LUNG POWER

BENCHMARKS AND TASKS

SC.F.1.2.1 The student knows that the human body is made of systems with structures and functions that are related.

SC.F.1.2.3 The student knows that living things are different but share similar structures.

- The student knows that processes needed for life are carried out by the cells and that complex animals have specialized organs to carry out life processes.
- The student uses a model to explain the functions of the major organ systems of the human body (e.g., digestive, respiratory, circulatory, skeletal, nervous, muscular, excretory).
- The student collects personal health-related data (e.g., temperature, heart rate) with simple devices such as a watch, a thermometer, and a stethoscope, to get a sense of how such information varies.

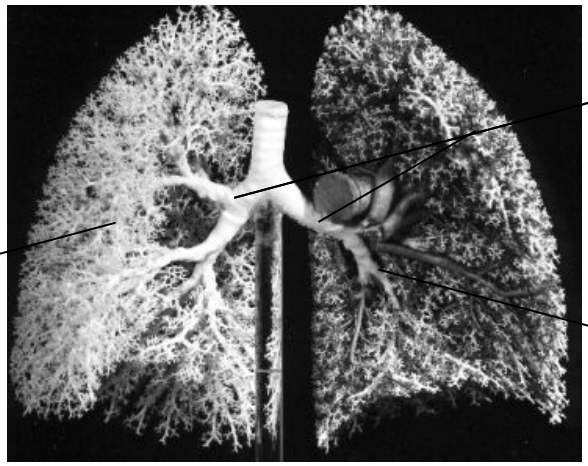
KEY QUESTION

What is your vital lung capacity?

BACKGROUND INFORMATION

All animals need oxygen to live. Land animals get oxygen when their lungs pump in air. When air is inhaled, the diaphragm contracts and drops down to enlarge the chest cavity. At the same time, rib muscles contract and lift the ribs upward and outward. Air rushes in to fill the space. When air is exhaled, the diaphragm relaxes back into its up position, and the ribs settle down. The space shrinks and air is squeezed out of the lungs. Different people have different lung capacities and different breathing rates; what's natural for one person may not be for another. (Note regarding this activity: A person cannot exhale all the air that is in the lungs. The amount that can be exhaled is the vital capacity, although sometimes it is incorrectly called the lung volume. The lung volume is actually all of the air that can be held inside the lungs.)

The lungs are about the size of a pair of footballs, and they fill the chest from neck to ribs. Air passes in through the windpipe, which divides into two branches, called the bronchial tubes. These divide into smaller tubes called bronchioles. These open into little air sacs called alveoli. You have about 600 million of these spongy sacs. Our breathing **system** allows us to take in air, remove oxygen from it, and exhale a body waste product called carbon dioxide. One's rate of breathing is controlled automatically in the brain.



MATERIALS

Per group

1 plastic tub or basin
1 plastic, gallon jug
water
1 measuring cup or graduated cylinder
1 permanent marker
paper towels
1 bag for used straws
newspaper
several metric measuring tapes

Per student

several flexible straws
science journal
The Human Lungs worksheet
1 index card

TEACHING TIPS

1. Be sure that each student uses a clean straw!
2. Be sensitive to individual student data. The purpose of the investigation is to show that there are differences in lung capacity due to <u>many</u> factors.
3. Note that there may be some students who can push all of the water out of the gallon jug!
4. This activity is easier to manage if student groups work near a sink area. You may choose to give each group a set of materials, or you may choose to set up only one station near a sink area where each group can take a turn.
5. Before the lesson, have students work with partners to determine their height in centimeters.

ENGAGE

1. Ask students to sit still and count the number of times they breathe out in one minute.
2. Have students compare their breaths per minute to other students' rates. (Note: A line plot would be useful here.)
3. Ask: *Is everyone's breathing rate the same? Why do you think they're different?*
4. Tell students to bend and touch their toes 50 times and then count their breaths for one minute.
5. Ask: *How does exercise affect your breathing rate?*

EXPLORE

1. Instruct groups to cover their table with newspaper. Distribute the other materials to each group.
2. Have each group fill a large basin half full (approximately 6 inches) of water.
3. Students should tape a bag to the table for the disposal of used straws.
4. Show students how to calibrate the jug:
   - Have students use a measuring cup or graduated cylinder to add 400 mL of water at a time to the jug. Using a permanent marker, students should mark the water level along the side of the jug after each addition.
   - Students should continue adding water and marking until the jug is completely filled. (The last addition of water will probably be just a portion of the 400 mL.)
   - Write the calibrations on the jug, starting at the top, with the jug turned upside down.
   - Have students completely fill the jug with water (if it was emptied to write on) and screw on the lid.
5. Students will need to put two straws together by inserting one part of the way into the other to make them long enough.
6. Tell students to tip the jug upside down in the basin so the bottleneck is underwater. Remove the lid.
7. The first student should put one end of the lengthened, flexible straw inside the bottleneck. The student should take a deep breath and exhale as slowly and completely as possible into the straw. Tell students not to exhale too quickly or some of the air will bubble out the sides instead of going up inside the jug.
8. Quickly put the lid back on the jug.
9. Observe the level of the water to determine how much water has been pushed out of the jug by the air that was breathed into it. Record.
10. Students should continue the process until each person has had a chance to determine his/her vital lung capacity. Remember to refill the jug with water each time.

EXPLAIN

1. Discuss:
   What pushed water out of the jug? (air that was exhaled into the jug)
   What would be equal to the amount of air you breathed into the jug? (The volume of air in the jug is approximately the same as the volume of air that was exhaled.)
2. Have students write their height in centimeters on one side of an index card and their vital lung capacity in milliliters on the other side of the card.
   - Have students stand up and order themselves according to their vital lung capacity.
   - Use the class data to discuss these questions:
     What is the class range of vital lung capacities?
     What is the most frequent vital lung capacity measurement (the mode)?
     What is the median?
     What is the average vital lung capacity of the class (the mean)?
   - Next, have students stand up and order themselves according to their height.
   - Discuss: *Are we in the same order for height as we were for vital lung capacity? Does the tallest person also have the greatest vital lung capacity?*

EXTEND/APPLY

Discuss the flow of air through the lungs as students label the picture on the student worksheet.

EXTENSIONS

1. It is a fact that continuous exposure to polluted air or cigarette smoke over a long period of time damages the lungs. One result of this damage is that the lungs slowly lose their ability to absorb oxygen from the air and eliminate carbon dioxide. Contact the American Lung Association for educational materials or request speakers on this topic.
2. Students can investigate exercise and age as factors that influence lung capacity (e.g., How can people keep maximum lung capacity as they age?).

THE HUMAN LUNGS