Science

Milk Emulsion

Grade Level
4-6

Length of Lesson
30 minutes

Objective
By the end of this lesson, students will have a better understanding of how sensitive the fats and proteins of milk are to new substances.

Materials Needed
- Milk (whole or 2%)
- Small bowls
- Cotton swabs
- Food coloring (4 colors)
- Dish-washing soap

Standards
Common Core
CCSS.ELA-Literacy.RI.4.3; RI.5.3

NGSS
5-PS1; MS-PS1

Lesson Summary
This lesson is a fun, hands-on activity designed to help students understand how fats and proteins are sensitive to the changes in the surrounding solution (the milk).

Suggested Sequence of Events:
1. Read through the IAITC Dairy Ag Mag to learn more about milk and other dairy products! Interactive online versions can be found on our website.
2. Complete the activity following the procedures:
    - Pour enough milk in the bowl to completely cover the bottom. Allow the milk to settle. There should be no ripples in the milk before starting this activity.
    - Add one drop of each of the four colors of food coloring - red, yellow, blue, and green - to the milk. Keep the drops close together in the center of the plate of milk.
    - Find a clean cotton swab for the next part of the experiment. Predict what will happen when you touch the tip of the cotton swab to the center of the milk. It's important not to stir the mix. Just touch it with the tip of the cotton swab.
    - Now place a drop of liquid dish soap on the other end of the cotton swab. Place the soapy end of the cotton swab back in the middle of the milk and hold it there for 10 to 15 seconds.
    - Add another drop of soap to the tip of the cotton swab and try it again. Experiment with placing the cotton swab at different places in the milk.
4. Whole class discussion and reflection of activity. Here are some prompting questions:
    - Describe how the milk reacted when you first added the food coloring drops (step number 2).
    - Explain what happened when the soapy cotton swab was held on the surface of the milk.
    - What happened when you placed the soapy cotton swab in different locations of the plate? Would this work with the plain cotton swab, why or why not?
    - Read the background information on the teacher resources page.
        - What makes the food coloring in the milk move?
        - Explain why this activity would or would not work with regular tap water.

TEACHER RESOURCES

Background Information:
When you add soap to milk, the weak chemical bonds that hold the proteins in the solution are altered. It becomes a free-for-all! The molecules of protein and fat bend, roll, twist and contort in all directions. The food coloring molecules are bumped and shoved everywhere, providing an easy way to observe all the invisible activity.

At the same time, soap molecules combine to form a *micelle*, or cluster of soap molecules. These micelles distribute the fat in the milk. This rapidly mixing fat and soap causes swirling and churning where a micelle meets a fat droplet.

Milk is mostly water and has surface tension like water. The drops of food coloring floating on the surface tend to stay put. Liquid soap wrecks the surface tension by breaking the cohesive bonds between water molecules and allowing the colors to zing throughout the milk. What a party!

Extension Ideas:
- Read "Clarabelle: Making Milk and So Much More" by Cris Peterson. Look at the pictures and have students analyze the images.
    - Have students write a short story or create a comic strip from Clarabelle's perspective.
- Take a closer look at emulsion. What are other types of emulsions?
    - Try out IAITC "The Chemistry of Butter" activity and make your own butter while deepening their understanding of emulsion.
- Take the experiment to the next level and have students test different types of milk-different fat contents and even different brands!
- Take a field trip to a dairy farm and learn about dairy farming.
- Invite a dairy farmer into the classroom.
- Go to agintheclassroom.org to contact your County Literacy Coordinator for free classroom sets of our Ag Mags!