

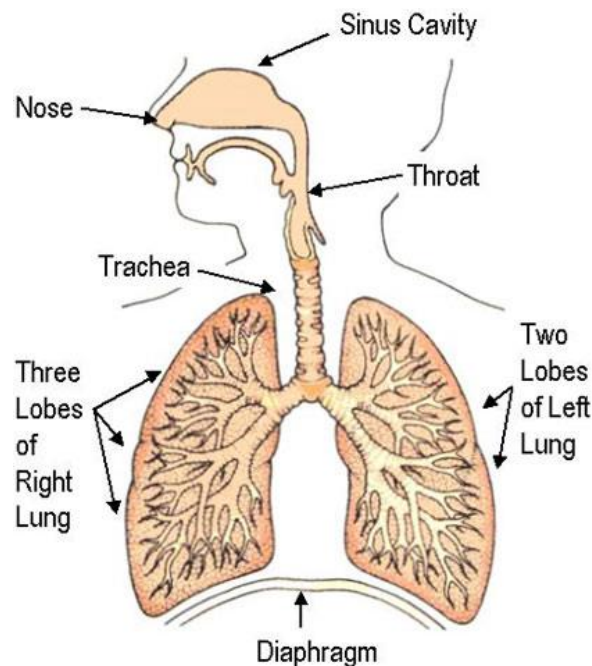
Lesson Plan for Build Your Own Lung Model

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Introduction/Background Info

When we breathe, we mainly use our lungs. But how does air get into our lungs? When we inhale through our nose or mouth, air travels to the back of the throat, down to the trachea, and finally to the lungs. (The trachea is a tube that is also known as a windpipe.)

Our lungs expand and contract with the help of a strong wall of muscle called the diaphragm. When we breathe in, the diaphragm moves downward to allow air to enter the lungs. We can test that by placing our hands on our ribs and inhaling slowly; we can feel that our chests slowly expand as our lungs fill with air. Air has come in to equalize the pressure difference created by the change in volume. When we breathe out, the diaphragm moves upward to push air out of the lungs.



Some interesting facts about the lungs:

- Most vertebrate animals have two lungs.
- The left and right lungs are not exactly the same. The left lung is slightly smaller.
- People can live with only one lung. Removing one lung does not stop us from living; it only limits our physical abilities.
- Lungs are the only organs that can float on water.
- Lungs are also the largest organs in the body. The surface area of the lungs can be spread out to fill an entire tennis court.
- Smoking is really bad for the lungs!

Basic concepts of pressure:

1. Definition of pressure:

When you place an object on your arm, you feel pressure. That is because the weight of the object applies a force on your arm, so pressure is actually a force per unit area exerted on an object by the weight of another object. **Air pressure** is the force exerted on things by the weight of air.

2. Air flow: occurs when there is a difference between pressures.

Air flows from a region of high pressure to a region of low pressure.

Relating to the lungs: When we inhale, air flows in because the pressure at the mouth is higher than the lung pressure. When we exhale, air flows out because the lung pressure has become higher than the pressure at the mouth.

3. Boyle's Law:

When the temperature remains unchanged within a closed system, the pressure of a gas increases as the volume decreases, and vice versa.

$$P_1V_1 = P_2V_2$$

Relating to the lungs: When we inhale, our chest expands which means volume increases, so the pressure inside the lungs decreases, and vice versa.



Student Objectives

By the end of this activity:

- Students will have a better understanding of how the lungs work.
- Students will know that pressure is inversely proportional to volume.

Overview of Lesson Process

1. Introduce the purpose of the activity to the students by asking them the following questions (10 mins)

- What is the thing that we all do every day, no matter where we are, who we are with, and whether we are awake or sleeping?
- Have you ever wondered how we breathe?
- How does your body make air go in and out of your lung?

All the answers to these questions can be found in the intro. Mentors should also show the students the diagram of the lungs above and share the interesting facts.

