

SNC2D/2P Tissues, Organs, and Systems of Living Things/Tissues, Organs, and Systems

Teacher Demo: Lung in a Bottle

Topics	Timing
respiratory system	preparation: 15 min. demonstration: 10–15 min

Specific Expectations

SNC2D

A1.1 formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions

B3.4 explain the primary functions of a variety of systems in animals (e.g., the circulatory system transports materials through the organism; the respiratory system supplies oxygen to and removes carbon dioxide from the body)

B3.5 explain the interaction of different systems within an organism (e.g., the respiratory system brings oxygen into the body, and the circulatory system transports the oxygen to cells) and why such interactions are necessary for the organism's survival

SNC2P

A1.1 formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions

B3.4 explain the general function of some of the systems in the human body (e.g., the function of the circulatory system is to transport materials through the body; the function of the digestive system is to absorb nutrients; the function of the respiratory system is to bring oxygen into and remove carbon dioxide from the body)

B3.5 describe the interaction of systems in the human body (e.g., the respiratory system brings oxygen into the body, and the circulatory system transports the oxygen to cells), and explain why these interactions are necessary for survival

Introduction

This is a simple, yet extremely effective model of human lungs. Students are able visualize how the lungs, thoracic cavity and diaphragm work together to facilitate inhalation and exhalation. This model can be prepared before class to be used as a demonstration and re-used year after year. Alternatively, this demonstration model could be turned into a student activity and partners could create their own model of the lungs.

Materials

2 L clear plastic pop bottle
1 nitrile glove
duct tape (or elastic band)
modelling clay

2 straws
2 balloons
scissors

Safety Considerations

None

Procedure

Build the model before performing the demonstration.

1. Cut off the bottom half of the plastic pop bottle and discard it or use it for another activity.
2. Stretch the glove over the cut portion of the upper half of the pop bottle. Secure it with duct tape or an elastic band. The seal must be airtight.
3. Wrap the ball of modelling clay around the two straws so they are parallel to each other and make an airtight seal.
4. Attach the opening of a balloon to the end of each straw and tape them on securely.
5. Insert the balloon end of the straws into the top of the plastic bottle, and wedge the modelling clay in the mouth of the bottle, ensuring an airtight seal (Fig.1).

Organize your class into groups of 2–4 students per group.

6. **Predict/Explain**

Ask each group to predict what will happen when the fingers of the glove are pulled down and then pushed back up (Figs.2 and 3). Each group should also attempt to come up with a rationale for their prediction.

7. **Observe**

Slowly pull down on the fingers of the glove and then push them back up. Repeat this several times. Provide time for students to record their observations.



Fig.1 Apparatus at rest



Fig.2 Pulling down on the glove



Fig.3 Pushing up on the glove

8. Explain

Ask the groups to reconvene and revise their explanations, if necessary. Also ask students to explain what each part of the model represents and why each component is necessary.

Disposal

The model can be stored and reused—although the modelling clay may get dry and have to be replaced. The bottom portion of the pop bottle can be recycled.

What happens?

When the fingers of the glove are pulled down, air enters the balloons through the straws and the balloons expand. When the fingers of the glove are released, air leaves the balloons through the straws.

How does it work?

The bottle represents a chest with the straws representing the trachea and bronchi. Each balloon represents a lung and the glove represents the diaphragm. The space inside the pop bottle represents the thoracic cavity.

The diaphragm is a flat muscle at the base of the thoracic cavity. During inhalation it contracts and lowers, increasing the volume of the thoracic cavity and lowering the air pressure in the lungs. Air moves from areas of high pressure to low pressure, so this causes the lungs to expand as they fill with outside air entering through the trachea. When the diaphragm expands, it rises and decreases the volume of the thoracic cavity. This causes the lungs to contract, increasing the air pressure in the lungs and expelling air up through the trachea out of the body. The autonomic nervous system controls the contractions of the diaphragm.

Teaching Suggestions/Hints

1. A rubber glove also works well as a diaphragm.
2. This could easily be modified into an activity and the students could create their own lung models.
3. Ask students to suggest ways in which the model does not accurately represent a real chest. (Hint: Consider the direction of force required to move the diaphragm.)

Next Steps

This demonstration could be used to describe the role of the diaphragm in breath control for singers and players of wind instruments. It could also be used to introduce other explorations of the respiratory system such as a dissection (real or virtual) or a computer simulation.

Additional Resources

1. Video of similar but smaller model of lung with explanation: http://sciencesquad.questacon.edu.au/activities/model_lung.html
2. More information about the respiratory system: <http://www.nhlbi.nih.gov/health/health-topics/topics/hlw/system.html>
3. Video of gas exchange: http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter25/animation_gas_exchange_during_respiration.html