

Modeling Breathing

As you breathe, your body moves air in and out of your lungs. All body movements depend on your muscles, which work only by contracting. How does your body use muscles to cause air to flow into and out of your lungs? In this investigation, you will make a working model of human lungs that will help you answer this question.

Problem

How do muscle contractions move air into and out of the lungs?

Materials

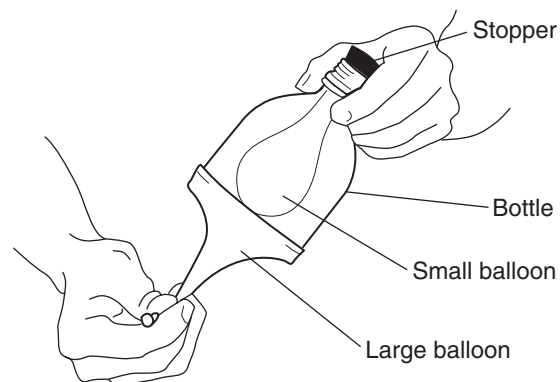
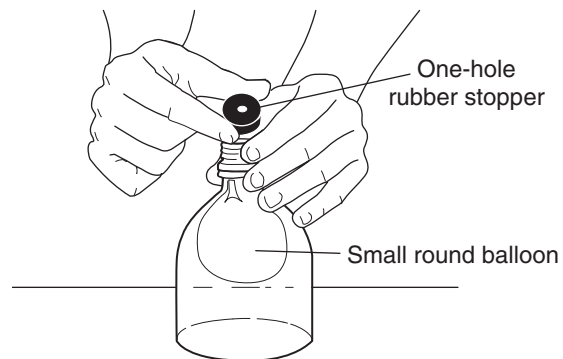
- small, clear plastic bottle
- large round balloon
- small round balloon
- one-hole rubber stopper
- scissors

Skills Using Models

Design Your Experiment

Part A: A Model of Normal Lungs

1. Place a clear plastic bottle on its side. Press one point of a scissors through the side of the bottle about 1 cm from the bottom.
2. Using the scissors, cut off the bottom of the bottle by cutting all the way around. Trim any rough spots from the edge.
3. Stretch a small balloon, and blow it up several times to make it pliable.
4. Pull the opening of the small balloon over the bottom of a one-hole rubber stopper.
5. Insert the balloon through the mouth of the bottle. Press the stopper tightly into the bottle so that it holds the lip of the balloon in place.
6. Stretch a large balloon, and blow it up several times to make it pliable.
7. Using the scissors, cut off about 1 cm from the rounded, closed end of the large balloon. Tie the other end closed.
8. Stretch the large balloon far enough over the cut end of the bottle to keep it from slipping off, as shown.



9. As you watch the small balloon, pull down on the knot of the large balloon. Then, still watching the small balloon, press up on the large balloon.

Part B: Model of a Chest Injury

10. **Formulating Hypotheses** If a person receives an injury that punctures the skin and muscles of the chest, outside air can come into direct contact with the outer surfaces of the lungs. How would such an event affect a person’s ability to breathe? Record your hypothesis of how this would affect breathing on the lines below.

Hypothesis: _____

11. Think of a way that you could modify your model of human lungs to represent the lungs in a person with a punctured chest. Write a description of your plan, including your prediction of how the model will behave and how the model will test your hypothesis.

Experimental Plan: _____

12. Show your plan to your teacher. If your teacher approves, make a model of a punctured chest. Use your model to test your hypothesis.

Analyze and Conclude

1. **Observing** What happened to the small balloon in your first model when you pulled down on the large balloon?

2. **Observing** What happened to the small balloon when you pressed up on the large balloon?

3. **Inferring** What happened to the pressure inside the bottle when you moved the large balloon up and down?

4. **Formulating Hypothesis** What caused the small balloon to expand and contract?

5. **Using Models** How is the first model you constructed similar to the human respiratory system? How is it different from the human respiratory system?

6. **Evaluating** Was your prediction in Part B correct? Did the behavior of your second model support or conflict with your hypothesis? Explain the reasons for your answer.

7. **Drawing Conclusions** How do muscles cause air to flow into and out of human lungs?

8. **Drawing Conclusions** What did your second model demonstrate about the importance of the chest wall in breathing? Explain the reasons for your answer.
