Membrane Transport Lab Lesson Plan – 2 Days

Grade Level:	9th grade	**Subject:**	PreAP Biology	**Prepared by:**	Jessica Svoboda, Modified from Jennifer Giannou

Objective	**Warm Up**	**Reminders**	**Key Concepts**
(Both Days) Examine the movement of matter into and out of living cells across a semi-permeable membrane.	1. What does it mean for the cell membrane to be semi-permeable? 2. What will the molecules do when the concentration is equal on both sides of a semi-permeable membrane?	ALL late work due by 11/2 Exam 11/15	Compare the two types of transport within a cell. Study the effects of osmosis on cells. Conduct an experiment to further analyze the effects of osmosis on carrot cells. Hypothesize the results of different solution concentrations on the permeability of carrot cells. Observe diffusion across an artificial membrane. Measure and observe the changes in the size of the carrot as a result of movement of substances across the membrane's of the carrot cells.

B.4.B. investigate and explain cellular processes, including homeostasis, energy conversions, transport of molecules, and synthesis of new molecules; and Readiness Standard

Materials:

Plastic cups (2 per group)

Distilled water

Salt water

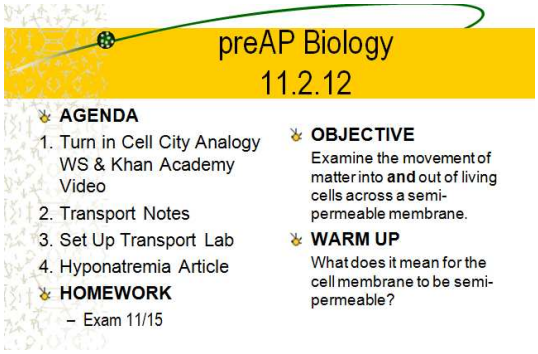
Baby carrots (2 per group)

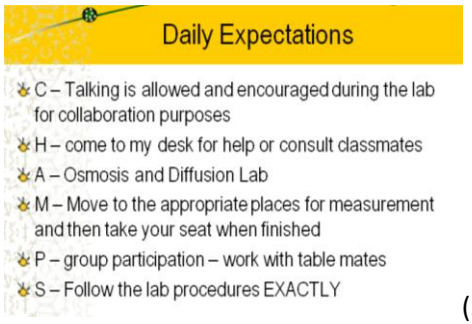
Triple beam balance (1 per group)

String and Ruler for measuring

Activities: Independent Practice – Modeling – Group Practice – Check for Understanding

DAY 1





(5 min – before bell)

Students have their binders out and are writing down the objective and warm up for the day.

(3 min)

Students are writing down their objective and warm up and turning in their homework from the day before. I'm accommodating the students who were absent.

(5 min)

Go over the objective and warm up for the day. Announce that the end of the six weeks is approaching.

(25 - 30 min): Pass out Cellular Physiology: Membrane Transport Notes

"Lately we have been learning about the specific structures in a cell and how they work together to perform various tasks in order to keep the cell and organism alive. In order for these processes to work, the cell must allow certain things to come in and ensure certain things move out. What structure have we learned about that regulates what enters and exits the cell?" Pause and wait for a response. "The cell membrane is definitely responsible for regulating what enters and exits the cell. It is what we call a semipermeable membrane, allowing only certain things in and out based on physiological and structural components within the membrane. Now we are going to take notes over how the cell allows things to be transported in and out of the cell."

Go through the notes with e students, explaining important features BEFORE they start writing. Interject with examples and comparisons. **Group practice**

(15 - 20 min): Diffusion Demo: pass out Diffusion and Osmosis papers

"Before we set up for our own lab, I want to go through a standard demonstration of what we want to see in our own experiment. Like with the yeast lab, it is important to observe and pay close attention. Please refer to your packet, the Part A Data Table number one. In the bag, we have starch and water." (Use the document camera to **Model** what the students should be recording and to give everyone a good view of the demo). "What are some things we know about starch?" (Guide the students to answer things like: a polymer of carbohydrates, stored in plants, and a large biomolecule). "Great answers! Now in my beaker I have Iodine or I2 mixed with water. Iodine is simply an element and I2 is a molecule of two iodine elements. Do you think that I2 is small? Do you think it is smaller than starch?" (Direct them to the correct answers and explain the relevance) "Now we are going to predict which way the molecules will diffuse across this membrane. In Data table two, we need to illustrate the initial contents of the bag and beaker." **Model**. "Now this is your turn to predict what will happen and what will diffuse across the membrane. In the middle section of data table two, predict what will be inside the bag and what will be outside the bag at the end of the experiment. Once you are finished with your illustration, answer the questions below the Data Table under hypothesis. Use what we just discussed about the size

