Name_____Period_____Assignment #_____

See Lecture Question #'s 11 & 12

_____Teacher initials for procedures_____Teacher initials practice data collection

_____ Teacher initials for data collection

Osmosis and Diffusion: What affects the rate of osmosis?

Annotate text and answer questions 1-11

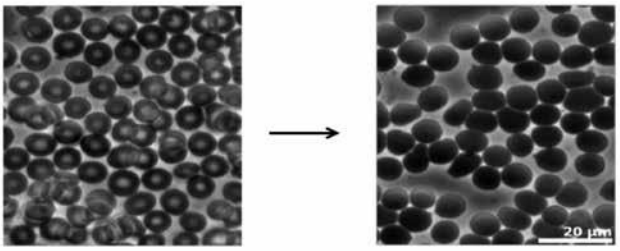
Annotating Text
☐ **UNDERLINE** concepts you think might be useful for understanding or solving the problem
☐ **Box** information you think might be helpful for designing your investigation
☐ ← Write **notes** in the left margin
☐ → Write **questions and answers** in the right margin
Each paragraph (including each step of the procedures) must have something underlined or boxed, **AND** have something written in the margins (a question and/or note).

Introduction

All living things are made of cells. Some organisms, such as bacteria, are *unicellular,* which means they consist of a single cell. Other organisms, such as humans, fish, and plants, are *multicellular*, which means they consist of many cells. All cells have some parts in common. One part found in all cells is the *cell membrane.* The cell membrane surrounds the cell, protects the cell, and is essential for maintaining cell homeostasis. Nonpolar molecules such as oxygen, water, and carbon dioxide can pass in and out of the cell membrane by simple diffusion. Polar and large molecules must be transported via channel proteins or carrier proteins by facilitated diffusion or active transport. All cells also contain *cytoplasm.* The cytoplasm is a jelly-like substance inside the cell where most of the cell's activities take place. It's made out of water, proteins, and other chemicals.

Some cells found in multicellular organisms are highly specialized and carry out very specific functions. An example of a specialized cell found in vertebrates is the erythrocyte, or red blood cell (RBC). RBCs are by far the most abundant cells in the blood. The primary function of RBCs is to transport oxygen from the lungs to the cells of the body. In the capillaries, the oxygen is released so other cells can use it. Ninety-seven percent of the oxygen that is carried by the blood from the lungs is carried by the protein hemoglobin; the other 3% is dissolved in the plasma. Hemoglobin allows the blood to transport 30–100 times more oxygen than could be dissolved in the plasma alone.

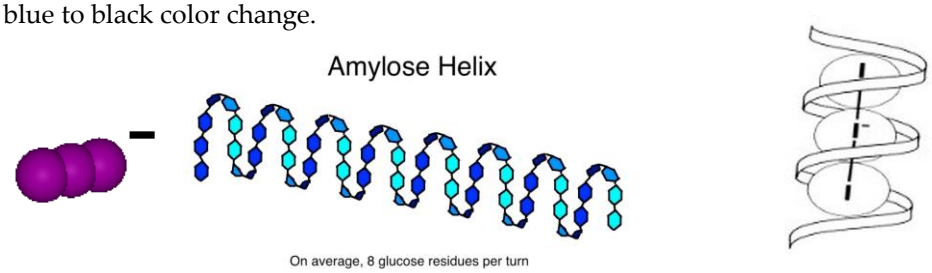
As you can see in the figure to the right, RBCs look like little discs when they are viewed under a microscope. They have no nucleus (the nucleus is extruded from the cell as it matures to make room for more hemoglobin). A unique feature of RBCs is that they can change shape; this ability allows them to squeeze through capillaries without breaking. RBCs will also change shape in response to changes in the environment. For example, if you add a few drops of distilled water to blood on a microscope slide, the cells will look bigger after a few seconds (see the figure's right panel).



