COLOR CHANGING MILK – SURFACE TENSION & EMULSIONS

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WHAT YOU WILL NEED:

- Shallow bowl or dinner plate
- Food coloring
- Dish soap
- Q-Tips

Procedure:

1. Pour enough milk in the plate to cover the bottom.
2. Add one drop of four colors of food coloring (close to one another) in the center of the milk.
3. Using a clean Q-Tip, touch the milk. What happens?
4. Now place a drop of liquid dish soap to the other end of the Q-Tip and touch it to the center of the milk.
5. What happens?
6. Try touching the soap end of the Q-Tip to different parts of the plate and watch what happens.

Why?

Milk is mostly water, but contains proteins and fat.

Dish soap is a **surfactant,** an agent that lowers the surface tension of a substance to allow easier spreading. It's **bipolar**, polar at one end and non-polar at the other end. Touching it to the milk weakens the chemical bonds that hold the proteins and fats in the solution, causing the fat and protein molecules to twist and bend as the soap molecules race to join up with them. The food coloring, sitting on top due to a lower density, is bounced around because the invisible reaction.

See the following page for a visual representation.

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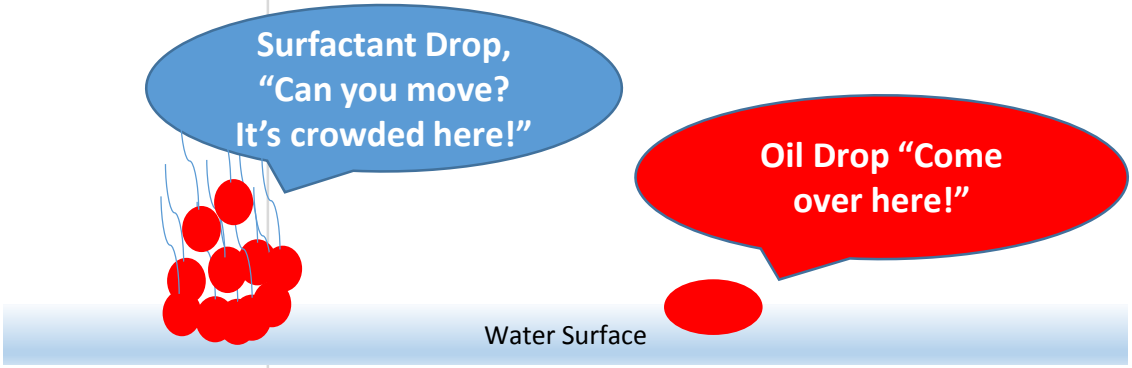
What is a surfactant?

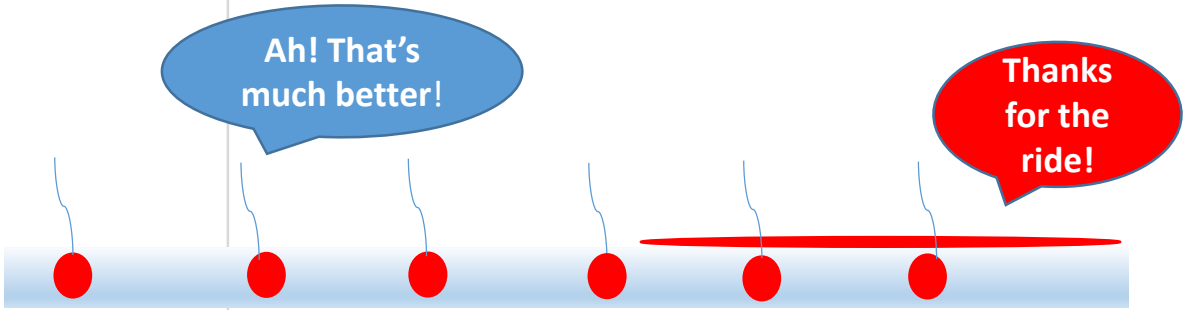
A surfactant is an agent that lowers the surface tension of a substance to allow easier spreading. Surfactants have a water-loving end (**hydrophilic**) and a water-fearing end (**hydrophobic**).

What is surface tension?

Surface tension is the force that causes molecules to be pushed together and form a layer on the surface. The blue line above represents the surface of the milk in the experiment. The red dot represents a food dye drop on the milk. The food dye sits on top of the milk because the food dye has a lower **density**.



When you initially add the drops of soap, the soap lowers the surface tension of the milk because it spreads out and covers out the surface. As the surfactant spreads, it pushes the food color across the milk surface. The soap's water-loving end (the red circles above) dissolves in water and the water-fearing end (the blue tails above) attaches to the fat in the milk. The surfactants in the soap are too close together when they are first added, so they bend, roll and twist away from each other. The molecules in the food dye get shoved during this process, which is why it is easy to see!



The surfactants eventually move apart, which is why you see the food dye moving in different directions. The reaction you see between the soap and fat in the milk is what helps to remove grease off of dirty dishes. Cleaning products that you use all the time use this same process to clean your dishes!

Whether it's the surfactants in your cleaning products or the emulsions in your food, lots of products and mixtures are the result of all of these chemistry concepts working together!