🖉***AP Biology Lab Investigation 4(new)/1(old):***

🖉 Indicates that this should be written in lab notebook.

**Diffusion and Osmosis – Procedure 1 Surface Area and Cell Size**

🖉**GROUP MEMBERS**

LEADER - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ MATERIALS MANAGER - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

DATA COLLECTOR - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ SAFETY/CLEAN UP - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**INTRODUCTION**

Sizes of cells vary greatly, depending on whether they are prokaryotic or eukaryotic, and also by cell type (some neurons are a meter long!). No matter what its size, materials must be transported in and out of cells, and larger cells have developed structures to facilitate transport. In this lab, cells are represented by agar/gelatin cubes that will be submerged in a solution to determine the rate of diffusion.

The ***volume*** of a cell determines the amount of metabolic activity it carries out per unit of time.

The ***surface area*** of a cell determines the amount of substances that can enter it from the outside environment, and the amount of waste products that can exit to the environment.

🖉**QUESTION (copy)**

How do surface area – to – volume ratios affect the rate of diffusion?

🖉**LEARNING OBJECTIVE (copy)**

* Calculate surface area – to – volume ratios to predict how cell size and shape can affect the overall rate of diffusion (LO 2.6 and LO 2.7)

**🖉PRE-LAB QUESTIONS (answer)**

1. What is diffusion?
2. How do you calculate surface area – to – volume ratio?
3. Cell size and shape are important factors in determining the rate of diffusion. Think about cells with specialized functions, such as epithelial cells that line the small intestine or plant root hairs.
   1. What is the function of these cells?
   2. Sketch the shape of these cells.
   3. How does the shape of these cells relate to their function?
4. What color does phenolphthalein indicator turn when it is in the presence of a base?
5. Complete this chart:

|  |  |  |  |
| --- | --- | --- | --- |
| **Cube Size** | **Surface Area (SA)** | **Volume (V)** | **SA / V** |
| **1 cm3** |  |  |  |
| **2 cm3** |  |  |  |
| **4 cm3** |  |  |  |

1. How many 1 cm cubes would be needed to make a 4 cm cube? Use the data you calculated in question 5 to explain your answer.

🖉**HYPOTHESIS**

Write down your hypothesis in an “If…then…” statement. (Answer the question.)

🖉**PROCEDURE (flowchart format with pictures)**

1. Cut the agar/gelatin into (approximately) 1 cm, 2 cm, and 4 cm size cubes.
2. Measure the cube dimensions and record in data table. (Don’t worry too much about which side is the L, W, or H – you can consider it just as “Side 1”, “Side 2”, and “Side 3”.)
3. Place cubes into beaker (try not to have them touch each other). Pour solution until cubes are completely submerged.
4. After 10 minutes, take out cubes with plastic spoon and cut each cube in half.
5. Measure the dimensions of the region of no color change (the “center”) and record in data table (you may have to estimate one of the sides because you are cutting the cube in half).

🖉**DATA TABLE**

Use colored pencils and a ruler to sketch a cross section of each cube (to scale – include measurements) in your lab notebook. Measure to the **tenth decimal place** (example: 2.4 cm). Remember that for one side, you will have to multiply the measurement by 2 (because you are cutting the cube in half).

\*\*\*After the lab, use the data to calculate the **diffusion rate** of each cube (% diffusion/time). Time = how long you ran the experiment.\*\*\*

|  |  |  |  |
| --- | --- | --- | --- |
| **Cube** | **Small** | **Medium** | **Large** |
| Cube Dimensions (cm) | L: W: H: | L: W: H: | L: W: H: |
| Region of No Color Change Dimensions (cm) | L: W: H: | L: W: H: | L: W: H: |
| A. Total volume (cm3) |  |  |  |
| B. Region of No Color Change volume (cm3) |  |  |  |
| C. Diffused volume (cm3) (A-B) |  |  |  |
| D. % Diffusion ([C/A] X 100) |  |  |  |

🖉**DISCUSSION (answer)**

1. At 10 minutes, which “cell” had the highest **% diffusion**? Which “cell” had the lowest **% diffusion**? Justify your answer using data from the experiment.

2. Based on your data, predict which “cell” would have the highest **diffusion rate** (which would turn pink first?). Which “cell” would have the lowest **diffusion rate** (would turn pink last?)? Justify your answer.

3. What is the relationship between cell surface area and cell volume?

4. For cellular respiration to occur, oxygen must diffuse into a cell and carbon dioxide must diffuse out. Which cube accurately represents an efficiently respiring cell? Use the data that you have calculated in this activity to support your choice.

Use this figure to answer questions 5-10.

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5. List the materials that are leaving the cell.

6. List the materials that are entering the cell.

7. Which dimension of size (surface area or volume) is most closely related to the movement of materials into cells? How do you know? Justify your answer.

8. What is the outcome for the cell if it does not receive the materials that are entering? Explain using a specific example from the diagram.

9. What is the outcome for the cell if it cannot remove the materials that are leaving? Explain using a specific example from the diagram.

10. How might the cell’s functions be affected if its volume were too small?

🖉**CONCLUSION (answer)**

Using the data and what you observed during the lab, write one paragraph explaining **why cell size is limited**. Include vocabulary words – surface area, volume, diffusion, nutrients, waste.