of the molecules and the ability of certain things to be transported in and out of the cell to make hypotheses about diffusion. At this time, please ignore the analysis questions until tomorrow." **Independent Practice**: Give them about 3 minutes to make hypotheses about the new contents of the bags. Walk around and help anyone who is completely lost.

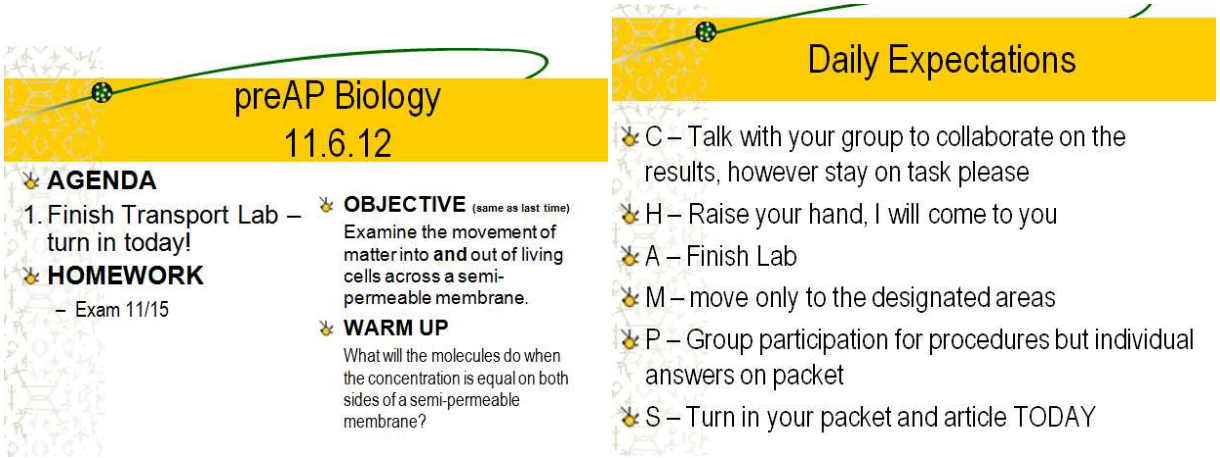
"Now please turn to the second page of the packet and look up here for instructions. **MODELING** Remember when we looked under the microscope at the plant cells with fresh water versus salt water?" Wait for a response. "Please raise your hand and tell me what happened to the plant cells when they were in salt water rather than fresh water?" **Check for Understanding** (Some students may make observations that are true but besides the point. You may have to rephrase to: What happened to the cytoplasm of the plant cell when it was placed in salt water after fresh water? Or rephrase further to: How did the plant cell look differently in size and structure when placed in salt water?) We want the students to understand that the cytoplasm shrinks away from the cell wall. "On the second page of your packet, use your knowledge about tonicity (table with pictures on their notes packet) to predict where the water is going to move with the plant cells in your carrots. For example, if we put a carrot in regular distilled water, is there an equal amount of water in both the carrots and the surrounding solution? **Check for Understanding**(Students may have a really hard time understanding this or getting me an answer, clarify by stating: For the purposes of this lab, imagine there are no soluble solutes in the carrots, that there is an equal amount of water) How would the water move in that situation?" Wait for it… "Yes, the water would be able to move freely from the cells and would be considered isotonic. **Guided Practice** Your job now is to tell me what is going to happen when we place the carrot in salt water. Refer to what we learned in the plant cell lab and your notes. Afterwards, answer the questions below in order to receive your materials. Meet me by the front of the room, the location of the materials, once your group has answered all of the hypothesis questions ONLY."

(30 min): Students set up their lab according to the procedures in "Class set" of the osmosis lab.

