Biochemist: Milk on the Move

Time: 45 Minutes **Skill Level:** Elementary (age 6–11), Middle School (age 12–14)

Background

What is Science Inquiry?

Children are natural scientists. From a very early age they explore the world, ask questions and seek answers. This journey of exploration and discovery is Science Inquiry. Science Inquiry helps young people understand their environment, solve problems and gain knowledge about scientific ideas and processes.

Next Generation Science Standards (NGSS)

Science Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions	**PS1:** Matter and its interactions	**2.** Cause and effect: Mechanism and explanation
3. Planning and carrying out investigations	**PS2:** Motion and stability: Forces and interactions	**7.** Stability and change
6. Constructing explanations	**LS1:** From molecules to organisms: Structures and processes	
7. Engaging in argument from evidence		

Objective

In this activity, students will investigate the properties of milk.

About the Scientist

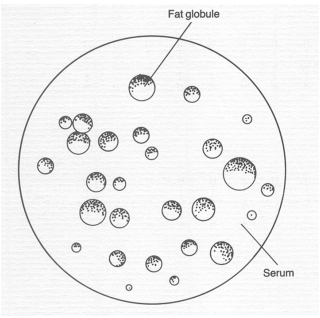
Biochemists are scientists that study chemical processes within and relating to living organisms. The name *biochemist* is short for *biological chemist*. They study a wide range of phenomena, including the affects of foods, drugs, and other substances on living tissues. Some biochemists also study genetics or chemical reactions in metabolism, growth, and reproduction.

The Science of Milk

All liquids have a property called surface tension, which is due to the cohesive forces of the liquid's molecules. Pour water in to a clear glass with a smooth inside surface. Bend down so your eyes are on the same level as the top of the water in the glass. The water will appear to rise up the side of the glass; this is surface tension.

Milk is mostly water. The amount of water ranges from 85.5% to 88.7%. Milk also contains vitamins, proteins and fats. The fats are broken into tiny pieces called globules which, when homogenized, are spread evenly throughout the milk.

The Science of Milk *(continued)*



Dish soap works to clean dishes because it is bipolar. The molecules have a hydrophilic or "water loving" end and a hydrophobic or "water-fearing" end. The hydrophobic end attaches to fat. When placed in milk, soap attaches to the fat globules. When the dish soap is gently introduced to the center of the bowl of milk several things happen at once. The soap reduces the surface tension of the milk freeing the food color to flow. The soap reacts with both the proteins and fats in the milk; this sets the molecules in motion.

Materials List

- A small bowl for each liquid to be tested
- 3 colors of food coloring
- Dish soap
- Tooth picks
- Whole milk
- Fat-free milk
- 2% milk
- Heavy cream
- Chocolate milk
- Water

Discuss and Ask Questions- What do the students know about milk? Have they ever cooked or made anything using milk? What are some of milk's unique properties? What questions do they have?

Predict …What do the students think will happen when the dish soap comes in contact with the milk? Will this reaction be the same or different in different kinds of milk?

Experience- Planning and/or Carrying out an Investigation:

1. Pour a cup of whole milk into the bowl and let it settle.
2. Place three drops of each food color into the milk making sure they do not overlap each other. Observe the food color before proceeding with the activity
3. Dip the toothpick into the dish soap. Touch the soap coated toothpick to the milk in the middle of the bowl. Observe.
4. Repeat the process of dipping a toothpick into the dish soap then gently touching the milk. Observe.

Share– Analyzing and Interpreting Data: Ask students to describe what they observed happening after each drop of food coloring was added to the bowl of milk. Did the fat content of the milk change how the food color behaved BEFORE the soap was added? (Does it sink? Does it spread? Does it move at all? Food color is less dense than milk with a fat content; it floats on the surface.) Ask students to describe what they observed when they first touched the milk with the soap covered toothpick (What was the initial reaction?). Ask students to describe what they observed after the dish soap being introduced (Is there a continuing reaction?). Ask students to describe what they observed when more dish soap is added to the mixture (What was the reaction compared to the first introduction? Is it the reaction the same or different?).

Reflect –Construct Explanations and Engage in Argument from Evidence: Discuss among the group. What other questions do you have now that you have conducted this experiment? Will other types of milk react the same? (chocolate milk, fat-free milk, heavy cream?) Repeat the experiment using various types of milk and using cold, warm, and hot milk.

Generalize- to real world examples. Construct explanations. In which type of milk did the soap create the most movement? Why? In what temperature of milk did the soap create the most movement? Why?

Apply –Assessment and Processing Questions: How can we use what we learned today in cooking? How does the fat content and/or temperature of the milk effect milk's behavior?

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