



**Science Unit:** *Human Anatomy – How Do We Move?*

**Lesson 4:** *The Respiratory System*

School year: 2007/2008

Developed for: Henderson Annex Elementary School, Vancouver School District

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Grade level: Presented to grades 3-5; suitable for 3-7 with age-appropriate modifications but optimally matches Grade 5 curriculum.

Duration of lesson: 1 hour and 15 minutes

**Objectives**

1. Learn about the respiratory system.
2. Measure lung capacity.

**Background Information**

This is the fourth in a six-part series of “Human Anatomy” activities that all focus around the question: “How Do We Move?” The first session focused on the skeletal system, the second session focused on the muscular system and the third session focused on the circulatory system. Subsequent sessions will focus on the digestive system (providing the energy we need to undertake physical activity), and the nervous system (the system that coordinates the activity).

**Vocabulary**

Word:

lungs	organ, located in the chest cavity, that is used for breathing
lung capacity	the amount of air that your lungs can hold
spirometer	an instrument used for measuring lung capacity
trachea	windpipe
bronchus (plural bronchi)	tube that connects the trachea to the bronchioles; it is smaller than the trachea, but bigger than the bronchioles
bronchiole	tiny tubes that connect the bronchus to the alveoli; it is smaller than the bronchi
alveolus (plural alveoli)	tiny sacs at the end of the bronchioles; the place where oxygen enters your bloodstream and carbon dioxide is released from your bloodstream

**Materials**

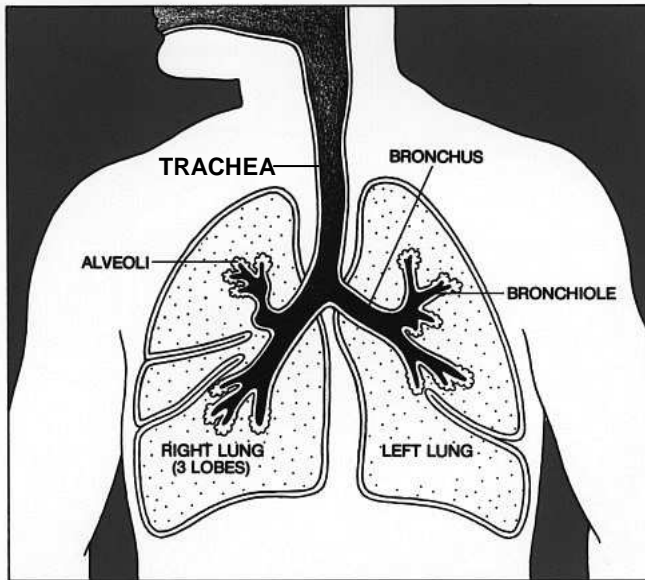
- 2 L plastic bottle
- large bowl or dishpan
- water
- masking tape
- measuring cup
- a few feet of flexible tubing



## In the Classroom

### Introductory Discussion

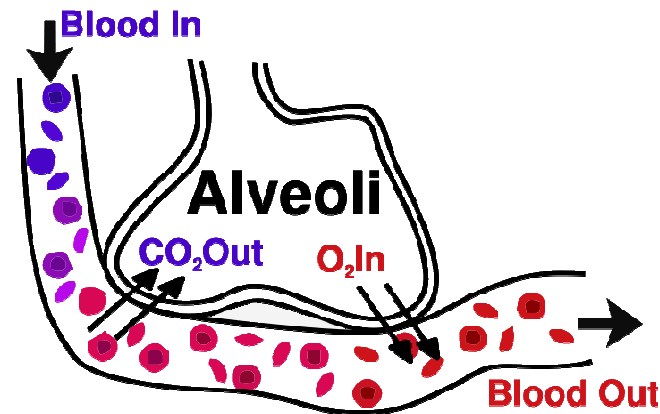
1. Have the students take a deep breath. Ask them what they know about breathing.
2. Short description of other items to discuss or review.
  - Last week, we talked about how the circulatory system transports things, including oxygen, which our muscles need to move us around. To get the oxygen into the circulatory system, we have to breathe it in and in order to do that, we need our lungs!



