**Cell Size Activity   
Background:**   
When cells reach a certain size, their rate of growth slows down. They will eventually stop growing. Each of these cells divides into two smaller cells, which begin to grow. What causes this? An easy way to investigate such questions is to build models. A model is often thought of as a small copy of something larger. Here we will be making a larger model of something small.

When a cell becomes too large, it is no longer as efficient as it used to be. It now has a greater volume and it takes much longer for materials that enter the cell to reach the center of the cell. This concept will be demonstrated in the lab.

**Purpose:**   
To build a model of a cell to understand why when cells reach a certain size they stop growing.

**Materials:**

·         Block of phenolphthalein agar, razor blade, 100 ml 4% sodium hydroxide  (you MUST wear goggles!!!)

·         plastic spoon, 250ml beaker , plastic table knife, millimeter rulerpaper towel

**Procedure: alternate procedure watch video: (**[**http://www.youtube.com/watch?list=PL48AAE5CCD058BDE9&v=xuG4ZZ1GbzI&feature=player\_detailpage**](http://www.youtube.com/watch?list=PL48AAE5CCD058BDE9&v=xuG4ZZ1GbzI&feature=player_detailpage) **)**

1. With the razor blade, cut the block of phenolphthalein agar into cubes. The first cube should be 3cm on each side; the second, 2 cm on each side; and the third, 1 cm on each side. Measure carefully and trim away the waste. Examine the cubes. Think of them as giant models of tiny cells. *Which of your three different-sized cells do you think would be most likely to survive? Why do you think so? Materials used during cell activity and growth enter the cell from the outside and must travel through the cell to their destination. Waste products go through the cell surface to the outside. Do you think the cell with the greatest total surface area will do the best job of moving materials in and out of the cell? Why or why not?*

2.   Calculate the total surface area of each of your three models using the following formula: Surface area = 6 x (length x width), that is, the total surface area is 6 times the surface area of one side.

3.     Record the total surface area for each cube in Table 1.Which cell has the greatest surface area?

4.     The cells have different surface areas and they have different volumes (amounts of materials inside). Calculate the volume of each cube. Volume = length x width x height.

5.     Record the volume of each cube in data Table 1. Look back at the prediction you make in #1. Do these new calculations change any of your earlier   ideas? Why or why not?

6.     Place the cubes in the beaker. Pour enough sodium hydroxide solution to cover them. Record your starting time. Use the plastic spoon to turn the cubes often for the next 4 minutes. Be careful not to cut or scratch the surface of the cubes. Blot them dry.

7.     Slice each cube in half with the plastic knife. *What differences do you see? Draw a 3cm, 2cm and 1cm square below and draw what you see. Measure the distance from the edge that the sodium hydroxide traveled and color code that on your drawings.*

*Phenolphthalein Cube Drawings*

|  |  |  |
| --- | --- | --- |
|  |  |  |
| *3 cm cube* | *2 cm Cube* | *1 cm Cube* |

8.     Calculate the ratio of surface area to volume for each cube. To do this, for each cube size, divide its surface area by its volume. The number obtained can be expressed as a ratio. For example, a surface area of 24cm2 divided by a volume of 3 cm3 = 24/3 = 8/1 = 8:1.

9.     Record this ratio on data Table 1.

*Which cell model is the most efficient? Why?*

*How does this demonstrate why larger cells would want to divide?*

**Results:**

**Table 1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Phenolphthalein – Agar Cubes** | | | |
| **Side of cube (cm)** |  |  |  |
| **Total Surface Area (cm2)** |  |  |  |
| **Volume (cm3)** |  |  |  |
| **Surface area to Volume Ratio** |  |  |  |

**Questions:**

1. What surrounds a cell and controls what enters or leaves?
2. Materials move into and out of a cell by what process?
3. Is diffusion more efficient over short or long distances?
4. The size of a cell is limited by the ratio of what TWO characteristics of the cell?
5. Which increases faster --- surface area or volume of a cell?
6. Why is the surface area of a cell so important to life of a cell?
7. Did the phenolphthalein diffuse into each cube in the same amount?  Why or why not?
8. When a cell’s volume becomes too large for its surface area, what do the cells do?

Day 2:

1. Using the 1 cm cubes, make a perfect cube that is 4 cm on each edge.

a. What would be the surface area of this cube?

b. What would be its volume?

Cut the cube in half, forming 2 new equal prisms.

c. What would be the surface area of each prism?

d. What would be their combined surface area?

e. What is the volume of each prism?

f. What is the total volume?

2. Make a 5 cm cube on each edge.

a. What would be the surface area of that cube?

b. What would be the volume?

4. Using 27 one cm cubes, arrange the cubes so that each cube has at least one side against full side of another cube.

a. Draw the arrangement that will yield the greatest possible surface area.

b. Draw an arrangement that will yield the least possible surface area.

5.  Jack rabbits found in desert areas have very long ears, while Arctic Hares have much shorter, rounder ears. Hypothesize how ear shape (surface area) relates to heat loss.