(5 min): Wrap up

"Please put all of your cups in the cabinet marked with your class period. Also make sure you have your names, and period labeled on your cup. I have placed an article on your desks about how this applies to humans and human cells. This article was recently in Austin Fitness, so it is a very local, applicable story. If you do not finish reading the article and answering the questions, it is due next time for homework."

Day 2



(5 min – before bell)

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(3 min)

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(5 min)

Go over the objective and warm up for the day. Announce that the end of the six weeks is approaching and that students should hold onto their articles until the end of the class period.

(10-12 min): Analysis of Demonstration **Guided Practice**

"I'm interested in your predictions about what happened to our bag of starch over the past two days. Please take 2 minutes to discuss your predictions with your table mates. Specifically: What did you think would be in the solution and in the bag now that it has been sitting for 48 hours?" Allow the students to discuss their predictions, walk around to listen for interesting things, but do not comment or interrupt. "I heard an interesting conversation at the _____ table, would anyone like to share what _____ said at that table about his/her prediction?" **Check for understanding** Did anyone else's tale agree with _____? Why or why not?" Allow the students to share their predictions. "I suppose we will just have to see!" Take out the bag of starch soaking in iodine solution. "Wow class, what happened? Let's enact the first step in the scientific method. Does anyone have any careful observations they would like to share about the experiment?" Take answers and either clarify or probe further. "Everyone now write on their first sheet what the solutions look like in the bag and in the solution." **Modeling** "Now we are going to decide what went in and what came out. Starch, being a large molecule was not able to pass through the bag and stayed in the bag. However, there is obviously a distinct color change, so what went INTO the bag to cause this color change?" **Check for Understanding** "Yes, the iodine went into the bag and reacted with the starch to cause a chemical reaction. We know thisbecause of the color change in the bag. Raise your hand if your initial hypothesis was correct? Now I will not count off points for an incorrect hypothesis as long as you answer the questions below that make you explain what actually happened. Take five minutes to do that now. Please do not talk, we have lots to do and need to make sure this gets completed."

(10 – 15 min): Instructions for Transport lab Part 2:

"Before we go over the directions for the transport lab, turn to the venn diagram labeled osmosis and diffusion. With your table, come up with at least one property that goes in each category. You have two minutes. If you are having trouble coming up with answers, turn to your notes from yesterday." Set timer for 2 minutes, allow students to come up with answers. **Guided Practice**

"Now who wants to share something they got in the diffusion column? Did anyone have anything else?" Continue with this process until the venn diagram is full. "Now we are going to see how the movement of water affected our carrot cells based on tonicity. First, you will do the same procedures as last time, weigh and measure your carrots and write their measurements in the table on the second page. Then, follow the procedures on the class handout and once you are finished you will sit down and quietly answer your analysis questions. These handouts are due today and need to be complete. Does everyone

understand my expectations?" **Check for Understanding** "You are released to retrieve your cups from the cabinets and start your measurements."

(40 min): Students go through the procedures for Day 2 and complete the analysis questions

Walk around and ensure students are on task, using the equipment properly and then answering questions once completed. If students complete everything, tell them to work on their articles or re-read them if completed as we will have a discussion at the end of class.

(10 – 15 min) Article Discussion

"This was a very applicable article to the study of cells and tonicity. Please take five minutes to discuss what you liked about it with the rest of your table mates. Make sure everyone gets a chance to share." Allow the students to share what they liked about the article (this also gives lazy students the chance to finish the article if they had not done so before class). Walk around and listen to the conversations. Do not interrupt or clarify, just listen. "I like the conversation over at the _____ table. Can anyone over there tell me what kinds of things you discussed?" Go through until about 2 minutes before the bell.

(2 min): wrap up/ announcements

"We will be taking a standardized test next class, so make sure you bring your own pencil. I've noticed you are all really good at borrowing pencils but not necessarily good at bringing them back. Please make sure you return any pencils you borrow from the basket, I will not have many to offer you for the test next time. "

Differentiation:

Learning Style	Accomodations
Visual: Students make observations from the demonstration and the lab. Verbal: Students engage in several conversations concerning the material and talk throughout the lab procedures. Kinesthetic: Students move around the lab to learn through experimentation and manipulatives.	Students are grouped to encourage conversation and scaffolding. Students are seated based on needs and necessary accommodations. Students can converse and write anything they missed, fill in the blanks.