- You can draw out the lungs on the board and point out the different parts:
  - trachea (a.k.a. the windpipe): a tube that leads into the lungs
  - bronchus (plural: bronchi): tubes that branch off from the trachea; smaller than the trachea; air passes through them
  - bronchiole: still smaller tubes that branch off from the bronchi; unlike the trachea & the bronchi, they don't contain cartilage (cartilage = a dense tissue that makes the trachea and the bronchi more rigid/less flexible); air passes through them
- alveolus (plural: alveoli): little empty sacs at the end of the bronchioles; this is where gas exchange occurs (i.e., oxygen goes from the air into the bloodstream and carbon dioxide goes from the bloodstream into the air)

### Fun Facts About the Lungs:

- We have two lungs: the left lung has 2 lobes, but the right lung has 3 lobes
- All the airways together make up about 2,400 km
- If an adult unfolded their lungs, it would cover 75 m<sup>2</sup> – about the size of a tennis court!



3. Briefly describe science experiment/activity.
  - In today's experiment, students will test their lung capacity. They will be building a device called a "spirometer."
4. Briefly describe the processes of science that the students will focus on (prediction/hypothesis, observations, recording results, conclusions.)
  - Students will be making a hypothesis (how much air do they think their lungs can hold?).
  - Students will be making observations (measuring the amount of air their lungs hold)
  - Students will be recording their observations (on the worksheet at the end of this document)
  - Students will be drawing conclusions (comparing their results to their hypothesis and talking about why they got the results they did)
5. Remind students that this is not a competition! We are measuring everyone's lung capacity to see how much air their lungs can hold, not to find out whose lungs can hold the most!

### Science Experiment

Experiment Title: How Much Air Can Your Lungs Hold?

Purpose of Experiment: To test the amount of air that your lungs can hold.

Prediction or Hypothesis: Have students predict how much air their lungs will hold.

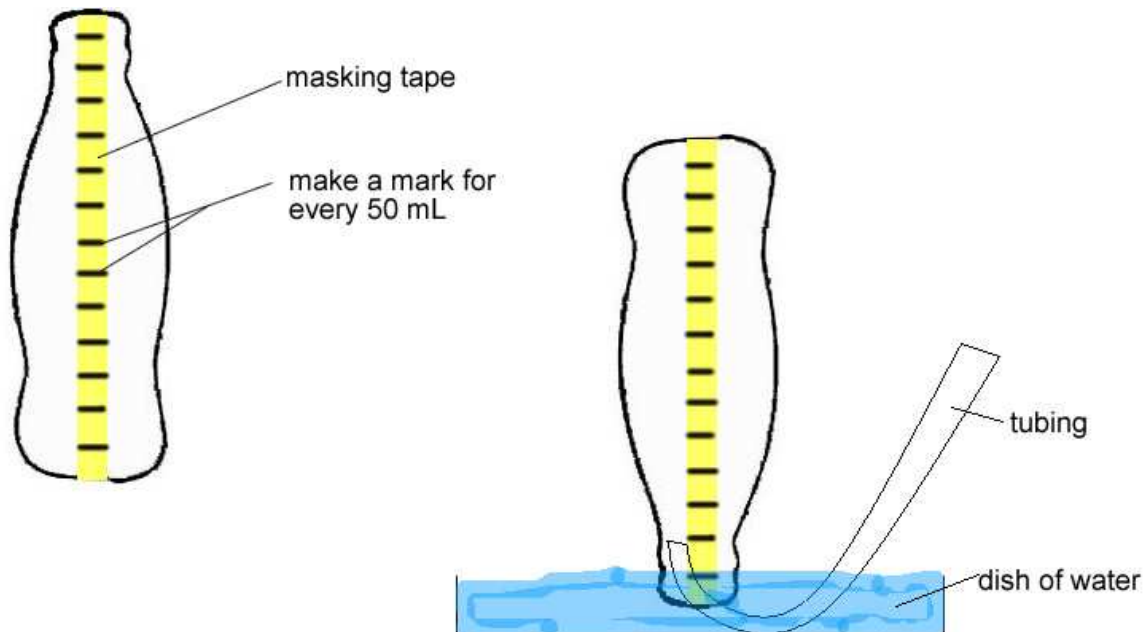
Methods and Instructions:

1. Attach a strip of masking tape vertically along the side of the plastic bottle from the bottom to the top, as shown in the diagram.
2. Using the measuring cup, measure 50 mL of water and pour it into the bottle. Mark the water level on the tape.
3. Repeat step 2 until you've reached the top of the bottle.
4. Fill the bowl/dishpan with about 10 cm of water.
5. Fill the plastic bottle completely with water. Hold your fingers over the mouth of the bottle.



