Cell Membranes: Diffusion and Osmosis

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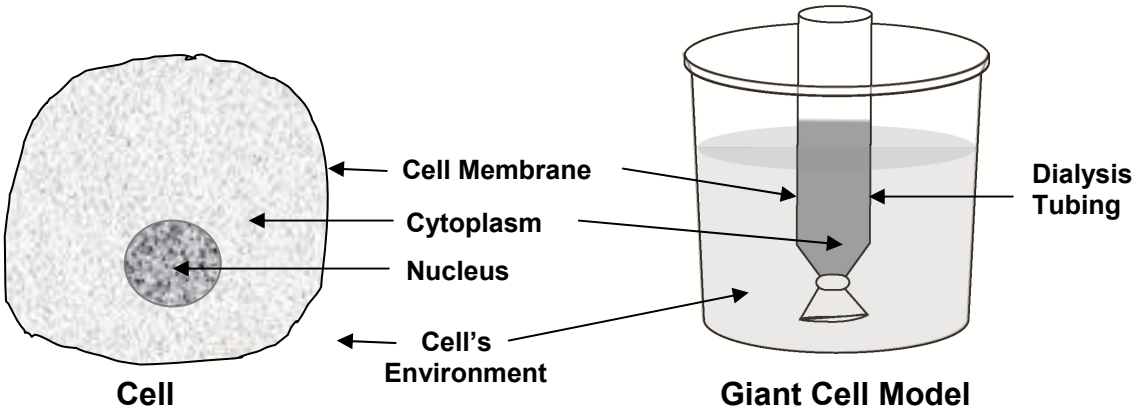
Part 1: Diffusion

Diffusion is a process by which molecules move into or out of cells. To diffuse into or out of a cell, molecules must pass through the cell membrane.



Observing the diffusion process in real cells is difficult because they are too small to be seen easily. In this lab, you will make a giant model of a cell so that you can observe the effects of diffusion through a membrane. In your cell model:

- The dialysis tubing represents the "cell's membrane."
- The contents of the bag represent "cell's cytoplasm."
- The area outside the bag represents the "cell's environment."

A. Make a "Cell" model

1. Put warm tap water into the large plastic cup. The cup should be about ¾ full.

2. Empty the contents of the iodine tube into the cup of warm water. Iodine is a "starch indicator".

3. Close the end of the dialysis membrane tubing by making a knot at one end. Make sure you pull the knot tight.

4. Add 15 mL of hot water to the small measuring cup.

5. Add one starch "packing peanut" to the water in the small measuring cup. Pour the contents of the glucose tube into the small measuring cup.

6. Mix the water, starch, and glucose thoroughly. The starch will dissolve in the hot water, but you may still see a few lumps of starch.

7. Use the plastic dropper to transfer the water, starch, and glucose mixture from the small cup into the dialysis membrane bag. Be careful not to drip any of this mixture onto the outside of the dialysis membrane bag!

8. Gently lower the dialysis membrane bag into the cup of warm water.

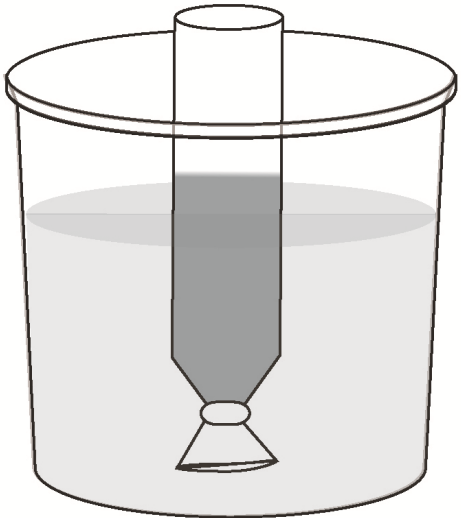
9. Set the cup with membrane bag aside and allow it to sit for **at least 15 minutes**.

