balloons.

4. Now insert the Y-piece with the two balloons into the bottom of the cut plastic bottle. Guide the tubing through the bottle opening.
5. Use modeling clay to seal the opening around the piece of tubing. Wind electrical tape around this seal.
6. Now it gets tricky: Cut off the lower edge of the zipper storage bag.
7. Use the transparent packing tape to attach the bag to the lower edge of the bottle.
8. Open a small section of the zipper seal and press the bag into the bottle until the zipper seal just barely protrudes.
9. Close the zipper seal again.

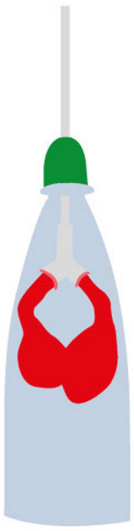

Figure 4: Sealed bottle with tubing and balloons.

How to conduct the experiment:

1. Tug on the zipper storage bag while observing the balloons inside the bottle.
2. Press the bag back into the bottle while again observing the balloons inside.

Figure 5: How to conduct the experiment.

Write down your observations:

Match the parts of your respiratory system model to the corresponding body parts. Refer to Figure 2 and fill in the table.

Part in the respiratory system model	Body part
Bottle	
Bottle opening	
Tubing	
Y-shaped tubing connection	
Two balloons inside	
Zipper storage bag as the bottom of the bottle	

Write down what you observed when you moved your respiratory system model.

Evaluate your observations:

1. What changes when you tug on the zipper storage bag at the bottom of the bottle and then press it back into the bottle? Also pay attention to the available space in the bottle: How does that change?
   Fill in the blanks in the text below using the following terms: smaller – larger – pressure – tubing – tubing – suction

When I pull down on the zipper storage bag at the bottom of the bottle, the space (the volume) of the bottle becomes _____. This creates _____ and the red balloons fill with air via the _____.

When I push the bag back into the bottle, the space (the volume) becomes _____ again. This creates _____ on the red balloons and the air escapes again via the _____.

2. Relate your experience with the respiratory system model to respiration in humans.

_____

_____

Doing further research:

In the case of some illnesses or after an accident, the body can no longer raise and lower the chest without help, that is, it cannot change the volume of the chest. As a result, the person doesn't receive enough air and can be in a life-threatening condition.
With your partner, discuss how machines could provide breathing support.