Science 10-Biology
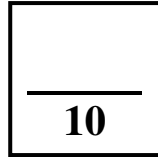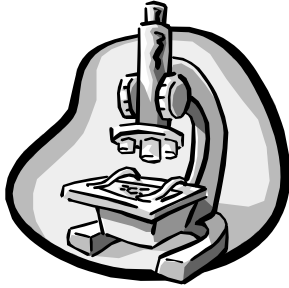## Activity 10
Experiment on Cell Surface Area and Volume

Name _____

Due Date _____

Show Me ☐   Hand In ☐

10

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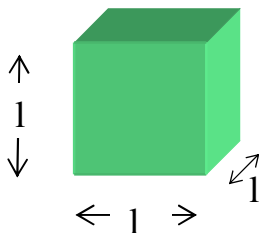
Surface Area
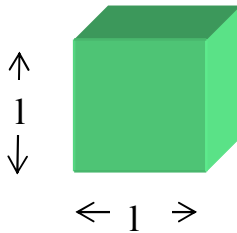
Each side has an area of $1 \times 1 = 1^2$

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.

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

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.

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

Equipment and Materials:

|	
250 mL beaker	150 mL Lugol's Solution
potato	forceps
scalpel	graduated cylinder
metric ruler	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 $= 6l^2$	**Volume** $= l^3$	**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: d = 0.2 cm →
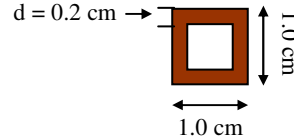
      1.0 cm

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.

   _____

   _____