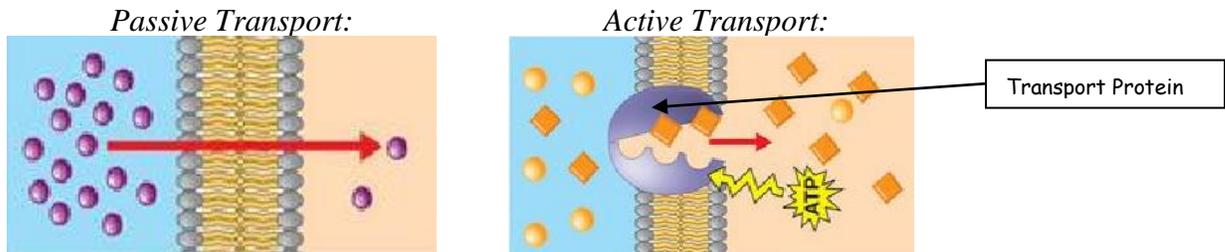


Case Study – Cellular Transport

Passive Transport vs. Active Transport:

When materials need to be transported across the cell membrane, either into or out of the cell, cellular transport occurs. When molecules are moved from a high to low concentration across the membrane, this process is called passive transport because no energy is used. The movement of any molecule across the cell membrane through passive transport is called diffusion. However, when diffusion of water molecules takes place, the process is called osmosis.

When molecules are moved from a low to high concentration, energy is needed to actively transport materials across the membrane. In the cell, this energy is called ATP. Because the molecules that use active transport are so large, special transport proteins that extend across the membrane are needed for cell transport to take place.



Diarrhea:

When food exits the stomach, it moves into the small intestine where digestion and absorption of nutrients occurs. At this point, the waste that remains in the small intestine contains quite a bit of water. Once this waste reaches the large intestine, most of this water is absorbed through cells in the wall of the intestine. The remaining solid waste then travels to the rectum and leaves the body through the anus. However, when too much water is in the large intestine with the waste, diarrhea happens. Believe it or not, people have diarrhea as a result of cell transport! There are two main types of diarrhea, osmotic and secretory.

Osmotic Diarrhea:

Osmotic diarrhea occurs when extra sugars in solid waste cause water to be drawn from the body into the large intestine. This can happen when people drink diet drinks that contain artificial sweeteners. These artificial sweeteners can't be absorbed by the small intestine like regular sugars so they remain in the waste as it moves into the large intestine. Because there is so much extra sugar in the solid waste, osmosis transports water through the intestinal wall to maintain the correct sugar/water balance. Osmotic diarrhea also happens in people who have lactose intolerance. Patients with lactose intolerance can't digest dairy products because they are not able to break down a sugar called lactose. Just like with the artificial sweeteners mentioned above, extra lactose in solid waste results in water entering the large intestine to balance out the sugar. In both of these cases, osmosis occurs in the wrong direction. Instead of being absorbed through the intestinal wall so that it leaves the large intestine and creates a more firm stool (poop), excess sugars cause water to enter the large intestine. OH NOOOOOO! This results in diarrhea!

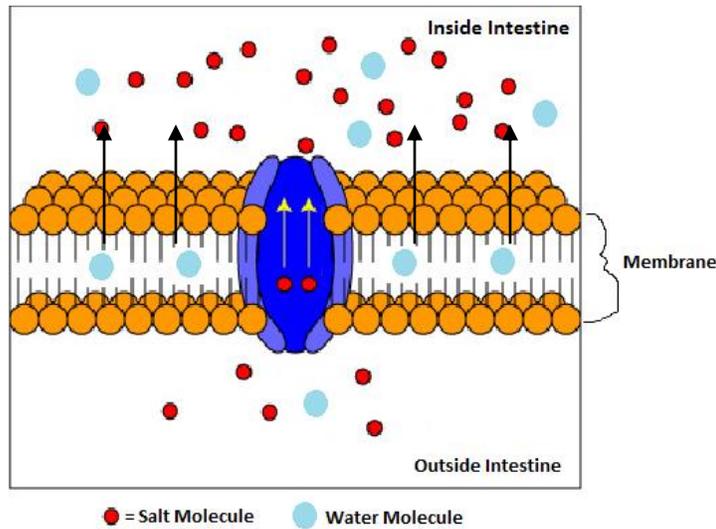
Secretory Diarrhea:

Secretory diarrhea usually occurs when a human is infected by some sort of bacteria. Bad strains of E. coli bacteria that cause food poisoning can be responsible for this kind of diarrhea. Similarly, cholera is a bacterial disease that causes secretory diarrhea. Cholera bacteria cause the active transport of salts through transport proteins into the large intestine. Because this results in a high concentration of salts in the intestine, water will travel by osmosis into the intestine to maintain the correct salt/water balance. This extra water in the intestine causes diarrhea! Other symptoms are usually present if cholera bacteria are responsible for secretory diarrhea. For example, the patient will usually have low blood pressure, a rapid heart rate, and wrinkled skin. All of these symptoms are due to an abnormal salt/water balance.

Case Study: Molly

Molly arrives at the doctor’s office complaining of diarrhea. She has just returned from a safari trip in Africa. In order to treat Molly’s symptoms correctly, the doctor runs a series of tests in order to determine which type of diarrhea she has and what might be causing it. The results of these tests are explained below.

- 1) The doctor had Molly bring in a stool sample that was later analyzed at the lab. He discovered that Molly’s sample had a higher concentration of salts than would be expected for a healthy patient. The sugar levels in the sample were normal.
- 2) The doctor used a special camera to take microscopic images of the cells in the wall of Molly’s large intestine. He wanted to see which molecules were entering and exiting the intestine. One image that he took is shown below. Labels have been included to help you analyze the picture. Use them!



- 3) The doctor also took a picture of Molly’s hands when she arrived at his office and compared it to a snapshot from her iphone that she had taken of a manicure that had been done before she left on her trip. These images are pictured below. *(Note: Molly did not get magically older.)*

Before Trip:



At Office:



- 4) The doctor also measured Molly’s heart rate while she was at his office. Her resting heart rate was 87 beats per minute. Below is a chart showing how healthy certain resting heart rates are in women. Compare Molly’s heart rate with what you see in this chart. *(Note: Molly is 49 years old.)*

WOMEN						
AGE	18 -25	26 -35	36 -45	46 - 55	56 -65	65+
ATHLETE	54-60	54-59	54-59	54-60	54-59	54-59
EXCEL'T	61-65	60-64	60-64	61-65	60-64	60-64
GOOD	66-69	65-68	65-69	66-69	65-68	65-68
ABOVE AV	70-73	69-72	70-73	70-73	69-73	69-72
AVERAGE	74-78	73-76	74-78	74-77	74-77	73-76
BELOW AV	79-84	77-82	79-84	78-83	78-83	77-84
POOR	85+	83+	85+	84+	84+	84+

Name: _____ Date: _____ Period: _____

Analysis

Directions: Answer the following questions about Molly's Case based on the information provided on the previous pages. Questions should be answered in complete sentences.

1. Which type of diarrhea is Molly suffering from, osmotic or secretory? What causes this type of diarrhea?
2. Explain how you know what type of diarrhea she is suffering from based the analysis of Molly's stool sample.
3. Explain how you know what type of diarrhea she is suffering from based the analysis of the microscopic image of the cells in Molly's intestine. You must include two pieces of evidence from the picture.
4. Explain how you know what type of diarrhea she is suffering from based the analysis the images of Molly's hands before and after her trip to Africa.
5. Explain how you know what type of diarrhea she is suffering from based the analysis from Molly's heart rate reading.
6. Provide at least two reasons why you know that this is not the other type of diarrhea. Use evidence from the tests that Molly's doctor performed.
7. Describe how active transport and osmosis caused Molly's diarrhea.