Milk Polarity

Target Grade: Grades 6-8

Time Required: 5 minutes

Standards/Topics Covered:

NGSS Standards

- MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.

NGSS Crosscutting Concepts

- 2. Cause and Effect: Events have causes, sometimes simple, sometimes multifaceted. Deciphering casual relationships, and the mechanism by which they are mediated, is a major activity of science and engineering.

Central Focus:

This phenomenon driven demonstration is intended to teach students about the hydrophobic, hydrophilic, soluble, and insoluble characteristics of polar and non-polar molecules. This activity uses dish soap, milk, and food coloring to demonstrate the differences in polarity. Even though the food coloring disperses, your students won't want to!

Keywords: interactions, opposite, attraction, repulsion

Background Information:

Polarity refers to an unequal distribution of charge in a molecule. This leads to the molecule having a dipole moment, where one end is negatively charged and the other end is positively charged. Polarity occurs when there is a difference in electronegativity between the bonded atoms in a molecule. The term "non-polar" is the opposite: an equal charge throughout a molecule. Polar and non-polar molecules cannot mix, so the phrase "like dissolves like" is often used to describe the solubility of molecules.

Milk is made of water, vitamins, minerals, proteins, and fats. These fats are nonpolar, meaning they do not dissolve in water. Dish soap is amphipathic, meaning that it has both polar and nonpolar sections. "Like dissolves like." In other words, polar dissolves polar and nonpolar dissolves nonpolar. In the case of dish soap, the non-polar section will cling to the fat molecules in the milk while the polar section will repel it. Due to the rapid movement of the molecules, the food coloring is pushed along with it, dispersing it to the edges of the plate.

Materials

- Plate or shallow dish
- Milk
- Food coloring
- Q-tips
- Dish soap

Instructions

- Pour the milk onto the plate so that there is a thin layer.
- Add food coloring to the center of the plate.
- Dip a Q-tip into dish soap.
- Carefully touch the tip of the Q-tip into the middle of the dye.
- Watch the colors disperse!

Closure

1. What did you see when the dish soap covered Q-tip was touched to the food coloring in the milk? Why?

When the Q-tip is touched to the middle of the food coloring, the color disperses across the plate. This occurs because of the differences in polarity between the fat molecules and water in the milk and the amphipathic structure of the dish soap.

2. What would happen if you touched the Q-tip to the milk without dish soap?

The color would not move because there will not be anything to disperse the molecules. The dish soap has an amphipathic structure that allows the fat molecules and the water molecules to both cling to the soap molecules as the polarity drives dispersion. Without the dish soap on the Q-tip, there will be no polarity to drive dispersion, and the color will not move.

3. What would happen if you used different fat contents of milk (Skim, 1%, 2%, whole)? Which would have the best dispersal?

They would all still create some dispersal, but the whole milk would work the best. This is because there are more fat molecules in the whole milk than in the reduced fat milks, causing the food coloring to be quickly moved to the edge of the plate with the fat molecules.