Assessment:

Students will turn in their lab handouts and article analysis.

Reflection:

Students had a lot of trouble understanding the concepts of tonicity. It is a really hard concept to understand for any age group. Next time, I would use the tonicity models on the last page of this lesson plan to demonstrate a visual of what is going on in the cells and solutions. Tonicity was also just confined to how it affects cells which is a small scale of the tonicity concept. I believe applying it to other aspects of the concept would not confuse but actually enrich their understanding.

Instructions for Teacher Demo

Procedures – Part A: Diffusion Demo

1. Spray starch into a plastic sandwich bag.
2. Add tap water to bag until full, but leaving enough room to tie the bag.
3. Record observations about the color of the solutions in the bag in Data Table 1.
4. Pour tap water into 400 mL beaker and add several drops of Iodine.
5. Record observations about the color of the solution in the beaker in Data Table 1.
6. Place bag into solution
7. Iodine is yellow/light brown. In the presence of starch, iodine reacts and turns black.
8. Complete the first two columns of data table 2. In the first column, write where the molecules (water, starch, iodine) are located in the beaker and in the bag before time has lapsed. In the second column, predict which direction the molecules will move, if they move at all.
9. Write a hypothesis for the experiment.
10. After 48 hours observe again and record observations in the data table 1 and 2.
11. Answer the Questions

CLASS SET - DO NOT WRITE ON

Lab: Diffusion and Osmosis

Objectives

1. Observe diffusion across an artificial membrane.
2. Observe osmosis in plant cells.
3. Measure and observe the changes in the size of the carrot as a result of movement of substances across the membrane's of the carrot cells.

Background

The cell membrane acts as a barrier to some substances while allowing other substances to enter or leave the cell. When a membrane allows a particular substance to pass through it, it is said to be *permeable* to that substance. If a membrane allows the passage of some molecules or ions but blocks others, the membrane is *semi- or selectively permeable*. Cell membranes of living organisms are selectively permeable. The cell membrane acts as a selective barrier between the internal and external environments of the cell. The permeability of the cell membrane can change in response to changes in the cell's external and internal environments. Some substances, such as water, oxygen, and carbon dioxide, can pass freely through a cell membrane. Other substances have a more limited access to the cell.

In this lab, your teacher will do a demonstration using a sandwich bag as a model for a living cell membrane. Like a living cell, the bag is selective, but unlike living membranes, the bag's selectivity does not vary. That is, there are no protein channels to allow large things to pass through. Only small molecules will pass through the baggie's membrane.

In this lab, you will set up conditions to observe osmosis in plant cells. You will make macroscopic observations and infer from those the microscopic changes in the plant cells.

Materials

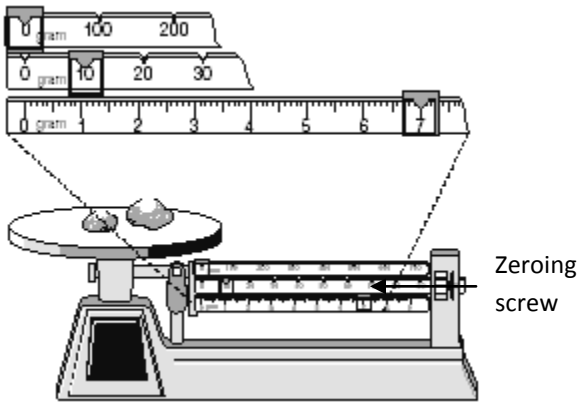
2 plastic cups
distilled water
salt water
2 baby carrots
triple beam balance
string
ruler

<u>Procedures – Part B: Osmosis Lab</u>

You will be placing carrots in distilled water (it is pure water) and salt water. Before performing the experiment, write a hypothesis for each experimental set up. Complete the predictions for data table 3 and 4 to predict which direction water will move with regards to the plant cell, <u>and</u> what the effect will be on the cell for each type of solution.

