

# HUMAN BODY

## SECTION 6: RESPIRATION

From *Hands on Science* by Linda Poore, 2003.



Westminster College

### STANDARDS:

*Students know* how blood circulates through the heart chambers, lungs, and body, and how carbon dioxide (CO<sub>2</sub>) and oxygen (O<sub>2</sub>) are exchanged in the lungs and tissues.

*Students know* plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO<sub>2</sub>) and water (respiration).

### KEY WORDS:

#### THE RESPIRATORY SYSTEM:

A system that exchanges gases in the blood. Oxygen is collected from the air by the lungs and carried to the cells by the blood. The blood collects carbon dioxide, a waste product, from the cells and returns it to be exhaled by the lungs. The exchange of oxygen and carbon dioxide takes place in air sacs in the lungs called alveoli.

**BTB (Bromthymol blue)** is a nontoxic substance that changes color in the presence of an acid. (It changes to green or yellow in an acid. In a base it becomes a deeper blue.)

### DISCUSS:

What gas do you need to live?

*Have students:* Breathe in oxygen O<sub>2</sub>.

Blow on their hand.

What did you blow out? (carbon dioxide CO<sub>2</sub>)

Do you really believe these 2 gases are different? Let's test them!

### MATERIALS:

#### *For Each Pair*

2 straws

1 cup (with 1" water)

¼ Alka-seltzer tablet

1 plastic lid for the cup

#### *For The Teacher*

1 bottle BTB (bromthymol blue)

4 vials with lids

6 piece anacharis

elodea

### EXPLORE:

#### COMPARING GASES WE INHALE AND EXHALE

#### HOW DO OXYGEN AND CARBON DIOXIDE DIFFER?

1. Pass out cups of water.

Teacher adds 2 drops of BTB to each cup.

Observe how it mixes (BTB remains suspended). Then stir gently. Discuss color. (BTB spread throughout becoming a solution with water.)

**2. WHAT HAPPENS IF YOU ADD CARBON DIOXIDE TO BTB?**

Blow into the BTB water<sub>2</sub> for 2 minutes (The water turns green.)

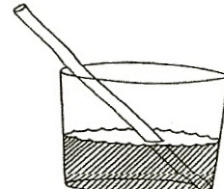
Discuss what was added to the water. (CO<sub>2</sub>)

List all the objects in this system: BTB, water, cup, CO<sub>2</sub>, straw.

Carbon dioxide mixes with water, becoming carbonic acid. (H<sub>2</sub>O+CO<sub>2</sub>+H<sub>2</sub>CO<sub>3</sub>)

CO<sub>2</sub> is the only 'safe gas' that is an acid in water.

BTB turns green or yellow with acid.



**3. HOW CAN WE GET THE CO<sub>2</sub> OUT OF THE WATER?**

Discuss how to turn BTB to blue again. How can we get the CO<sub>2</sub> out? (Add air – use a bicycle pump or stir with a straw)

**4. Put a lid on one cup and ask what is in this cup system.**

(BTB, water, air, carbon dioxide, cup lid)

How can we get the air into the BTB? Pass out lids to students.

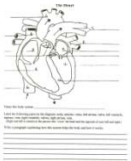
Shake cups. (Air pushes the CO<sub>2</sub> out. The BTB returns to blue.)

**5. WHAT HAPPENS WHEN YOU HOLD YOUR BREATH?**

Have 4 students hold their breath for 10 seconds and then blow all their air quickly through straws into 1 cup of water with BTB.

Have 4 students who do not hold their breath blow 1 big breath into a different cup of water the BTB. Compare results.

CO<sub>2</sub> builds up in the lungs when you hold your breath and thus the BTB in the water turns greener or yellow.)



