

**There's a Limit! (to Cell Size)**  
**or,**  
**Why The Blob Is Only Science Fiction**

**Introduction**

Is there a reason that cells keep dividing rather than just growing larger and larger? The optimal size of cells is a function of the relationship between surface area and volume. Nutrients, oxygen, and water enter through the cell membrane, and wastes are eliminated through it.

**Materials:**

Cubic cell models  
Scissors  
Tape  
Pencil and paper  
Cornmeal or millet (optional)  
Scales (optional)

**Procedure:**

Cut out the 4 cube diagrams

Fold and tape as directed

Write a formula for finding the:

- Area of 1 face (when "s" = length of one side)
- Total Surface Area of the cell
- Volume of the cell
- Distance from the cell center to middle of a cell wall

Calculate the above data for each cell

Calculate the Surface Area to Volume Ratio for each cell

Make a Table for your Data

### **To Notice and Discuss:**

Which measurements represent the cell membrane? Which the cell contents, or cytoplasm?

As a cell grows larger, what happens to the Total Surface Area to Volume ratio?

What happens to the Distance from the center of the cell to the cell membrane?

What could this mean for the cell?

Which size cell has the best chance of efficient interactions with its environment?

What could cells do to increase their Total Surface Area to Volume ratio?

### **Extensions:**

Fill the cell models with cornmeal or millet and weigh the amounts. Discuss the relationship of Total Surface Area to Weight and what relevance this would have to a cell.

Experiment with the rate of reaction of a substance by changing the surface area:

Break an Alka Seltzer tablet in 2. Crush one half into pieces. Place the half tablet and the crushed half into two film cans partly filled with water. Put on the lids and time how long it takes for the released gas to blow the tops off.

### **What's Going On:**

As the activity shows, the volume of a cell grows faster than the surface area as a cell enlarges. The larger a cell gets, the harder it is to get things in and out of it, as substances must traverse a greater distance **within** the cell to get to or from the membrane. Smaller cells are more efficient because it is easier to get things, such as nutrients and waste, in and out. The size of individual cells in multicellular organisms is remarkably similar. Most eukaryotic (nucleus-containing) cells of most organisms are about 10 micrometers in diameter. (This pertains to the nucleus-containing cell body, even in cells with long extensions, such as neurons.) The cell size of newborn organisms is approximately the same as that of adults; organisms grow by making more cells.

(This activity based on ideas from James Deaver and Truman Holtzclaw)