10. Label the diagram by drawing arrows between the words and the parts of the diagram of a model cell.

Model of a cell membrane

Model of cytoplasm

Model of a cell's environment



Glucose

Starch

Iodine (starch indicator)

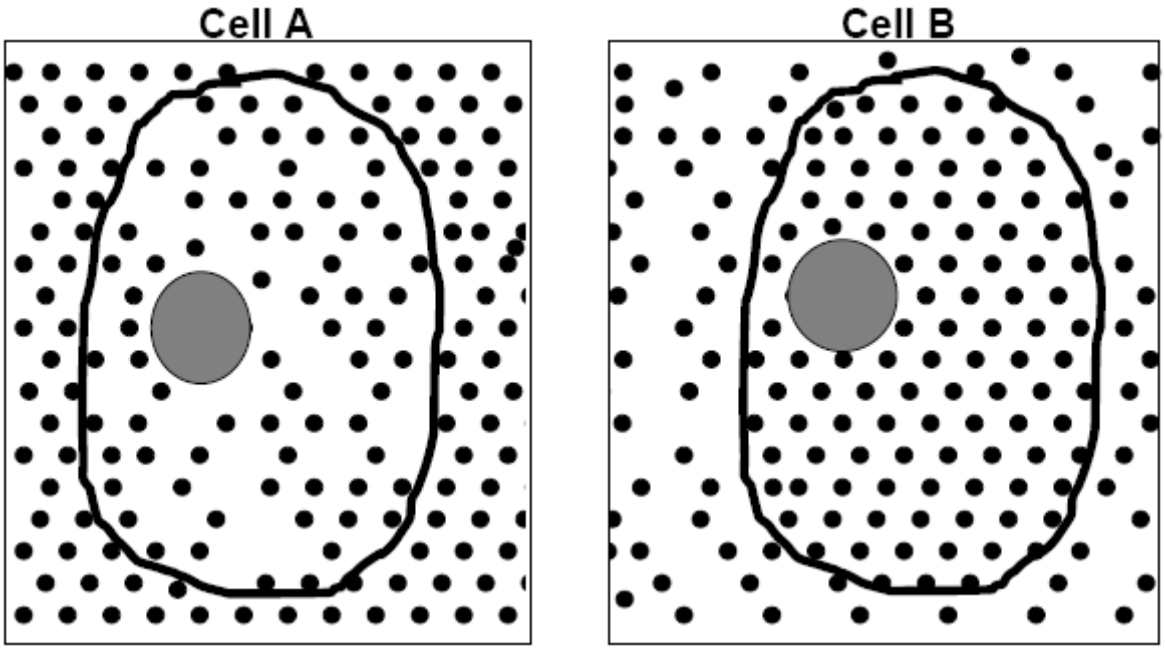
White color

Amber color (orange/brown)

What is Diffusion?

Molecules are constantly moving. Collisions between moving molecules cause them to spread out. As molecules spread out they move from areas of high concentration to areas of low concentration.

Diffusion is the movement of molecules from a region of high concentration to a region of low concentration.



The small dots represent solute molecules that are dissolved in water.

11. Which cell contains a higher concentration of solute molecules (dots)? _____

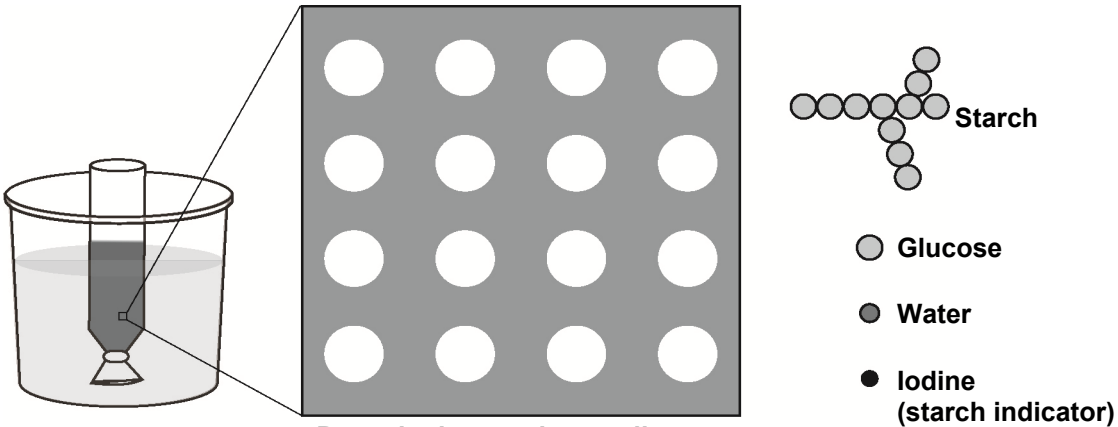
12. When molecules diffuse, they move from _____ (high or low) to concentration to _____ (high or low) concentration.

13. Draw an arrow on the diagram to indicate the direction that the solute molecules will diffuse for cell A.

14. Draw an arrow on the diagram to indicate the direction that the solute molecules will diffuse for cell B.

B. Predicting which molecules can diffuse through a membrane

All cells are surrounded by a porous cell membrane. The cell membrane is **selectively permeable** – it allows some molecules to enter and exit while blocking others. Small molecules can diffuse through the pores in the cell membrane, while large molecules may be blocked.



Pores in the membrane allow some small molecules to pass through

1. Explain why the dialysis tubing membrane is a "selectively permeable" membrane.

   _____

2. Put an X in front of the molecules that you predict (based on the model above) will be able to diffuse through the pores in the dialysis membrane.

   _____ water _____ iodine _____ glucose _____ starch

   Why do you think these molecules will be able to diffuse through the membrane?

   _____

Remember that you put:
- **Water, starch, and glucose into the dialysis bag**
- **Water and iodine (starch indicator) in the cup outside the dialysis bag**

3. Put an X in front of the molecules you think will be present INSIDE the dialysis bag at the end of the experiment.

   _____ water _____ iodine _____ glucose _____ starch

4. Put an X in front of the molecules you think will be present OUTSIDE the dialysis bag at the end of the experiment.

   _____ water _____ iodine _____ glucose _____ starch

C. Test your predictions

To determine which molecules have diffused through the membrane, you will use **chemical indicators**. Chemical indicators change color when the substance you are testing for is present. The chart below shows the chemical indicators that you will use and what colors they turn to indicate the presence of the substances you are testing for.

Indicator Chart

Chemical Indicator	Positive Test (If substance is present)	Negative Test (If substance is NOT present)
Iodine (starch indicator)	Blue-black when starch is mixed with iodine	Amber (orange-brown) when starch is not present
Glucose Indicator Paper	Green or blue when glucose is present	Orange when glucose is not present

1. Originally the mixture in the dialysis bag "cell" was white and the mixture in the cup was amber (orange-brown).
   - What color is mixture inside the "cell" (bag) now? _____
   - What color is the mixture outside the bag now? _____

2. Use the information in the Indicator Chart, above. Explain why the color inside the bag changed. Hint: what substance diffused into the bag?

   _____

   _____

3. Did starch diffuse out of the bag (yes or no)? _____

   How can you tell?

   _____

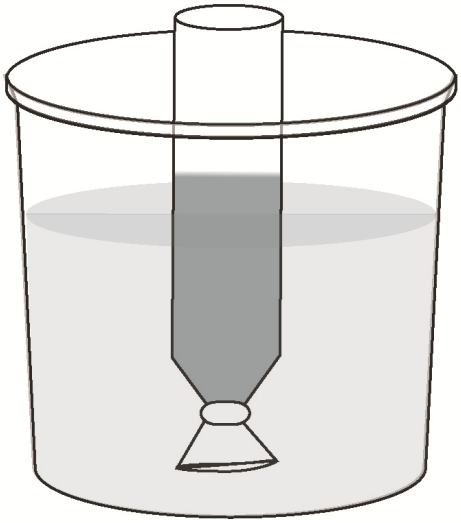
4. Test the contents of the cup using the orange glucose indicator paper. Refer to the Indicator Chart, above. Did glucose diffuse out of the bag (yes or no)? _____

   How you can you tell?