**6. WHAT HAPPENS TO SELTZER TABLETS IN WATER? WHAT IS IN THE BUGGLES? WHAT GAS IS IT?**

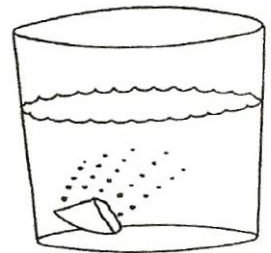
Pass out ¼ Alka Seltzer per pair.

Students have blue BTB systems.

Add Alka Seltzer and put a lid on immediately.

Observe and discuss.

The lid may pop up from pressure of the CO<sub>2</sub> gas. BTB turns yellow indicating an acid is present. (CO<sub>2</sub> + water = carbonic acid.)



**7. WILL OXYGEN ENTER THE BTB GREEN CUP AND PUSH THE CARBON DIOXIDE OUT?**

Leave 2 full vials of green BTB overnight. Cover one vial. Predict what will happen in each. (O<sub>2</sub> from air pushes CO<sub>2</sub> out of the uncovered vial and it turns blue.)

**DEMONSTRATE:****1. WHAT GAS DO PLANTS GIVE OFF?****PLANT WITH LIGHT:**

Get a houseplant or grow 3 seeds in a cups of soil.

(e.g., beans or plain popcorn)

Tape an open vial of green BTB on a ruler stuck into the soil.

Cover the plant with a plastic bag, pushing out all the air and tie the bag shut with a twist-tie or string. Leave the plant in sunlight for 1 day.

What happens to the green BTB? Why?

(The plant gives off oxygen-the green BTB will turn blue.)

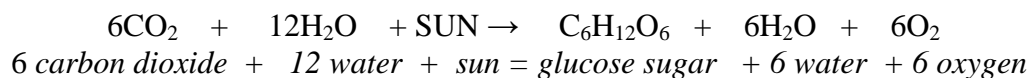
What is inside the bag? (Condensation: Plants give off water.)

**2. PLANT IN THE DARK:**

Leave the plant in a dark closet with blue BTB in one vial and green BTB in the second vial for a day. Label the color on each lid and put the lids on the bottom of the vials. Push all the air out of the bag again and tie the bag with string.

**3. Predict:** What color will each vial of BTB be the next day? *Ask students:* What will happen if the plant gives off oxygen? What will happen if the plant gives off carbon dioxide? (Students must give a reason for their prediction.)**4. Observe:** What color is the BTB the next day?  
The BTB turns green showing CO<sub>2</sub> gas was given off.**5. WHY?** *Photocopy the photosynthesis/respiration chart.*

When plant cells break down sugar to obtain energy (respiration), carbon dioxide (CO<sub>2</sub>) and water are given off. Plants give off oxygen only during the day as part of photosynthesis. Plants undergo respiration and give off carbon dioxide at night when there is not sun! Look at the formula for photosynthesis and notice that one of the products is oxygen:

**CHEMISTRY:****ATOMS, ELEMENTS, AND MOLECULES**

Reinforce the Chemistry Standards. Make a transparency of the chart showing the chemical formulas for respiration and photosynthesis. Ask the students to name all the elements involved in photosynthesis. (carbon, oxygen, hydrogen)

Write the formula for a sugar molecule.. (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>)

List how many atoms of carbon are in this molecule. (6)

Name 3 products of photosynthesis. (sugar, water, oxygen)

**KEY WORD:**

**DIAPHRAGM:**

A muscle under the ribs that helps breathing by changing air pressure in the lungs. As the diaphragm contracts (is pulled downward), the size of the chest cavity increases. This makes less air pressure in the lungs and air from the outside rushes in, making the lungs expand.