Red blood cells ***before*** adding distilled water

Red blood cells ***after*** adding distilled water

A solution of I_3K (potassium iodide), also called Lugo's solution, is red to orange depending on the concentration of potassium iodide. I_3K is an ionic compound, which means the iodine and the potassium will disassociate in solution forming negative iodine ions and positive potassium ions. Iodine reacts with polysaccharides causing a blue to black color change.



$$I_3^- + \text{Starch} \xrightarrow[\text{fast}]{} \text{Dark Blue Complex}$$

Molecules and ions are not to scale.

Molecules that are impermeable to the cell membrane are more concentrated inside the cell than outside the cell when the cell is in a hypotonic solution. These molecules would move out of the cell because of the process of diffusion, but are blocked by the cell membrane. Water molecules move into the cell because the concentration of water is greater outside the cell than it is inside the cell. As a result, the net movement of water is into the cell making it bigger.

Molecules that are impermeable to the cell membrane are more concentrated on the outside of the cell than on the inside when the cell is in a hypertonic solution. These molecules would move into the cell because of the process of diffusion, but are blocked by the cell membrane. Water molecules move out of the cell because the concentration of water is greater on the inside of the cell than it is on the outside of the cell. As a result, the net movement of water is out of the cell making it smaller.

Your Task

Design and carry out an experiment to determine what affects the rate of osmosis.

Materials

You may use any of the following materials during your investigation and others are available upon request:

- 1% and 3% Starch solutions (starch is a polysaccharide)
- 1.3% KI solution
- Distilled water
- Beakers
- Graduated cylinder
- Balance
- Dialysis tubing (use as a model for RBCs, but remember that models are simplified representations of complex systems)
- Safety goggles
- Aprons

Getting Started

You will use models of cells rather than real cells during your experiment. You will use cell models for two reasons: (1) a model of a cell is much larger than a real cell, which makes the process of data collection much easier; and (2) you can create your cell models in any way you see fit, which makes it easier to control for a wide range of variables during your experiment.

You can construct a model cell by using the dialysis tubing. Dialysis tubing behaves somewhat like a cell membrane. To create a model of a cell, place the dialysis tubing in water until it is thoroughly soaked. Remove the soaked tubing from the water and tightly twist one end several times and either tie with string or tie a knot in the tubing. You can then fill the model cell. Once filled, twist the open end several times and tie it tightly as shown in the figure. You can then dry the bag and place it into any type of solution you need.

In designing your experiment, you must determine what type of data you will need to collect, how you will collect it, and how you will analyze it.

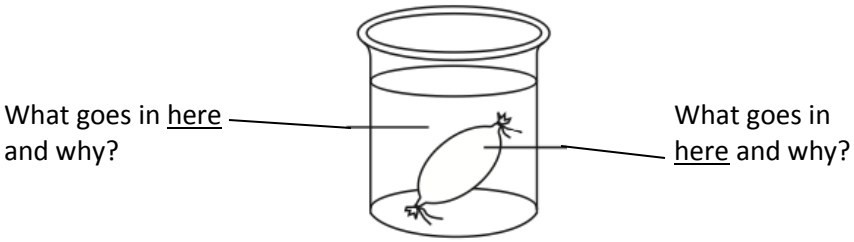
To determine *what type of data you will need to collect,* answer the following questions:

1. What will serve as your dependent variable?

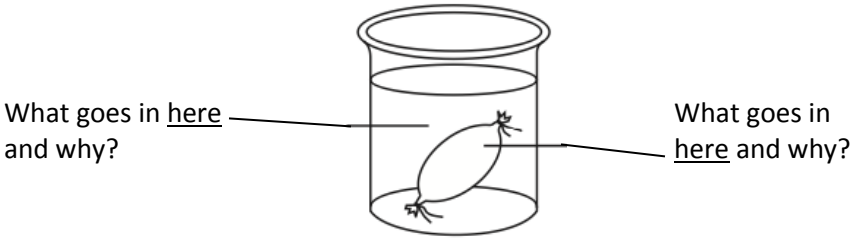
2. What type of measurements will you need to make during your investigation?

