Cool Carrot Osmosis

Overview Osmosis is how water moves through a membrane. We're going to do two experiments on a carrot: first we're going to figure out how to move water into the cells of a carrot. Second, we'll look at how to move water within the carrot and trace it. Last, we'll learn how to get water to move out of the carrot. And all this has to do with cells!

What to Learn Water always moves through cell membranes towards the side with higher chemical concentrations. For example, a carrot sitting in salt water causes the water to move *into* the salty water. The water moves because it's trying to equalize the amount of water on both the inside and outside of the membrane. The act of salt will draw water out of the carrot, and as more cells lose water, the carrot becomes soft and flexible instead of crunchy and stiff. When surrounded by pure water, the concentration of water outside the carrot cells is greater than the concentration inside. Osmosis makes water move from greater concentrations to lesser concentrations.

Materials

- 3 carrots
- Food coloring
- 3 tablespoons of salt
- Three glasses
- String
- water

Experiment

Experiment #1: Salt water moving into the Carrot

1. Cut the tip off of a carrot (with adult supervision).
2. Place the carrot in a glass half full of water
3. Place the carrot somewhere where it can get some sunshine.
4. Observe the carrot over several days.
5. Re-do the four steps above in a new cup, and this time put several (10-12) drops of food coloring into the water.
6. With the help of an adult, cut the carrot in half length-wise.

Experiment #2: Water moving out of the carrot

7. Snap the carrot in half and tie a piece of string around each piece of carrot (make sure they're tied tightly).
8. Place each half in a glass half full of warm water.
9. In one of the glasses, dissolve the salt.
10. Leave overnight.
11. The next morning pull on the strings. What do you observe?

Cool Carrot Osmosis Data Table

Food Item	**Type of Liquid** *(fresh water, salt water, fresh water with food coloring)*	**Results** *(change in size, movement of liquid, change in flexibility)*

Reading

A carrot is made up of cells surrounded by cell membranes. The cell membrane's job is to keep the cell parts protected. Water can pass through the membrane, but most things can't.

The carrot itself is a type of root—it is responsible for conducting water from the soil to the plant. The carrot is made of cells. Cells are mostly water, but they are filled with other substances too (organelles, the nucleus, etc).

And water always moves through cell membranes towards higher chemical concentrations. For example, a carrot sitting in salt water causes the water to move *into* the salty water. The water moves because it's trying to equalize the amount of water on both the inside and outside of the membrane. The act of salt will draw water out of the carrot, and as more cells lose water, the carrot becomes soft and flexible instead of crunchy and stiff.

You can reverse this process by sticking the carrot into fresh water. The water in the cup can diffuse through the membrane and into the carrot's cells. If you tie a string around the carrot, you'll be able to see the effect more clearly!

During the first part of the experiment, when surrounded by pure water, the concentration of water outside the carrot cells is greater than the concentration inside. Osmosis makes water move from greater concentrations to lesser concentrations. This is why the carrot grows in size—it fills with water!

During the second part of the experiment, the salt-water carrot shrunk while the non-salt-water carrot bloated! This is because of osmosis. Carrots are made up of cells. Cells are full of water. When the concentration of water outside the cell is greater than the concentration of water inside the cell, the water flows into the cell. This is why the non-salt-water carrot bloated—the concentration was greater outside the cell than inside. The concentration of water was greater inside the salt-water carrot than outside (because there was so much salt!) so the water flowed out of the cell. This made the salt-water carrot shrink.

Exercises

1. What happens if you try different vegetables besides carrots?

2. How do you think this relates to people? Do we really need to drink 8 glasses of water a day?

3. What happens (on the osmosis scale) if humans don't drink water?

4. What did you expect to happen to the string? What *really* happened to the string?

5. Which solution made the carrot rubbery? Why?

6. Did you notice a change in the cell size, shape, or other feature when soaked in salt water?

7. Why did we bother tying a string? Would a rubber band have worked?

8. What would happen to a surfer who spent all day in the ocean without drinking water?

9. What do you expect to happen to human blood cells if they were placed in a beaker of salt water?

Answers to Exercises: Cool Carrot Osmosis

1. What happens if you try different vegetables besides carrots?(In the case of celery, potatoes and beans, the water still travels into the vegetable, to the area of lower water concentration.)
2. How do you think this relates to people? Do we really need to drink 8 glasses of water a day? (When we drink water, it moves into the areas of low water concentration, hydrating cells).
3. What happens (on the osmosis scale) if humans don't drink water? (We will dehydrate and become thirsty. If we don't get enough water, we will die.)
4. What did you expect to happen to the string? What *really* happened to the string? (Answers will vary for expectation. The string really stayed the same, but the carrot shrunk or became bloated).
5. Which solution made the carrot rubbery? Why? (The salt water made the carrot rubbery, because the lower concentration of water in the salt water caused the water to move out of the carrot, making it more flimsy.)
6. Did you notice a change in the cell size, shape, or other feature when soaked in salt water? (answers vary)
7. Why did we bother tying a string? Would a rubber band have worked? (We tied a string to measure the change in size in the carrot. If it gets bigger, the string gets tighter, and if it shrinks, the string becomes loose. A rubber band would not have worked, because it would have expanded or shrunk with the carrot).
8. What would happen to a surfer who spent all day in the ocean without drinking water? (The water in his cells would move out to the ocean, where the concentration of water is lower. Eventually, the surfer would dehydrate).
9. What do you expect to happen to human blood cells if they were placed in a beaker of salt water? (I would expect the cells to shrink, because the water in them would travel to the lower concentration of water in the salt water.)