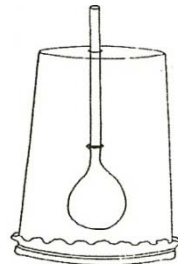
**MATERIALS:**

- 1 Quart-size plastic cup (has a small hole in bottom for straw)
- 1 straw
- 2 balloons ( 1 large, 1 small)
- 1 rubber band
- tape

**DEMONSTRATE:**

**HOW DOES THE DIAPHRAGM HELP BREATHING?**

1. Construct a model to show how the diaphragm helps breathing. The cup is the chest cavity and the suspended balloon is a lung.
2. Tape the straw tightly in the mouth of the small balloon and suspend the balloon inside the cup with the straw extending through the hole in the cup bottom. If the straw fits loosely in the hole, slide the balloon neck (cut off the large balloon) over the straw, twisting it tight and positioning it in the hole to seal the air inside.
3. Cut the neck off a large balloon and cover the cup opening with the balloon, securing it with a rubber band.
4. Pull down gently on the balloon (the diaphragm). The 'lung' inflates! Push up on the balloon. The 'lung' deflates.
5. When the diaphragm contracts downward there is more space in the respiratory cavity and thus the air pressure inside the cup is less than the pressure in the room. The room air pushes into the suspended balloon, filling it.



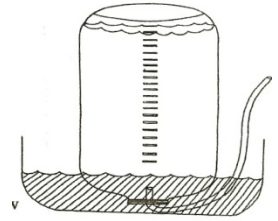
**DEMONSTRATE:**

**HOW DOES OXYGEN GET FROM THE LUNGS INTO THE BLOOD?**

1. Observe a helium or air inflated balloon in the classroom for several days. Oxygen and helium molecules are tiny and diffuse through the porous balloon.
2. Gas diffuses through the balloon's rubber and escapes. Likewise oxygen diffuses through the air sacs in the lungs and is collected by the capillaries. The blood carries oxygen to the cells.

**MATERIALS:**

- 36 Straws
- 2' plastic tubing
- 1 large plastic dish pan
- 1 gallon transparent bottle



**NOTE:**

**MARK THE BOTTLE:**

Using a measuring cup, add 250 ml of water to a 1-gallon plastic bottle. Mark a line in permanent marker to show the height of the water in the bottle. Fill the jug to the top with water, marking a line for every 250 ml with the permanent marker.

**EXPLORE:**

1. **WHAT IS YOUR LUNG CAPACITY?**

Fill the bottle with water and screw the lid on it.

Place the bottle upside down in a basin of water. Unscrew the lid while the jar neck is under water, so no water escapes.

Slip the tubing under the mouth of the bottle. (see picture)

Slip a straw inside the tubing.

2. **PLAN AN EXPERIMENT:**

Show students the materials.

What will happen if you blow on the tube?

How can we make a fair test? (only 1 big breath per person)

How can we find out if lung capacity differs in individuals?

3. **PREDICT** who has the most air in their lungs.

On the pretest write your prediction and explain why you made it. Write the word procedure and make a list of instructions for testing lung capacity.

Title your paper with a question we want to answer.

4. **MEASURING LUNG CAPACITY:**

Hold the straw tightly where it connects to the tubing so air does not leak out. Take a deep breath and blow out all the air from 1 breath into the jug through the straw. Use the 250 ml mark on the jug to measure the volume of air in your lungs. Your lungs will retain about 1 pint (473 ml) of air after you have tried to expel all of your air. (1000 ml=1 liter)

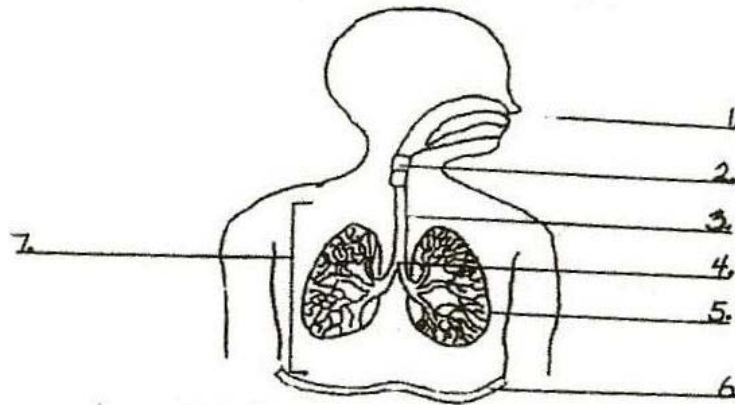
5. Compare the amount of lung capacity of different students. Refill the bottle so it is full of water for each student. Record data in milliliters (ml).