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6. Turn the bottle upside down, ensuring that the mouth of the bottle stays completely covered with your fingers so that no water escapes. Place the mouth of the bottle into the water and remove your fingers once the mouth of the bottle is totally submerged in the water.
7. Insert one end of the tubing into the mouth of the bottle
8. Have the student take a breath and exhale as completely as they can into the free end of the tubing. The air from their lungs will push water out of the bottle.
9. Measure how much air is in the bottle by counting the number of marks you made on the masking tape.
10. Calculate the students lung capacity by multiplying the number of marks on the bottle by 50 mL.
11. Cut off the free end of tubing before letting the next student measure their lung capacity to avoid spreading germs. Repeat steps 5-10 for each person who is having their lung capacity measured.
12. Measure lung capacity for teachers/scientists as well as students so that you can compare lung capacities of smaller people with bigger people.



### Closure Discussion

- What's happening: When you blow the air out of your lungs into the tube, the air forces water out of the bottle. The amount of water that is forced out of the bottle is equal to the air that you are breathing out of your lungs. This is called "displacement" – you displace a measurable amount (i.e., a volume) of water with a measurable amount (i.e., volume) of air.
- Some questions to ask the class:
  1. How much air did your lungs hold?



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2. Is there a correlation between body size and lung capacity (i.e., do bigger people have bigger lung capacities)?

### References

Lung capacity. <[http://www.tryscience.com/experiments/experiments\\_lung\\_athome.html](http://www.tryscience.com/experiments/experiments_lung_athome.html)> Try Science/New York Hall of Science. Accessed 21 February 2008.

### Image Credits

The image gas exchange in the alveoli is from <http://en.wikipedia.org/wiki/Image:Alveoli.svg> and is used under the [GNU Free Documentation License](#), Version 1.2 or any later version published by the [Free Software Foundation](#); with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts.

Image of the spirometer was created by Dr. Beth Snow. Dr. Snow grants the Scientist in Residence Program and the Vancouver School Board permission to use this image for educational purposes.

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### Extension of Lesson Plan

1. An alternative way of measuring: instead of marking the bottle in 50 mL increments, you can do the following. After step 8 (where the student has exhaled through the tube into the bottle), pour the remaining water from the bottle into a measuring cup to see how much is left over. Then subtract this number from the total amount of water that was originally in the full bottle (e.g., if you are using a 4L bottle and 2.5L of water was remaining, that means that  $4 - 2.5 = 1.5$  L of water was displaced; therefore, the student's lung capacity was 1.5 L).
2. Students can build a "breathing bottle" as a model of how the lungs work: <http://www.ubclts.com/docs/AirInMyLungs.doc>
3. Students can act out what happens in the lungs. Have some students act out what happens in the lungs. One student represents lung tissue, one student represents muscle tissue, and one student represents a red blood cell. A red ball represents oxygen, a blue ball represents carbon dioxide. Give the "muscle tissue" the blue ball and tell them that this is carbon dioxide, which was made when the muscles were active and the muscles want to get rid of it and wants to get some oxygen so it can continue to be active. Give the red ball to the "lung tissue" and tell them that it is oxygen from the air that they are breathing in. Tell the "red blood cell" that their job is to bring oxygen from the "lungs" to the "muscle" (and other tissues in the body) and carbon dioxide from the "muscle" (and other tissues in the body) to the "lungs". The "red blood cell" takes the "oxygen" from the "lungs" and brings it to the muscle; they trade the "oxygen" for the "carbon dioxide" and then the "red blood cell" brings the "carbon dioxide" and gives it to the "lungs."

# The Respiratory System

## WORKSHEET

### Hypothesis:

How much air do you think your lungs can hold? \_\_\_\_\_

### Observations:

How much air ended up in the bottle after you blew into the tube? (Count the number of marks on the water bottle) \_\_\_\_\_ X 50 mL = \_\_\_\_\_ mL of air

(Each mark represents 50 mL, so multiply the number of marks by 50 to calculate the total amount of air your lungs hold)

### Conclusion:

My lungs hold \_\_\_ L of air.

A picture of lungs:

