Lesson Plan for “Thirsty Potatoes”

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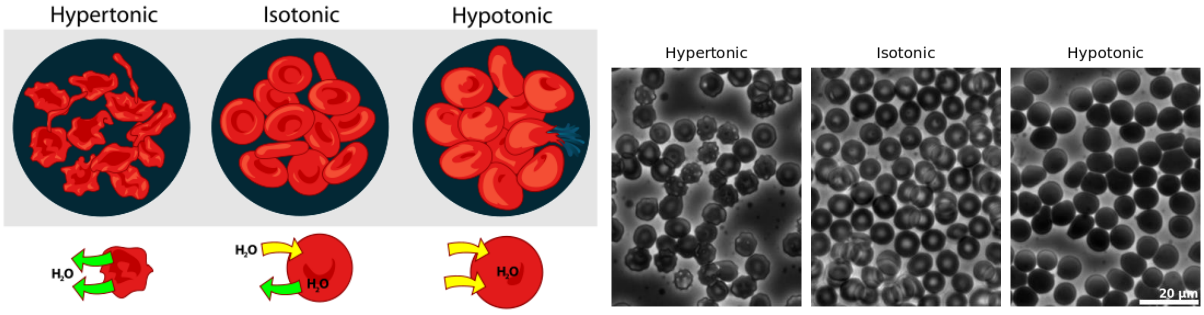
Introduction/Background Info

Osmosis is present in in many real life biological situations. For example, it is important for plant cells and is the main way for plants to obtain water from the soil. On the root of a plant, there are many root hairs that contain semi-permeable membranes. Inside the root of the plant is a very hypertonic solution of minerals and other solutes compared to the water in the earth. Water is drawn from the earth and into the root.

This concept not only applies to plant cells, but it also applies to the red blood cells in our body. Osmosis is very important for red blood cells because it transports oxygen to various parts of our body that needs it. But osmosis can also damage cells when conditions are not favorable. When cells are placed in hypertonic solutions, the water inside them to leave the cell, causing them to shrink. On the other hand when cells are placed in hypotonic solution, the water from the solution flows into the cell causing them to swell. Cells do the best in isotonic solutions because there is a stable balance of ions.

Osmosis in blood cells:



Student Objectives

- For students to understand solutions and concentration gradient.
- For student to understand how systems reach chemical equilibrium.
- For students to learn about osmosis and how it affects biological systems.
- For students to be familiar with the concepts of osmosis, hypertonic/isotonic/hypotonic solutions, semipermeable membranes, solute, solvent, equilibrium, and concentration.

Topics

- Solution: A mixture of two or more substances
- Solute: The substance that is dissolved in a solution (in our experiment the solute is table salt)
- Solvent: The substance in which the solute is dissolved and it has the higher ratio in a solution (in our experiment the solvent is water)
- Concentration: The amount of solute dissolved in a certain volume of solvent
- Osmosis: The movement of water from a higher solute concentration to a lower solute concentration
- Hypertonic solution: A solution that has a higher concentration of solute than another solution

- Hypotonic solution: A solution that has a lower concentration of solute than another solution
- Isotonic solution: A solution that has the same concentration of solute and solvent particles as another solution.
- Semi-permeable membrane: A specific surface that only allows certain materials to pass through.
- Equilibrium: The state between two solutions in which the net rate of movement through a surface (in this case, potato skin) is zero.

Overview of Lesson Process

5 minutes: Have some of the mentors cut the potatoes into small chunks and have the others explain to the kids that three solutions will be made: one with no salt, one with 2 tablespoons (moderate) of salt, and one with 4 tablespoons (a lot) of salt.

5 minutes: Have each group prepare their solutions and a place a potato slice in each cup. Also put a potato slice in an empty cup. This is the control. Don't forget to have the kids label which cup represents each solution.

30 minutes: Put the cups aside and start the formal lesson plan.

- 15 minutes: Explain to the kids what each of the solutions they made is called. Also explain to kids what should happen to the potatoes and how water enters or leaves the potatoes depending on the condition of the solution it is in. For example, how these concepts can apply to living organisms?
- 5 minutes: Perform the experiment with diffusion and food coloring.
- 10 minutes: Have them fill out the first part of the worksheet about blood and plant cells.

15 minutes: Take out the potatoes and have the kids observe the characteristics of the potatoes. Have them compare the potatoes with the control and other potatoes. Record the observations on the worksheet (i.e. physical characteristics, what it looks like)

5 minutes: Some mentors clean up while other mentors conclude the lesson plan and compare the actual results to what was predicted to happen.

Materials

Item	Quantity	Price
Potatoes	1 bag (10 lb)	At most $5.00 (Trader Joes, Ralphs)
Morton Salt	2 26 oz containers	At most $3.38 (Trader Joes, Ralphs)
Clear Plastic Cups	24	$2.79 (Target)
Knife	1 (because we are cutting for them)	Around $6 (Target)
Masking Tape for Labeling	1 stack	At most $3 (Target)
Food Coloring	1	At most $7 (Target)
Paper Towels	One roll	$.99 (99 cents store)
Total		$28.16

Procedures

1. Once you arrive at the site, immediately start preparing the potatoes. Explanations will come after the potatoes are soaking in the solutions.
2. Wash and cut the potatoes into inch-thick slices. It will probably be safest if the mentors cut the potatoes instead of the kids.
3. Have the kids prepare three cups of water and an empty cup. Label the cups as very hypertonic, hypertonic, and hypotonic with masking tape and a marker.
4. In the very hypertonic cup, pour about 4 tablespoons of salt. This does not have to be very exact, just estimate. Stir the solution.
5. In the hypertonic cup, pour about 1 to 2 tablespoons of salt. This also does not have to be very exact. Stir the solution.
6. Don't add anything to the cup labeled hypotonic.
7. In the empty cup, place a piece of potato. Don't do anything further to it. This is the control.
8. Place one piece of potato each of the three solutions prepared.
9. Put all the cups to the side.
10. Soak the potatoes for 20-30 minutes.
11. While the potatoes are soaking, explain the goal of the experiment and the theory behind it.
12. Part of the explanation involves physically demonstrating the movement of substance. Fill a clear plastic cup with water. Drop food coloring into the water, and watch it move across the water. You can allow the students to do this part.
13. Give the students the prepared worksheet.
14. Explain how osmosis happens in cells and have them fill out the worksheet.
15. After they are done, and it has been 20-30 minutes (15 minutes minimum), they can look at their potatoes.
16. Have them record observations on the worksheet. For example, the physical changes in the potatoes compared to the control potato.
17. Clean up and dispose of all the potatoes.

Resources

http://herbarium.desu.edu/pfk/page17/page18/page19/page19.html
http://www.biology4kids.com/files/cell2_passivetran.html
http://www.thefreeresource.com/facts-about-osmosis-for-kids
http://science4mykids.com/2013/03/10/jelly-worm-osmosis-experiment-for-kids/
http://www.youtube.com/watch?v=VJMkgAPuufM