6. **GRAPH** several students' lung capacity in the class.

Compare lung capacity to height of the student.

Write a conclusion based on the experiment results.

7. **EXPERIMENT REPORT:** (Add to pretest paper.)  
Add the word results and conclusions to this paper and complete the report.  
(The top half of the Science Experiment Lab sheet from Section 8 can be used for this report.)
8. Lung capacity is determined by a person's physical size and is increased with exercise and decreased by smoking.



**ASSESSMENT:**

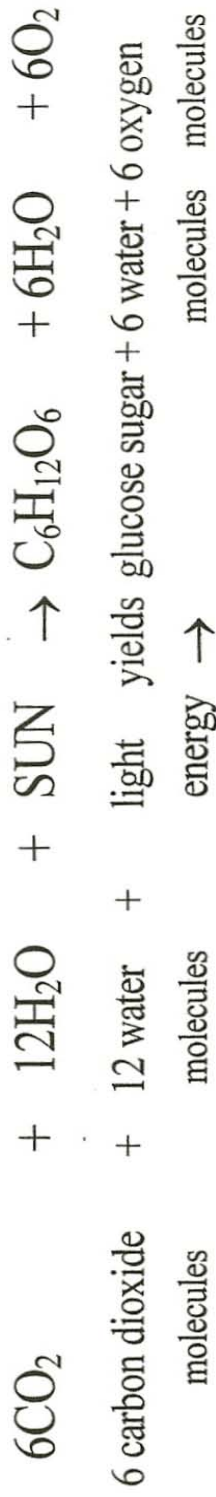
**HOW DOES THE RESPIRATORY SYSTEM WORK?**

Label the diagram and describe the system on the work sheet at the end of this section.

*Diagram Answers: 1. Nose, 2. Larynx, 3. Trachea, 4. Bronchi, 5. Capillaries, 6. Diaphragm, 7. Lung*

