Using Models to Study Cells

Identifying Relationships

The characteristics of organisms can often be understood by showing how their parts are related. Because most cells are microscopic in size, it is sometimes difficult to study them directly or to clearly see relationships among their parts. In this activity, you will make models of cells and use these models to find the relationship between the volume of a cell and its total surface area.

The materials that cells need for life functions move from the cells' surroundings into the cells. Waste materials are transported out of the cells into the cells' surroundings. The transport of materials occurs across the cell membrane. As a result, the amount of material that can be transported into and out of a cell is influenced by the size, or surface area, of its membrane.

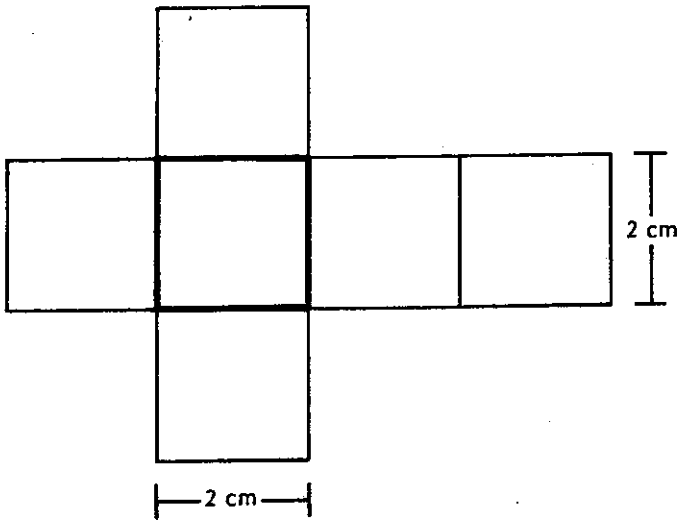
Scientists hypothesize that cell size is determined in part by the ratio of the cell's surface area to its volume. Most cells are small; therefore, materials can rapidly pass into and out of the cells. One question that scientists have explored is, does the surface area of the cell membrane increase in proportion to an increase in cell volume?

To make Cell Model I, cut out Figure 1. Fold it along the dark lines and tape the sides together to form a cube. To find the volume of a cube, multiply the length by the width by the height. With a metric ruler, measure the sides of the cube and calculate its volume.

Next, to find the area of one face of the cube, multiply the length of one side by the other. Because a cube has 6 faces, multiply the area of one side by 6 to find the total surface area of the cube.

Record your results in the first row of the table on the following page.

Figure 1



Next, make two more models, Cell Model II and Cell Model III. The length of each side of Cell Model II should be exactly 3 centimeters. The length of each side of Cell Model III should be exactly 4 centimeters. Determine the volume and the total surface area of each. Record your results in the table.

	Length of side (cm)	Volume (cm^3)	Surface Area (cm^2)
Cell Model I	2		
Cell Model II	3		
Cell Model III	4		

1. Using the table, compare the surface areas and volumes of each of the cell models. Which shows a greater increase, volume or surface area?

2. a. Which has the greater volume, Cell Model I or Cell Model III?

   b. how many times greater?

3. a. Which has the greater surface area, Cell Model I or Cell Model III?

   b. how many times greater?

4. To determine which cell model has the greatest amount of surface area per unit of volume, divide the surface area of each cell by its volume.
   Which cell model had the largest number?

   Which cell model has the greatest amount of area per unit of volume?

5. Look at Figure 2 and Figure 3. Explain how the shape of each cell shows an increase in the amount of its surface area compared to its volume.

Figure 2

Figure 3