# Pre-Lab Information

Purpose To understand how cell size affects the surface area to volume ratio and the diffusion rate into the cell

Time Approximately 60 minutes

Question How does cell size affect the diffusion rate?

**Hypothesis**

**Variables for H1** *Independent Variable*:

*Dependent Variable*:

Summary In this lab, you will use artificial cells (agar cubes) of different sizes and calculate the surface area, volume, and surface area to volume ratio. You will then observe the rate of diffusion into the artificial cell.

# Safety

* Behavior in the lab needs to be purposeful.
* Tie back long hair, roll up sleeves, and secure loose articles of clothing.
* Handle materials carefully. If something breaks, report it to your teacher immediately.
* Wear safety goggles at all times when conducting the experiment.
* Wipe up any spills when it is safe to do so.
* Report all accidents—no matter how big or small—to your teacher.

# Lab Procedure

1. **Gather materials.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| * Plastic knife * Agar * Ruler * 200 ml of 0.1 M NaOH | * Beaker (400 ml) * Tong or spoon * Paper towel * Calculator | * Timer or stopwatch * AP biology formula sheet |  |  |

1. **Create agar cubes of different sizes.**
   1. Carefully use the plastic knife to cut out a 1 cm x 1 cm x 1 cm agar cube.
   2. Repeat this for 2 cm x 2 cm x 2 cm and 3 cm x 3 cm x 3 cm agar cubes.
2. **Calculate the surface area and volume of your cubes.**
   1. Use Table A to record the surface area and volume of your cubes.
   2. Find the surface area to volume ratio for each cube. Record your answer in the appropriate column.
3. **Gather data.**
   1. Pour 200 ml of 0.1 M NaOH into the 400 ml beaker.
   2. Carefully add your 3 cubes to the solution in the beaker. Start timing.
   3. After 10 minutes, carefully remove the cubes using a spoon or tongs.
   4. Cut each cube in half.
   5. Sketch each cube. Measure the depth to which the pink color has penetrated each cube. Record this measurement on the sketch.
4. **Calculate the diffusion rate.**
   1. Calculate the volume in which the NaOH diffused into each cell by taking the total volume and subtracting the amount of volume that is not pink. In Table B, record the volume in which the NaOH diffused into each cell.
   2. Calculate the percent diffusion by taking the volume diffused and dividing by the total volume. Then, multiply by 100. Record the percent diffusion values in the appropriate cell in Table B.
5. **Clean up your area.** 
   1. Return unused materials and dispose of any trash according to your teacher’s directions.

# Data

Record the data either in your lab notebook or in the space below.

**Sketch each cube below (before and after diffusion).**

**Table A: Surface Area and Volume**

|  |  |  |  |
| --- | --- | --- | --- |
| **Cube Side Length** | **Surface Area**  **(cm2)** | **Total Cube Volume (cm3)** | **Surface Area to Volume Ratio** |
| **1 cm** |  |  |  |
| **2 cm** |  |  |  |
| **3 cm** |  |  |  |

**Table B: Diffusion in Agar Cubes**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Cube Side Length** | **Total Cube Volume (cm3)** | **No Pink Volume (cm3)** | **Pink, Diffused Volume (cm3)** | **Percent Diffusion** |
| **1 cm** |  |  |  |  |
| **2 cm** |  |  |  |  |
| **3 cm** |  |  |  |  |

# Follow-Up Questions

Answer the following questions:

1. Agar was used to model the cells in this lab. Why was a model useful in this investigation?
2. Describe the relationship between surface area to volume ratio and percent diffusion. Provide evidence from your lab to support your claim.
3. Why is cell size important to cells? Your finger has billions of small cells. Why not have a few hundred, larger cells? Use the information from this lab and what you know about living things to answer the question in claim, evidence, and reasoning format.