   _____

5. Draw arrows between the words below and the parts of the diagram of a model cell.

Model of a cell membrane
Model of cytoplasm
Model of a cell's environment



Glucose
Starch
Iodine (starch indicator)
Blue-black color
Amber color (orange/brown)

Final (end) state

6. Put an X in front of the molecules that diffused through the membrane.

_____ water _____ iodine _____ glucose _____ starch

7. Put an X in front of the molecules that could not diffuse through the membrane.

_____ water _____ iodine _____ glucose _____ starch

8. Why can some substances diffuse through the **selectively permeable** membrane while others cannot diffuse through the membrane?

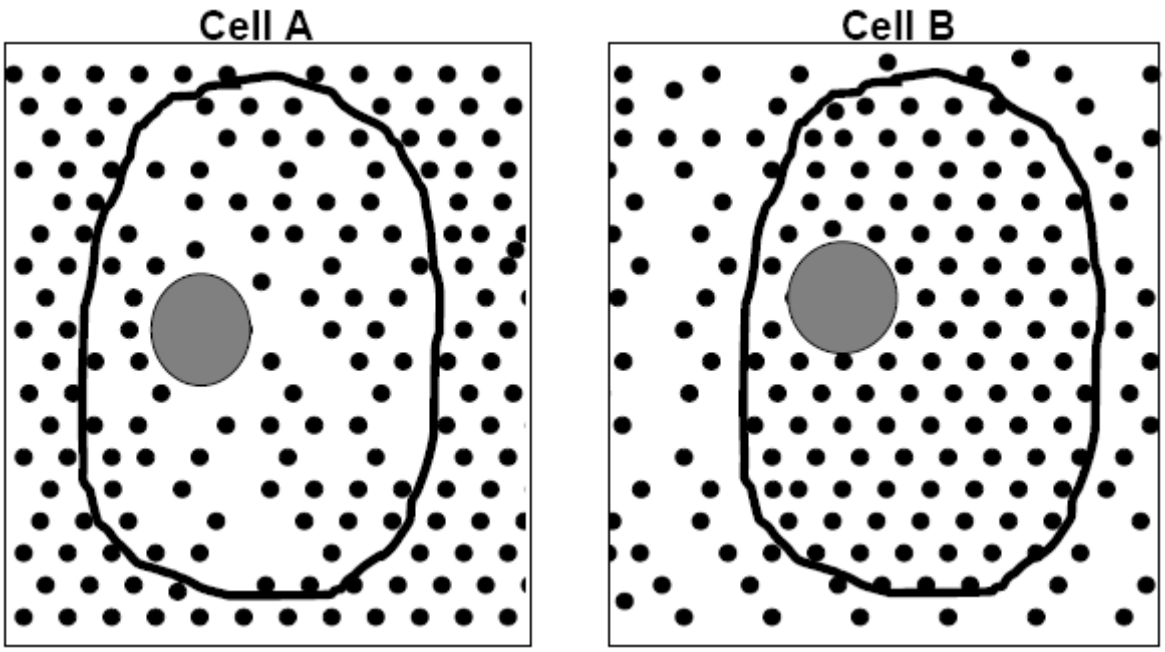
_____

_____

Part 2: Osmosis

Osmosis is a special term for the diffusion of water through a selectively permeable membrane. During osmosis, water molecules diffuse from a region of high water concentration to a region of low water concentration.

To understand how osmosis affects cells, you will need to pay attention to the water concentration in solutions. Adding a solute, such as salt or sugar, to water decreases the concentration of water.



The small dots represent solute molecules that are dissolved in water.

1. Adding solute, such as salt, to water will (increase **or** decrease) the water concentration?

2. Which cell contains the highest concentration of **water**, Cell A *or* Cell B? _____

3. Water will move by osmosis from a region with a (high **or** low) water concentration to a region with a (high **or** low) water concentration.

