States of Matter: Making Butter

Background Information

An emulsion is a (homogenous) mixture of two or more liquids that normally aren't able to mix. The two liquids that make milk an emulsion are water and fat. The fat is in the form of globules that are dispersed throughout the water. Think of the globules like little microscopic water balloons. When the milk is vigorously shaken, all of the molecules slam into each other. The force causes those fat globules to burst (like a water balloon hitting when it's popped) and the fat within the globule is free. The continued shaking causes the freed fat molecules to separate from the water and bond together, forming a clump which we call butter, and leaving behind the excess liquid which we call buttermilk.

Materials provided by McLean County Agriculture in the Classroom:

- one clear 2 ounce plastic cup with lid per student
- one ounce heavy whipping cream per student
- one saltine cracker per student
- one Dairy Jr. Ag Mag per student

McLean County AGRICULTURE in the Classroom SM

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1. Read through the Dairy Jr. Ag Mag to learn about dairy cows and milk products.

2. Complete the activity following the procedures:
   - Set out enough 2 oz. plastic portion cups for each student to have one of their own.
   - Fill each portion cup halfway full with heavy whipping cream and then put the lids on each cup.
   - Explain to students that milk has a lot of fat molecules all throughout it, and when those molecules are agitated, they start clumping together. When they are agitated enough, they form a clump. That clump is butter.
   - Give each student a portion cup with the whipping cream.
   - Tell them to hold the cups with their pointer finger and middle finger on the lid and their thumb on the bottom of the cup. Tell them to keep a firm grip, but not too firm, on their cups and start shaking.
   - Shake, shake, shake! You'll shake for 5-7 minutes depending on how cold the whipping cream is. At first, the liquid will slosh around. Next, you won't hear any sloshing. This means students have whipped cream in their cups. DO NOT open the cup yet! You will be ready to stop shaking once there is a large clump in the cup. There will still be some liquid left, which is called buttermilk. Many people keep their buttermilk to use in a variety of recipes.
   - Pass out crackers and let students enjoy their butter!

STEM/Scientific Inquiry

Help students deepen their understanding of science processes by testing different variables: What type of milk forms the most butter? There are different types of milk ranging from heavy whipping cream, which has a higher fat content, to skim milk, which has a low fat content. Does the temperature of the milk affect the butter-making process? Warmer temperatures cause molecules to move quicker than cold molecules. How can this idea apply to other processes? (Think about how water changes states, or the role temperature plays in weather patterns.) Can we make a non-dairy butter using non-dairy milks, such as almond milk, using this same shaking technique?

Next Generation Science Standards 2-PS1-1; 2-PS1-2; 5- PS1-1; 5-PS1-3-4