To determine *how you will collect your data,* think about the following questions:

3. What will serve as a control (or comparison) set-up?



4. What types of treatment setups will you need to set up and how will you do it?



Draw the other treatment set-ups you plan on using below

5. How many trials will you need to use in each condition?

6. How often will you collect data and when will you do it?

7. How will you make sure that your data are of high quality (i.e., how will you reduce error)?

8. How will you keep track of the data you collect and how will you organize the data?

To determine *how you will analyze your data,* think about the following questions:

9. How will you determine if there is a difference between the treatment conditions and the control condition?

10. What type of calculations will you need to make?

11. What type of chart could you create to help make sense of your data?

Connections to Crosscutting Concepts and to the Nature of Science and the Nature of Scientific Inquiry

As you work through your investigation, be sure to think about

- the importance of identifying the underlying cause for observations,
- how models are used to study natural phenomena,
- how matter moves within or through a system,
- the difference between data and evidence in science, and
- the nature and role of experiments in science.

Be able to answer the following questions

- How did you collect your data? Why did you use that method? Why did you collect those data?
- What did you do to make sure the data you collected are reliable? What did you do to decrease measurement error?
- What did you do to analyze your data? Why did you decide to do it that way? Did you check your calculations?
- Is that the only way to interpret the results of your analysis? How do you know that your interpretation of your analysis is appropriate?
- Why did your group decide to present your evidence in that manner?
- What other claims did your group discuss before you decided on that one? Why did your group abandon those alternative ideas?
- How confident are you that your claim is valid? What could you do to increase your confidence?

ADI Investigation Proposal TGB Version

Guiding Question:	
Claim:	
Alternative claims:	

Method:	What data will you collect? How will this data help you answer the guiding question? What safety precautions will you follow?

Data table(s) and chart(s)

Guiding Question:

Our Claim:

Our Evidence:

Analysis: break it down (Illustrate and describe your data)

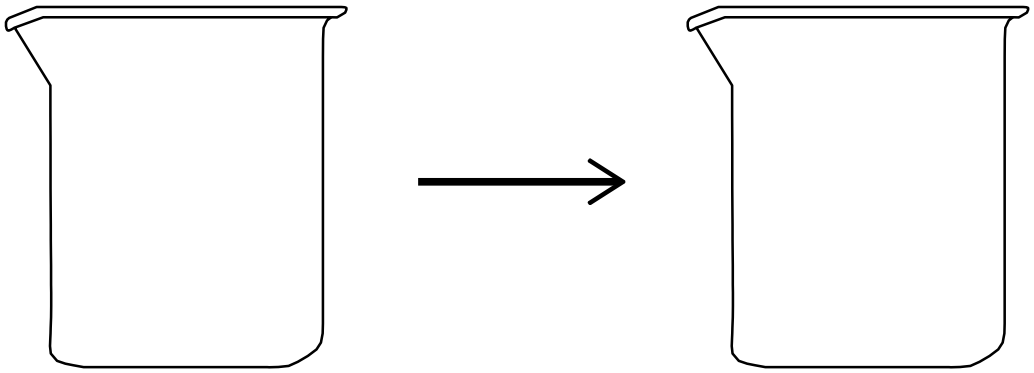
Interpretation: What does the analysis mean?

Our Justification of the Evidence:

Use your scientific knowledge and analysis to support your interpretation

Checkout Questions

1. A model cell that contains a concentrated starch solution is placed in a beaker of distilled water. Complete the illustration below of how this will affect the **size** of the model cell. Be sure to explain how this will affect the **mass** of the model cell and how you know.



2. Observations are an example of data. True or False

   Explain your answer.

3. The investigation that you just completed is an example of an experiment. True or False

   Explain your answer, using information from your investigation about osmosis and diffusion.

4. Scientists often try to explain the underlying cause for their observations. Explain why this is important, using an example from your investigation about osmosis and diffusion.

5. Scientists often use models to help them understand natural phenomena. Explain what a model is and why models are important, using an example from your investigation about osmosis and diffusion.

6. Scientists often track how matter moves within or through a system they are studying. Explain why, using an example from your investigation about osmosis and diffusion.