4. Draw arrows, on the diagrams above, to indicate the direction of **osmosis** for Cell A and for Cell B.

A. Osmosis and Plant Cells

A student prepared a microscope slide of red onion cells mounted in distilled (pure) water:

Photograph A on the Osmosis and Red Onion Cells colored sheet illustrates what the student saw when she observed the slide at using a microscope (400X magnification).

1. In the space below, draw and color one red onion cell mounted in water. Label the cell wall, cell membrane, and cytoplasm.

Diagram of red onion cell mounted in distilled water – 400X

The student then took another piece of red onion skin and made a second microscope slide using salt water.

The student observed the red onion cells mounted in salt water using 400X magnification and noticed a change in the cells from her previous observations.

Photograph B shows what the red onion cells mounted in salt water looked like.

2. In the space below, draw and color one red onion cell mounted in salt water. Label the cell wall, cell membrane, and cytoplasm.

Diagram of red onion cell mounted in salt water – 400X

3. Did the onion cells lose water or gain water when they were placed in salt water? How can you tell?

_____

_____

4. Use your understanding of osmosis to explain what caused this change in the amount of water inside the red onion cells.

_____

_____

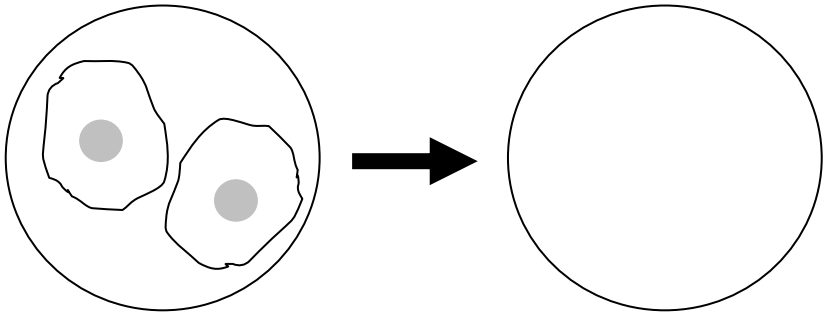
_____

_____

B. Check Your Understanding

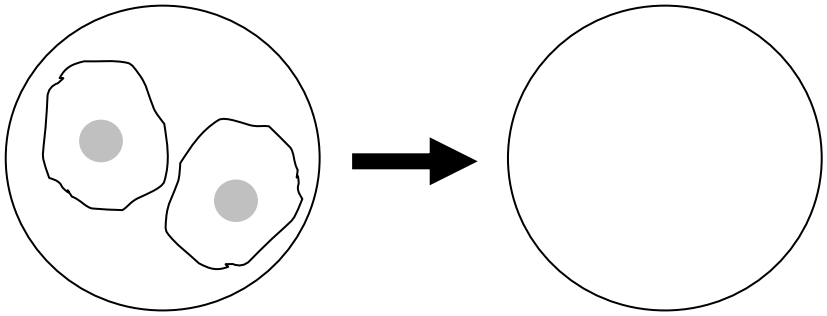
1. Tissue fluid (the liquid that surrounds cells) and cell cytoplasm have the same concentration of salt and water. A student observed a slide with two animal cells mounted in normal tissue fluid.

   In the circle on the right, draw what he should see if he added a concentrated salt solution to the slide.



Cells in normal tissue fluid **Cells after concentrated salt solution was added**

   In the circle on the right, draw what he should see if he added distilled (pure) water to the slide.



Cells in normal tissue fluid **Cells after distilled (pure) water was added**

2. You digest the starch that you eat into glucose molecules. These glucose molecules are then absorbed and transported through the blood to all of the cells of your body. If you didn't digest starch, what would happen?

   _____

3. Drinking seawater (salt water) can be dangerous. If you drink seawater, water will diffuse (into **or** out of) your body cells and into your digestive cavity.

4. Spreading salt on roads to reduce icy driving conditions can kill nearby plants. If there is a lot of salt outside a plant then water will diffuse (into **or** out of) the plants.