2. Fun and quick activities to demonstrate pressure (15 mins)

a. *The flow of air:*

When blowing up a balloon, we have put a lot of pressure in it. Now when we let it go, air goes out of the balloon because the air wants to go from regions of high pressure to low pressure.

b. *Boyle's law with syringe and marshmallow:*

Place a marshmallow inside a syringe. Use the thumb to cover the end of the syringe (so we have a closed system). As we push in the plunger, the marshmallow decreases its size because we have

increased the pressure. As we pull out the plunger, pressure decreases so the marshmallow expands in size.

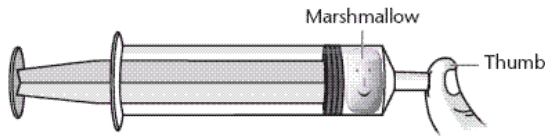


FIGURE 1.1. Boyle's Gas Law: Plunger In

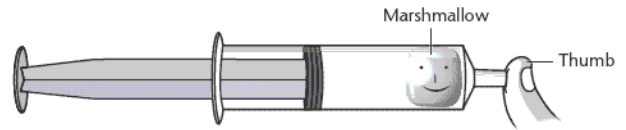


FIGURE 1.2. Boyle's Gas Law: Plunger Out

3. Build the lung model (20 mins)
 - Each group of students will build one lung model.
4. After finishing the models, mentors relate the lung model to the basic anatomy of the lungs (5 mins)
 - The bottle represents your chest.
 - The straws represent your trachea.
 - The two balloons represent your two lungs.
 - Finally, the plastic wrap paper represents your diaphragm.

It should be easier now for the students to relate to the lung diagram above.
5. Use the model to explain the basic concept of how air can get into the lungs/balloons (5 mins)

As we pull on the binder clip and increase the volume inside the bottle, the air pressure inside the bottle decreases; therefore, air outside the bottle will want to move in to equalize the air pressure inside and outside. But the only way air can get in the bottle is through the straws, which expand the balloons. (That is why we need to make sure we seal the bottle neck completely so air can come in through the straws.)
6. Clean-up (5 mins)

Materials

For air pressure demos:

- Extra balloons
- Marshmallows Smart&Final \$5
- Plastic syringes Fisher (#03-377-22) 100 syringes \$30

To build one lung model:

- A 2-liter bottle
- 2 balloons Smart&Final \$5
- 2 straws Smart&Final \$3
- Rubber bands OfficeMax (#20792019) 1550 rubber bands \$3
- Modeling clay Blick (#33216-1006) 1 lb. clay \$5
- Plastic wrap Smart&Final \$5
- A binder clip OfficeMax (#21258265) 6 clips \$6

Total: \$62

Procedures

1. Cut off the bottom of the 2-liter bottle.
2. Use a rubber band to attach the first balloon to one of the straws. Do the same thing with the second balloon and the other straw.
3. Place the balloon-attached straws inside the bottle where the open ends of the straws are at the side of the bottle neck.
4. Make sure that the open ends of the straws are above the rim of the bottle and then insert clay around the neck of the bottle so that no air can go inside except going through the straws.
5. Cover the cut end of the bottle with a piece of plastic wrap paper. Seal the wrap paper and the bottle using a rubber band.
6. Pull the wrap paper a little bit and attach a binder clip.
7. To inflate the "lung": pull on the binder clip. As we pull to increase the volume inside the bottle, air will come in through the straws and expand the balloons.



Resources

Interesting facts:

<http://www.sciencekids.co.nz/sciencefacts/humanbody/lungs.html>

<http://www.theasthmamom.com/2008/03/07/5-lung-facts-you-might-not-know/>

Procedure:

http://www.msichicago.org/scrapbook/scrapbook_exhibits/bodyworlds2/educ_resources/BW2_Additional_Activities.pdf

Syringe and marshmallow activity:

<http://www.education.com/reference/article/boyle-gas-law/?page=2>