Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Period: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**DIFFUSION AND CELL SIZE**

**PROBLEM:** How does the relationship between the surface area and the volume of a cell affect the rate of diffusion of materials in and out of a cell?

**BACKGROUND:** Diffusion is the net movement of molecules from an area of **HIGH** concentration to an area of **LOW** concentration. Diffusion is an important process for living cells. Materials that can pass easily through the cell membrane, such as water, oxygen, and carbon dioxide, enter and leave cells by diffusion.

The size of cells depends in part on how efficiently materials can move in and out of the cells by diffusion. When cells grow to a certain size, their rate of growth slows until they stop growing entirely. They have reached their size limit. When one of these larger cells divides into two smaller cells, the rate of growth again increases.

In this lab, you will use cubes of ***agar*** that have an ***indicator*** (***phenolphthalein***) dissolved in them. Think back – we used phenolphthalein as an indicator in the pH lab. In a ***basic*** solution, such as ***sodium hydroxide*** (NaOH), phenolphthalein turns pink or red. It remains colorless in an ***acidic*** solution. In this lab, you will determine diffusion in a period of time by measuring how far the color develops in the agar cubes that were immersed in a basic solution.

 

**MATERIALS:**

3 cubes of 3% agar-phenolphthalein (1 cm, 2cm, and 3cm on a side)

4% sodium hydroxide solution (NaOH)

Beaker ruler plastic spoon plastic knife paper towel

**PROCEDURE:**

1. Measure each agar block and trim if necessary to make the sides the correct sizes: 3 cm, 2 cm, and 1 cm each.

2. Place the agar cubes in the beaker and pour in the NaOH until the blocks are submerged (covered).

3. Record the time that you covered the blocks - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Turn the blocks frequently for the next 5 minutes.

4. After 5 minutes, remove the agar blocks from the NaOH and blot them dry. **Avoid handling the blocks until they are blotted dry.**

5. Use the plastic knife to slice each block in half. Measure the depth of diffusion of the NaOH in centimeters (how far in did the color change). Record this in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **CUBE DIMENSIONS** | **SURFACE AREA (CM2)** 6 (L x W) | **VOLUME (CM3)**L x W x H | **SURFACE TO VOLUME RATIO** |
| 3 cm / side |  |  |  |
| 2 cm / side |  |  |  |
| 1 cm / side |  |  |  |
| 0.01 cm / side |  |  |  |

|  |  |
| --- | --- |
| **CUBE DIMENSION** | **DEPTH OF DIFFUSION** (cm) |
| 3 cm / side |  |
| 2 cm / side |  |
| 1 cm / side |  |

1. Which has the greatest surface area, a cube 3 cm on a side or a microscopic cube the size of an onion skin cell?

 Which has the greatest surface area in proportion to its volume of the two cubes?

2. What evidence is there that NaOH diffuses INTO an agar block?

 Is there any evidence that something was diffusing OUT OF the agar blocks? Explain.

3. If the agar blocks were living cells and the NaOH were a vital substance, which block would have the most efficient ratio of surface area to volume?

4. What happens to the surface area to volume ratio of a cell as the cell grows?

5. Why does the growth rate of a cell slow down as it gets larger?

6. How does division affect the cell's ability to absorb material for growth?

**Now, think hard:**

When one cube-shaped cell divides into two equal parts, how does the volume of each small cell compare with the one large cell?

Does the surface area change in the same proportion? Explain.