1. Get materials for group.
2. Label the cups SALT WATER and DISTILLED WATER and put your period and initials on each cup.
3. Use the triple beam balance to get its mass. Record your data in the Data Table 5.
4. Using the same carrot, wrap a piece of string around it at its widest point. This is the circumference of the carrot. Mark this point on the string and measure the circumference with the ruler. Record your data in the Data Table.
5. Drop this carrot into the SALT cup.
6. Take another carrot and repeat the procedures 3-5. Record your data in the Data Table.
7. Drop this carrot into the DISTILLED cup.
8. Just cover the carrot in the SALT cup with salt water. Just cover the carrot in the DISTILLED cup with distilled water.
9. Cover the cups and let them sit undisturbed overnight.
10. Make hypotheses about what you think will happen to each carrot.
11. After 24h, make macroscopic observations about the carrots, by feeling them and noting the string around the carrots.
12. Record the mass, and take circumference measurements for both carrots and record data in the Data Table.
13. Throw away the string and carrots. Pour the water solutions in the sink, remove the tap labels, and stack your cups by the sink. Make sure your area is clean.

How To Use a Triple Beam Balance



1. Before placing the object on the scale, calibrate the scale by sliding all three weight poises (the metal brackets that slide along the three beams) to their leftmost positions. Twist the zeroing screw until the balance pointer lines up with the fixed zero mark.

2. Place the object to be weighed on the center of the pan. When you set an object on the balance platform, the pointer immediately goes up and is no longer zeroed.

3. To find out the weight of the object, slide the weights until the pointer is at zero again. Start with the two heavier weights and then use the lightest one to do the fine tuning.

4. To read the weight of an object in grams, add the number that each weight is at when the pointer is at zero. For example, the heaviest weight above is at 0 grams, the next one is at 10 grams, and then the smallest is at 7.0 grams, then the total weight of the object is 17.0 grams.

Name _____ Date _____ Per _____
Pre AP Biology

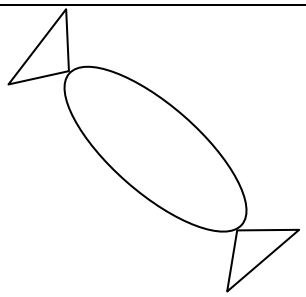
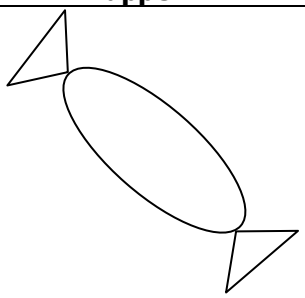
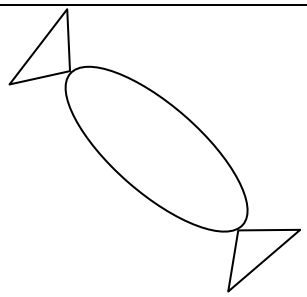
Lab: Diffusion and Osmosis

Part A – Diffusion Demo

Data Table 1

	Solution	Color of solution at start	Color of solution at finish
In bag			
In beaker			

Data Table 2

Before	Prediction on what will happen.	What Actually Happened
		

Hypothesis
Answer the following questions with a hypothesis. Which molecules, if any, will diffuse across the membrane?

How will you know diffusion has occurred?

Analysis

1. What molecules diffused across the membrane of the bag? Use data to support your answer.

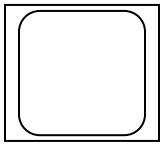
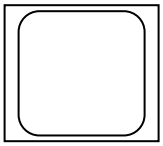
2. Explain the results you obtained. Include concentration differences and membrane pore size in your discussion.

3. Based on your observations, rank the following by relative size, beginning with the smallest: water molecules, iodine molecules, starch molecules, membrane pores.

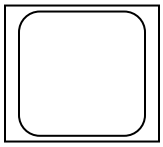
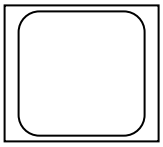
4. Evaluate your hypothesis.

