Name _____ Period _____ Date _____

# Lab: Size Matters (Cell Size and Surface Area)

Why are cells so small? Why do they stop growing after reaching a certain size? How does the size of a cell affect the transport of nutrients and waste across the membrane? What causes the cell to stop growing and then to divide into two smaller cells? In this lab you will use some cell "models" to learn about the relationship between the surface area of a cell, the volume of a cell, and the effect of cell size on the efficiency of transport.

## Materials

- 2 plastic cups
- plastic spoon
- plastic knife
- paper towel
- beaker of water
- ammonia, diluted 1:20
- metric ruler
- white paper plate
- 2 gelatin cubes in each of 3 sizes ($1cm^3$, $2cm^3$, $3cm^3$)

## Procedures

1. Place 1 of each size blocks into each of the plastic cups. Carefully pour diluted ammonia into both cups until blocks are covered with fluid. Begin timing (you will be removing one set of blocks after 5 minutes and one set after 20 minutes).

2. Note that the blocks on display at the teacher's lab table are left untreated—these will be your control (comparison) blocks.

3. After 5 minutes, use a spoon to remove one block of each size from a cup of the treatment liquid (the dilute ammonia). Dip blocks briefly in water, then place on white paper plate. Cut each block in half with the knife. Observe any color changes, and record your observations below (top of next page). Measure the distance the color change has penetrated from the exterior toward the interior, and record your measurements in the appropriate table. Use this number to estimate the percentage of the block that the treatment liquid has penetrated.

4. While the cubes are soaking in the treatment, you can fill out your data table. Calculate the surface area (SA) and volume (V) for each of cubes (your cell models).

5. After 20 minutes total (15 minutes after you took out the first set), repeat the above procedure with the second set of blocks.

6. Clean up. DO NOT THROW AWAY CUPS AND PLASTIC UTENSILS!!! Throw away used paper towels, plate, and cut up cubes in the trash receptacle. Discard used treatment liquid in the sink. Rinse out cups and plastic utensils, return all cleaned out items to lab baskets.

## Data Tables

1. TIME = 5 minutes

| Cube Dimensions | Surface area (SA) ($cm^2$) | Volume (V) ($cm^3$) | SA:V ratio | Depth of green (cm) | V penetrated | % Penetrated |
|---|---|---|---|---|---|---|
| 1 cm | | | | | | |
| 2 cm | | | | | | |
| 3 cm | | | | | | |

SA = number of sides x width x length of original gelatin cube
V = length x width x height of original gelatin cube
V penetrated = volume of original cube – volume of the purple portion of cube
% Penetrated = volume of green portion of cube / original volume x 100

*Observations at 5 minutes:*

2. TIME = 20 minutes

| Cube Dimensions | Surface area (SA) ($cm^2$) | Volume (V) ($cm^3$) | SA:V ratio | Depth of green (cm) | V penetrated | % Penetrated |
|---|---|---|---|---|---|---|
| 1 cm | | | | | | |
| 2 cm | | | | | | |
| 3 cm | | | | | | |

*Observations at 20 minutes:*

**Discussion Questions**

1. What do the gelatin blocks in this lab represent?

2. a. Nutrients that a cell needs for survival and wastes that a cell needs to get rid of must go through the membrane surrounding the cell. Which cell do you think will do the BEST job of moving materials into and out of the cell?

   b. Why did you pick that cell?

3. How do the depths of the green portions of each cube compare?

4. a. Which cell has the largest percentage of its volume green?

   b. What does this mean about how efficient this cell is in receiving materials from the outside?

5. Looking at the surface area to volume ratio (SA:V) for each of your cells, explain efficiency of a cell in terms of the SA:V ratio.

6. Given what you now know about the surface area to volume ratio, apply this to a real cell. How might cell size affect when a cell will divide into two?