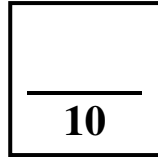
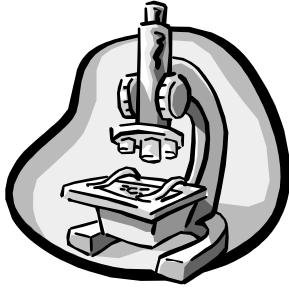


Science 10-Biology

Activity 10

Experiment on Cell Surface Area and Volume



Name _____

Due Date _____

Show Me Hand In

Correct and Hand In Again By _____

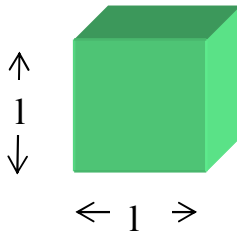
Purpose:

To examine how a cell's *surface area* and *volume* affects its ability to exchange nutrients and waste products.

Introduction:

Even though cells are **not** shaped like cubes, the mathematics involved with *surface area* and *volume* are simpler for cubes than for other shapes so for this lab we will *pretend* that cells are cubes.

Surface Area



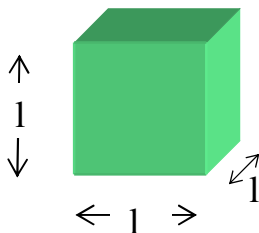
Each side has an area of $1 \times 1 = 1^2$

A cube has 6 equal sides, so the **Surface Area = 6×1^2**

Example: The length of one side of a cube is 0.5 cm. Calculate the Surface Area of the cube.

$$\text{Surface Area} = 6 \times 1^2 = 6 \times (0.5)^2 = 6 \times 0.25 = \underline{1.5 \text{ cm}^2}$$

Volume



The Volume of a Cube is **length** x **width** x **height** = 1^3

Volume = 1^3

Example: The length of one side of a cube is 0.5 cm. Calculate the Volume of the cube.

$$\text{Volume} = 1^3 = (0.5)^3 = \underline{0.125 \text{ cm}^3}$$

Equipment and Materials:

250 mL beaker
 potato
 scalpel
 metric ruler

150 mL Lugol’s Solution
 forceps
 graduated cylinder
 dissecting tray

Procedure:

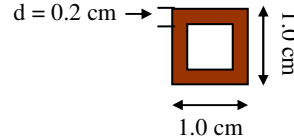
1. Cut **cubes** of potato the sizes stated below, starting from biggest to smallest.
 (l = the length of one side of the cube.)
 - l = 2.5 cm
 - l = 2.0 cm
 - l = 1.5 cm
 - l = 1.0 cm
 - l = 0.5 cm
2. When the cubes have all been cut, place them in a 250 mL beaker and add enough Lugol’s Solution to just cover them all.
3. Let the cubes soak in the Lugol’s Solution for about 20 minutes. While you are waiting, you can start the calculations on the following table:

Length of one side of Cube (cm)	Surface Area (SA) of Cube (cm ²)	Volume of Cube (cm ³)	Ratio of S.A./Volume
	Surface Area = 6l²	Volume = l³	Ratio = SA / Volume
0.5			
1.0			
1.5			
2.0			
2.5			

4. When the potatoes have sat in the Lugol's Solution for about 20 minutes, remove them with forceps and put them on a dissecting tray. Cut each cube in half and examine the cross-section.
For each cube, measure how far into the cube the Lugol's solution penetrated. Record this value on the following table:

Length of One Side of Cube (cm)	Penetration Depth of Lugol's Solution (cm)
0.5	
1.0	
1.5	
2.0	
2.5	

5. Make a sketch of each cross-section, showing the penetration of the Lugol's solution. Draw each square the actual size (using a ruler to measure). Shade in or colour the area that the stain has penetrated. Show the Depth of penetration (d) on each diagram.
Eg. If the solution penetrated 0.2 cm into the cube with a length of one side(l) of 1.0 cm, the drawing would look like this:



Cross-sections of Potato Cubes		
	l = 0.5 cm	l = 1.0 cm
l = 1.5 cm	l = 2.0 cm	l = 2.5 cm

Questions:

1. Study the diagrams on the bottom of page 3. Which cube (biggest or smallest) has the greatest **fraction** of its total volume which is **NOT** penetrated by the stain? (In other words, which one has the most white space compared to brown space?)

Answer _____

2. Which cube (biggest or smallest) has the greatest **fraction** of its total volume penetrated by the stain?

Answer _____

3. If Lugol’s solution was a nutrient and the cubes were unicellular organisms, which cube (smallest or largest) would be more able to “feed” its volume, the biggest or the smallest?

Answer _____

4. Go to the table in Procedure 3 on page 2, to get the information to fill in the following table:

Length of One Side of Cube (cm)	Ratio of S.A./Volume
0.5	
1.0	
1.5	
2.0	
2.5	

Which cube has the greatest **Surface Area / Volume** ratio? _____

Since nutrients are absorbed through the **surface** of the cell membrane, and nutrients are needed by the entire **volume** of the cell, a (larger/smaller) _____ Surface Area / Volume ratio would mean the cell has a better ability to “feed” itself.

5. Which is better able to absorb enough nutrients to supply its total volume, a **small** cell or a **large** cell? _____

6. Can unicellular organisms grow very large _____. Explain why or why not.

