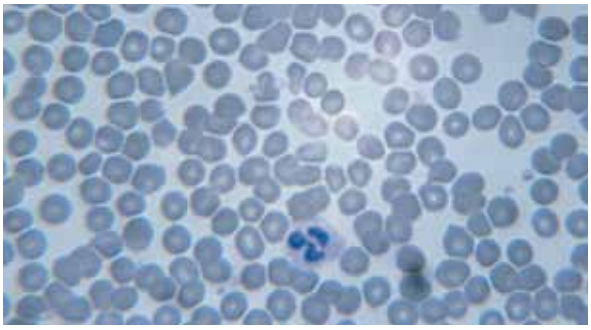
41 A Cell So Small

Some organisms, like bacteria, consist of only one cell. Other organisms consist of several to many cells. An adult human being is made up of approximately 10 trillion cells. One drop of human blood, has about 500 *million* cells!

Why do some cells need to be so small? Why aren't multicellular organisms like people made up of just one huge cell instead? Find out by modeling large and small cells.

CHALLENGE **Why are cells so small?**



Red blood cells are the most numerous cells in blood.

MATERIALS

For each group of four students

- 1 bottle of blue food coloring
- 1 plastic cup, ½ full with water
- 1 SEPUP tray
- 1 SEPUP filter funnel
- 2 pieces of filter paper
- 1 30-mL graduated cup
- 2 10-mL vials with caps
- 1 stir stick
- 2 pieces of carbon
- carbon powder
- 1 dropper (optional)

For each student

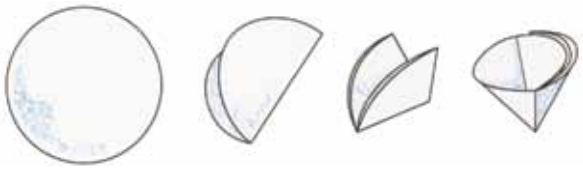
- 1 pair of safety goggles

SAFETY

Wear safety goggles. Be careful when handling carbon. It is messy and can ruin your clothes. Never place any carbon directly onto a counter; put it on a piece of paper or a paper towel. Be sure to carefully clean up any spills. Be careful not to inhale the powder. Wash your hands after completing the activity.

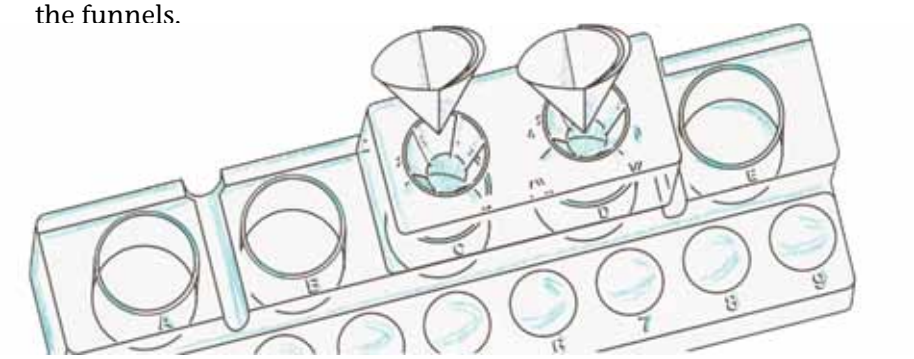
PROCEDURE

1. Fold 2 pieces of filter paper into cones as shown below: first fold each paper in half and then in half again. Open each filter paper into a cone (pull one piece to one side and push the rest to the other side).



FOLDING FILTER PAPER INTO A CONE

2. Place the plastic SEPUP filter funnels over large Cups C and D of your SEPUP tray, as shown here. Then place a filter paper cone into each of the funnels.



SETTING UP THE FILTER

3. Dye your cup of water blue by adding 2 drops of blue food coloring. Stir.
4. *Model large cells:* Place 2 pieces of carbon into one of the 10-mL vials.
5. *Model small cells:* Using the scoop on a stir stick, your teacher will measure out the same volume of carbon powder into the other vial. You should now have the same amount of carbon in each of the two vials.

6. Discuss with your group of four: Imagine that the blue dye models oxygen dissolved in the water. Which cell models—large or small—do you predict will absorb the most blue dye? Record your prediction and your reasons.
7. *Model how well the cells can take up oxygen or nutrients they need to live:* Use your 30-mL cup to add 7.5 mL of dyed water to each vial. Then cap the vials and shake each vial ten times.
8. Open the vial containing the carbon pieces. Pour the mixture through the filter paper over Cup C.
9. Open the vial containing the carbon powder. Pour the mixture through the filter paper over Cup D.
10. Observe and record the color of the water in each large cup of your SEPUP tray.
11. Clean up as directed by your teacher.
12. Read the information in the box below before answering the Analysis questions.

Cellular Respiration: A Function of Every Cell

All organisms use some form of cellular respiration to release the energy stored in food. Cellular respiration is a series of chemical reactions that take place within cells. This process breaks down food into smaller substances. Every cell in an organism must be able to absorb nutrients and release wastes produced by cellular respiration and other reactions that take place in the cell. Absorbing nutrients and releasing wastes take place through the cell membrane.

In animals, plants, and many microbes, cellular respiration requires oxygen. This type of cellular respiration is called aerobic respiration, and always produces carbon dioxide waste. Another type of cellular respiration is anaerobic respiration. This does not require oxygen. Your muscles rely on anaerobic respiration for a short time when they can't take in oxygen fast enough to meet their energy needs. This often leads to cramping from the buildup of wastes. Some microbes, like the yeast you studied in Activity 39, "Cells Alive!" can use either aerobic or anaerobic respiration, depending on whether oxygen is present.

Some organisms, including certain bacteria, use only anaerobic respiration. A number of anaerobic bacteria cause diseases, while others are helpful. Anaerobic bacteria are found in the human digestive system where they help break down some nutrients. Anaerobic bacteria in the mouth release waste products that cause bad breath.

ANALYSIS

1. In this model, what did each of the following represent?
   a. carbon powder
   b. carbon pieces
   c. blue dye
2. What happened to the blue dye in each vial? Explain.
3. According to the model, which cells—large or small—are most efficient at taking up oxygen and nutrients from the environment? Explain.
4. Which cells—large or small—do you think are most efficient at getting rid of carbon dioxide and other wastes?
5. What is one reason multicellular organisms, such as people, are made up of many small cells instead of one large cell?