Color Changing Milk:
Investigating Hydrophobic and Hydrophilic Properties

Background Information:

Some very unusual interactions take place when you mix a little milk, food coloring, and a drop of liquid soap. Milk is mostly water, but it also contains vitamins, minerals, proteins, and tiny droplets of fat suspended in solution. Fats and proteins are sensitive to changes in the surrounding solution. Dish soap has both polar and nonpolar characteristics. The soap’s polar region will dissolve in water because it is hydrophilic. The soap’s nonpolar region is hydrophobic and does not dissolve in water. These nonpolar regions form a globule/micelle of molecules and mix with the fat in the milk.

Objective:

To observe the invisible interaction between fat globules/micelles and the nonpolar regions of soap.

Materials:

• 2% milk
• Shallow pan
• Food coloring (red, yellow, green, blue)
• Dish-washing soap
• Q-Tip
• Lab apron

Procedure:

1. You must wear your lab apron during the experiment.
2. Pour the whole milk into the shallow pan so that the milk completely covers the bottom to the depth of about ¼ inch.
3. Allow the milk to settle before moving on to the next step.
4. Add one drop of each of the four colors of food coloring to the milk. Place 1 drop of red food coloring at 12:00, 1 green drop at 3:00, 1 blue drop at 6:00, and 1 yellow drop at 9:00. Keep the drops close together in the center of the shallow container of milk.
5. Get your iPad ready! Use your iPad to record the experiment for future viewings.
6. With one end of the Q-Tip, touch the tip in the center of the pan. Observe what happens and record in your data table.
7. Now dip the other end of the place a drop of liquid dish soap on the other end of the cotton swab. Place the soapy end of the Q-Tip back in the middle of the milk and hold it there for 10 to 15 seconds. Observe what happens and record in your data table.
8. Add another drop of soap to the Q-Tip and try it again. Experiment with placing the Q-Tip at different places in the milk. What happens to the milk even when the Q-Tip is removed?
9. Clean up your work station. Throw away the Q-Tip and wash the pan with water. Dry the pan and replace the lab materials to the work station as you found them.

Video: http://www.youtube.com/watch?v=LRZzoRAiuHo
Temperature Diffusion Lab

Background Information:

Diffusion is a process that allows molecules to move from a more concentrated area to a lower concentrated area. This process accounts for the movement of many small molecules across a cell membrane. Diffusion is the process by which cells acquire food and exchange waste products. Oxygen, for instance, might diffuse in pond water for use by fish and other aquatic animals. When animals use oxygen, more oxygen will diffuse to replace it from the neighboring environment. Waste products released by aquatic animals are diluted by diffusion and dispersed throughout the pond.

Objective:

To observe the process of diffusion of food coloring droplets and the effect of temperature.

Materials:

- 3 Plastic Cups
- Hot plate
- Beaker and Tongs
- Ice Water
- Food coloring (red, yellow, green, blue)
- Thermometer
- Lab apron and goggles

Procedure:

1. You must wear your lab apron and goggles during the experiment.
2. Begin a water bath by filling a beaker of water and allowing it to warm on the hot plate.
3. From the ice water container, obtain a cup of water. Insure that there are NO ice chips in the cup. You want ice water ONLY!
4. In the second cup, place the designated amount of room temperature tap water.
5. Carefully use beaker tongs to transfer the designated amount of warm water to the remaining cup.
6. Align the cups in the following order: Ice Water, Room Temperature Water, and Hot Water. Record the temperature of your water.
7. Get your iPad ready! Use your iPad to record the experiment for future viewings.
8. Place three drops of food coloring in each cup.
9. Record your observations.
10. Clean up your work station. Dispose of the water down the drain and rinse out the three cups completely. Ensure they are free from food dye, dry, and leave the lab materials as you found them.

Video: http://www.youtube.com/watch?v=-BZak2jTHc8
Color Changing Milk Lab

Data Table:

<table>
<thead>
<tr>
<th>Trial</th>
<th>Observation and Appearance of Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q-Tip without soap</td>
<td></td>
</tr>
<tr>
<td>Q-Tip with soap</td>
<td></td>
</tr>
</tbody>
</table>

Conclusion:

Remember: Milk is mainly WATER and contains fat which is NONPOLAR and HYDROPHOBIC. Soap has polar and nonpolar molecules. When soap is placed in milk, the polar (hydrophilic) portion dissolves in the water of the milk, the Nonpolar (hydrophobic) portion of the soap attaches with the fat. The fat molecules move in all directions as the soap molecules try to bond with it creating what we observed.

1) How does this lab experiment and our observations relate to our lesson on the Plasma Membrane?

2) In our experiment, we used 2% milk. What do you think would have happened if we used water, fat free or 1% milk?

Temperature Diffusion Lab

Data Table:

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Observation and Appearance of Water and Dye</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice Water</td>
<td></td>
</tr>
<tr>
<td>Room Temperature Water</td>
<td></td>
</tr>
<tr>
<td>Hot Water</td>
<td></td>
</tr>
</tbody>
</table>

Conclusion:

1) Explain the observation that was seen in our lab experiment in terms of transport and concentration gradient.

2) The movement of particles throughout a system is important for the rate of transport. What do the observations tell about the rate of reaching equilibrium in the beaker?