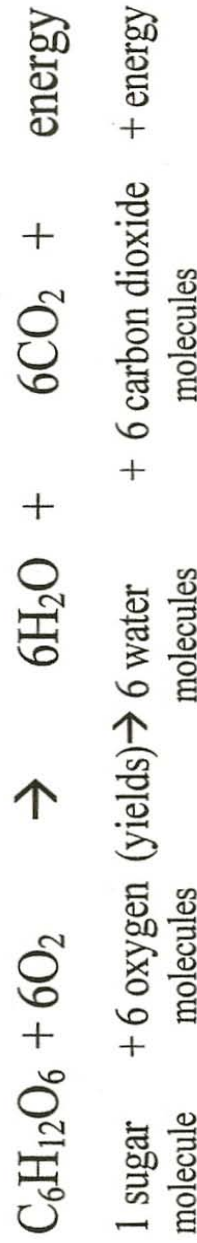


# PHOTOSYNTHESIS



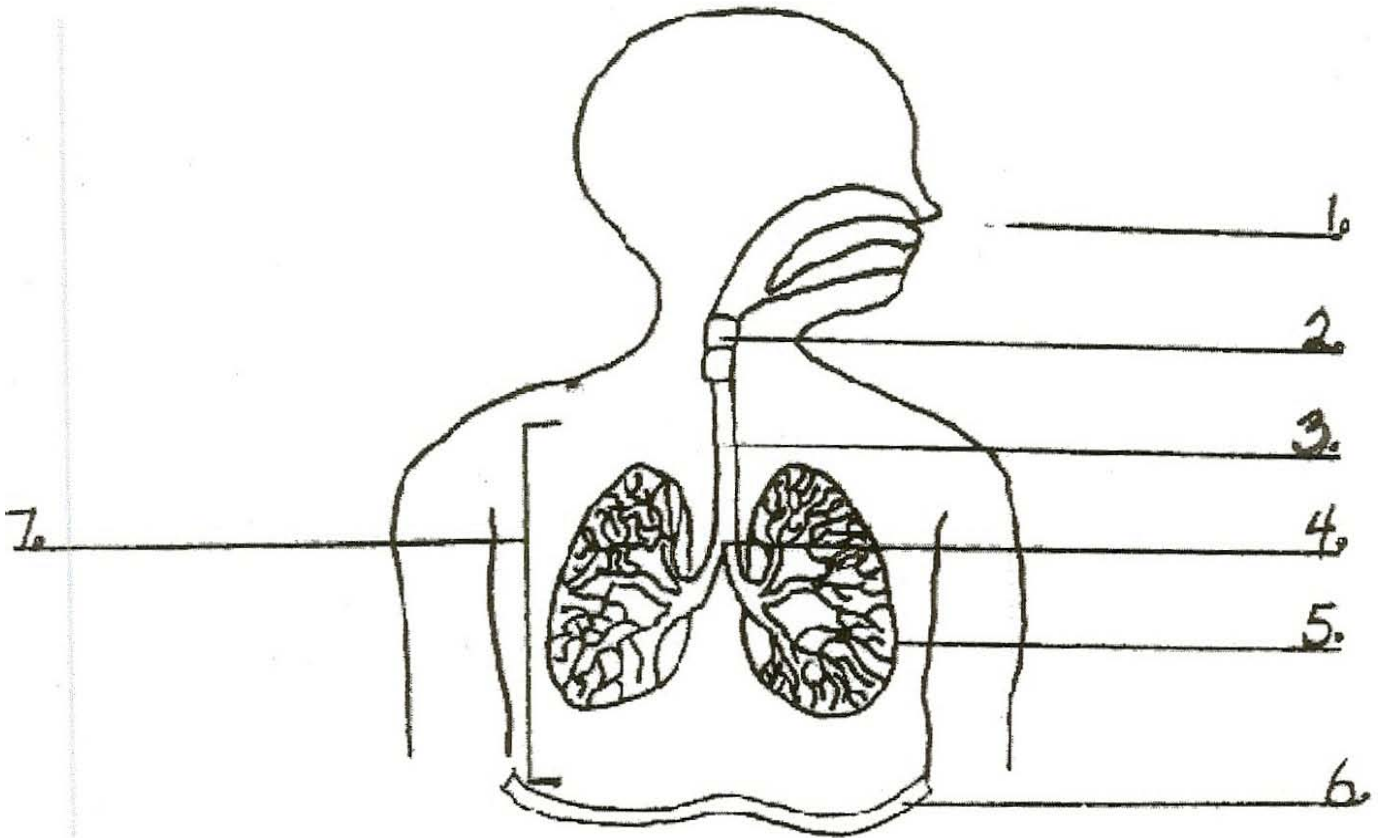
Sugar is made by green plants during photosynthesis. Oxygen and water are waste products produced during photosynthesis and given off by green plants through the stomata in the leaves. Plants give off oxygen only when light energy is available. In the dark, plants give off carbon dioxide during respiration

# RESPIRATION



Respiration is a chemical process that changes sugar (food) to energy. Every cell in your body carries on respiration to produce energy from food. Plant cells also undergo respiration, changing sugar to energy for growth and giving off carbon dioxide.

Label the following parts on the diagram: lung, diaphragm, capillaries, trachea, nose, chest cavity, larynx, and bronchi.



The esophagus includes the \_\_\_\_\_ and \_\_\_\_\_.

Write a paragraph explaining how this system helps the body and how it works.

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