STEM Sims™

Osmometry

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Osmometry

Do you need an idea for a scientific study?
Try out one of our ideas or make one of your own.

Osmometry involves a method of measuring the solute concentration in solutions. Take the following brief quiz to see how much you already know about how osmometry. See the bottom of page 4 to check your answers.

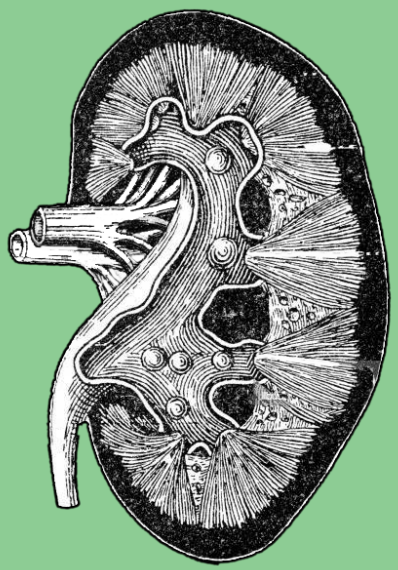
1. About how many milliliters of blood pass through a human kidney each minute?
   a. 1.3
   b. 13
   c. 130
   d. 1,300

2. All the following are parts of a human kidney *except* the:
   a. nephron.
   b. Loop of Henle.
   c. Isles of Langerhans.
   d. glomerulus.

3. About how many milliliters of urine in a human bladder are needed to stimulate the feeling of needing to empty the bladder?
   a. 30 – 40 mL
   b. 200 – 400 mL
   c. 500 – 700 mL
   d. 800 – 900 mL

4. About how many nephrons does one human kidney contain?
   a. 1,000
   b. 10,000
   c. 100,000
   d. 1,000,000

5. About how long is one normal human kidney?
   a. 1.0 centimeter
   b. 12 centimeters
   c. 32 centimeters
   d. 52 centimeters



Which Way Did It Go?

The human kidneys remove the wastes from blood and other body fluids. The kidneys do this process without losing many of the valuable substances the body needs, such as water, proteins, and glucose. Much of this work is completed using the process of osmosis. In this activity, you'll see how osmosis works on a super-sized cell…a chicken egg.

Materials

3 raw eggs (same size)	3 glasses (large enough to fit the egg plus liquid)
3 forks	White vinegar (about 3 cups)
Distilled water (about 2 cups)	Light corn syrup (about 1 ¼ cups)
Large spoon	Measuring cup (1 cup)
Measuring spoons (1 tablespoon and ½ tablespoon)	

Directions

1. Make sure to get permission before completing this investigation. No materials used in the investigation should be consumed! Make sure to wash your hands thoroughly after handling raw eggs.
2. Place one egg in each glass. Cover each egg completely with white vinegar. If needed, place a fork in each glass to hold the egg under the vinegar.
3. Place the three glasses with eggs in the refrigerator for 24 hours.
4. Remove the glass from the refrigerator. Holding the egg in place in the glass with the fork, carefully pour off the vinegar into the sink.
5. Repeat steps 2 – 4.
6. Use the large spoon to gently remove each egg from its glass. Carefully hold each egg over the sink and slowly rinse the egg with tap water. Place the "naked" eggs on a plate temporarily.
7. Rinse each glass with tap water and dry with a paper towel.
8. Label one glass as "Hypertonic" and place 1 cup of corn syrup into the glass.
9. Label a different glass as "Isotonic" and place 1 ½ tablespoons and 1 cup of distilled water into that glass.
10. Label the final glass as "Hypotonic" and place 1 cup of distilled water into the glass.
11. Note the appearance of each egg in the space below labeled "Before."
12. Carefully place one egg in each glass and place all three glasses in the refrigerator for 24 hours.
13. Remove the glasses from the refrigerator and note the appearance of each egg in the space labeled "After."
14. Clean all glasses and place the eggs in the trash or compost bin.

Egg Appearance	Hypertonic	Isotonic	Hypotonic
Before			
After			

Questions

1. Provide a reason for the difference in the appearance of the eggs.

2. Describe which direction water was moving in each of the eggs.

Osmometry

Why the Difference?

Osmosis is the process in which a substance passes through a semi-permeable membrane. This type of membrane allows some substances to pass through, while other substances are restricted from passing. Once the egg's shell was removed, the outer surface of the egg acted as a semi-permeable membrane. The membrane allowed water to pass through, but larger molecules, such as proteins, were not allowed to pass. The human kidneys operate in a similar way.

But the question must be asked: "What drives a substance to move from one side of the membrane to the other side?" The simple answer is osmotic pressure. Osmotic pressure occurs when there is a difference in solute concentration on either side of the membrane. The greater the difference in the concentration of the solute, the greater the pressure difference. Water always moves from a higher concentration of water to a lower concentration of water. The hypertonic solution had a higher concentration of solute than the inside of the egg, which means the hypertonic solution had a lower concentration of water than the inside of the egg. Since water always moves from higher to lower concentration, the water moved out of the egg and into the solution inside the glass. This resulted in the shrinking egg.

The isotonic glass solution had equal concentrations of solute and water inside the egg and in the solution. Therefore, water did not move from one system to the other and the egg remained the same size. The hypotonic solution had a lower solute concentration than inside the egg, so water moved from the solution in the glass into the egg. The egg increased its size due to the increase in water volume inside the egg.

What's truly amazing is that a similar process is happening right now in the millions of cells that make up the functioning part of your kidneys. Water is being transferred from inside of cells to the extracellular spaces and vice versus. All of this is happening to keep you healthy and alive.

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Answers: Page 2 Answers: 1) a, 2) c, 3) b, 4) d, 5) b. **Page 3 Answers:** Which Way Did It Go? 1) Hypertonic = Egg shrunk, Isotonic = Egg stayed the same size, Hypotonic = Egg increased in size. 2) Hypertonic = Egg lost water, Isotonic = No water loss, no water gain, Hypotonic = Egg gained water.