Name: _____   Date: _____   Period: _____

Diffusion In Agar Cubes
Is Bigger Better?   OR   Is Smaller Smarter?

Introduction:

  Diffusion is one of the very important processes by which substances such as nutrients, waste, water, and oxygen are transported between living cells and their environment through the cell's surface.

  A cell needs a large surface in order to carry out metabolic functions and as the cell grows it needs to carry out more and more reactions. As a cell grows in size (volume), the distance increases between the cytoplasm at the center of the cell and the cell membrane. The rate of chemical exchange with the surrounding environment may become too low to carry out all of the needed reactions. It may not be able to excrete waste quickly enough or take in important nutrients.

  The volume of a cell determines requirements while surface area determines supply. Because this surface area to volume ratio is so important, its size of the cell is limited.
The rate of exchange of materials (nutrients/waste) and energy (heat) is a function of its surface area.

  In this investigation, you will use agar cubes to which the indicator bromothymol blue has been added. BTB is an acid/base indicator that turns yellow in the presence of an acid such as acetic acid (vinegar). Thus the surface of the agar cubes will turn yellow immediately when put into an acid solution. The acid will continue to diffuse through the cube and gradually turn the inside of the cube yellow.

Materials:
- Agar
- ruler
- vinegar
- Knife/blade
- Beaker or cup
- Spoon/Tongs

Procedure:

1. ACCURATELY cut three agar cubes: A 3cm cube, a 2cm cube, and a 1cm cube.

2. Place your cubes in the cup or beaker.

3. Add enough vinegar to completely cover the cubes.

4. Let the cubes soak for 10 minutes, gently stir the solution and cubes periodically.

5. After 10 minutes, use a spoon or tongs to remove the cubes from the acetic acid (vinegar) solution and blot them with paper toweling. Be careful not to squish or deform your cube.

6. Cut each cube in half and measure the width of the inner blue cube that was not penetrated by the vinegar. This measurement is the Length, Width, and Height of your unpenetrated section. Record the resulting **volume** in the data table below.

Data Table 1: Diffusion In Agar Cubes

Cube Size	Total volume (cm³)	Unpenetrated volume (cm³)	Penetrated volume (cm³)	Percent Diffusion (%)	Surface area (cm²)	Surface area to volume ratio
1cm						
2cm						
3cm						

Calculation Helper

- Total volume of each cube (Volume = L x W x H)

- Unpenetrated volume (Volume = L x W x H of the blue remaining)

- Penetrated volume = Total Volume – Unpenetrated Volume

- Percent diffusion = (Penetrated volume/Total Volume) x 100

- Surface area of a cube = (L x W) x (# of sides)

- Surface area/volume ratio = SA:Vol

Conclusion:

1. In this investigation, the agar cubes represents living cells. What does the vinegar represent?

2. In terms of maximizing diffusion, what was the most effective size cube you tested? In other words, which cell(s) would live and which cell(s) would die? (Don't just say it, DEMONSTRATE IT! – Cite data from all three different sized cubes.)

3. Considering surface area to volume ratios, what cell shape is the worst for keeping a cell alive? The best? Explain your reasoning.

4. Why do organisms grow by increasing the number of cells in their bodies? Why not simply increase the size of their existing cells?