Surface tension - tie dye milk experiment

Objective:

Students will learn about surface tension.

Introduction:

Liquids, such as water and milk, have a physical property known as surface tension, which is a result of the cohesive forces of the liquid's molecules. Surface tension allows a liquid to resist an external force. This is why some insects are able to walk on the surface of water. Cohesive forces in liquid molecules pull each molecule in the bulk of the liquid in all directions by neighboring liquid molecules, thus resulting in no net force. However, the liquid molecules on the surface are not completely surrounded by other molecules and are thus pulled inwards, creating an internal pressure.

Things related to surface tension include the shape of water droplets and the separation of water and oil.

Surfactants, such as soap, help reduce the surface tension of liquids. Soap bubbles, for instance, have a large surface area but little mass and are able to reduce the surface tension of water by absorbing at the liquid-gas interface.

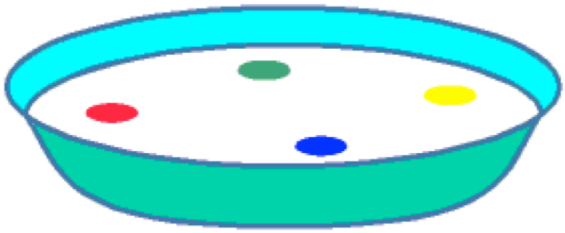
Materials:

- Whole milk
- Dish detergent
- Food coloring
- A clear shallow dish
- Toothpick

Protocol:

1. Fill the dish halfway with milk.
2. Carefully put **one drop** of each of the four food colors onto the surface of the milk, widely separated, and not in the center of the dish.

Your set-up should look something like this:



3. Get ready to watch what happens! Very carefully dip the toothpick into the dish soap and touch it onto the surface of the milk in the center of each dish (be careful not to add the soap directly on top of the food coloring).

Observations:

What happens to the food coloring when you first put it on the milk? Why do you think that is?

What happens when you add the drop of soap?

What direction does the food coloring move when you first add the drop of soap?

What direction does the food coloring move after the experiment has been running for a while?

Does the movement go on forever? What happens?

What happens if you add another drop of soap after the colors have stopped moving?

Expected Results:

Since the food coloring is less dense than the milk, the first droplets of color just float on the surface of the milk. The colors do not mix because you did not stir up the solution. When you add soap, it reduces the surface tension of the milk by dissolving the fat molecules. The milk outside of the soap drop has a higher surface tension, so it pulls the surface away from that spot. The food coloring moves with the surface, flowing away from the soap droplet. Due to the convection that results from the moving surface, the food coloring may be drawn down into the liquid and appear to rise somewhere else. As the soap and milk begin to mix evenly, the action slows and stops. If you add another soap droplet, the process will begin again.