Part B – Osmosis Lab

Data Table 3 – Cells Placed in DISTILLED Water

Prediction		Actual	
Show what direction the water will move in the cell below (in or out of the cell)	**Draw what will happen to the cell below.**	**Show what direction the water actually moved below**	**Draw what happened to the cell below.**
			

Data Table 4 – Cells Placed in SALT Water

Prediction		Actual	
Show what direction the water will move in the cell below (in or out of the cell)	**Draw what will happen to the cell below.**	**Show what direction the water actually moved below**	**Draw what happened to the cell below.**
			

Hypothesis 1
Answer the following questions with a hypothesis. What will happen to the cells in the SALT water?

How will you know that this has happened?

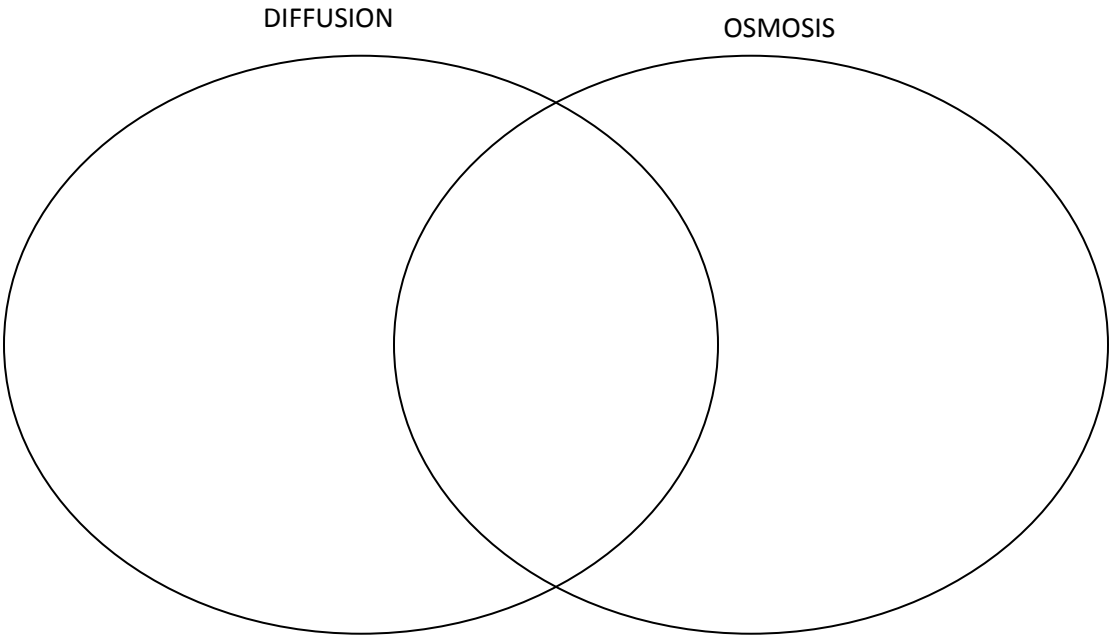
Hypothesis 2
Answer the following questions with a hypothesis. What will happen to the cells in the DISTILLED water?

How will you know that this has happened?

Data Table 5

	Mass at start (g)	Mass at finish (g)	Circum. At start (cm)	Circum. At finish (cm)
Carrot in SALT water				
Carrot in DISTILLED water				

Compare and contrast diffusion and osmosis by completing the following Venn Diagram.



Analysis

1. Explain the changes that occurred in the cells of the carrot in **salt water**, using tonicity terms (hypotonic, isotonic, hypertonic) in your response.

2. Explain the changes that occurred in the cells of the carrot **in distilled water**, using tonicity terms (hypotonic, isotonic, hypertonic) in your response.

3. Was the carrot in **salt water** flexible or stiff after 24h? How do you explain this in terms of osmosis?

4. Was the carrot in **distilled water** flexible or stiff after 24h? How do you explain this in terms of osmosis?

5. In which cup did the carrots **increase** in cell size? Explain your answer using appropriate vocabulary.

6. In which cup did the carrots **decrease** in cell size? Explain your answer appropriate vocabulary.

To answer the following questions, you may need to use outside resources, i.e. internet, books, etc.

7. If a cell has a high concentration of carbon dioxide molecules and a nearby blood vessel has a lower concentration of carbon dioxide, in which direction will the carbon dioxide move by diffusion? Explain your answer.

8. Explain what structures allow **animals** to prevent excess water loss?

9. Explain what structures allow **plants** to prevent excess water loss?