Classroom Activity

90-SECOND SCIENCE

Milk soap rainbow hands-on activity

Explain it: How does soap change the properties of milk?

Estimated time: 15 minutes

Grades: K–12, for individuals or small groups

Description: Students will experiment with surface tension and chemical change using milk, soap, and food coloring.

Content topics: States of matter, properties of matter, attractive forces, surface tension

Materials:

- 2 small bowls
- ½ to 1 cup of whole milk
- Food coloring: blue, yellow, red, and green
- Liquid dish soap
- Cotton swabs
- 1 medium-sized paper clip
- 1 plastic fork

Phenomenon background

Milk: Milk is mostly water but contains fat and protein molecules spread evenly throughout it. A mixture where small particles are spread evenly throughout a substance is called a colloid.

Surface tension: Because of electrical forces, molecules in a liquid can be attracted to each other and want to stay together. This is called cohesion. At the surface of an undistributed liquid, molecules can stick together creating a “skin” that is stronger and resists external forces.

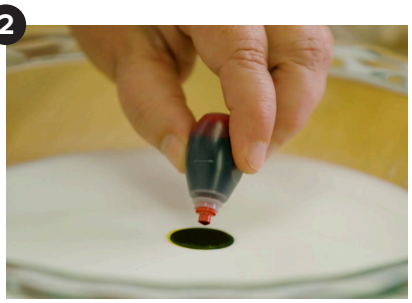
Soap: Soap molecules break up fat into smaller pieces. One end of a soap molecule is attracted to water and the other end is repelled by water.

Procedure

1

Pour the milk into the bowl.

2



Add one drop of each food color—one at a time—in the center of the bowl.

3

Dip a cotton swab into the soap. Then dip the swab into the center of the bowl of milk. (Be sure not to stir the milk with the swab.) Observe the phenomenon.

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Continued

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Gather information

What do we know?

- **Ask:** What do you think milk is made of? What are some properties of milk?
- **Guide:** What do you think would happen if we added food coloring to milk?
- **Make a claim:** What would happen to the food coloring in the milk if we added soap to the milk?

Note: If students do not mention that milk has different fat content in it (1%, 2%, and whole milk), ask, "What kinds of milk can you buy in the store?" If students do not mention that milk is made of water, ask, "Do you think there is any water in the milk?" Follow up with, "What properties do both milk and water have?" Record students' different answers publicly.

Teacher tip: Avoid telling students whether their claims are correct. Use prompting questions like, "Tell me more about that."

Take action

- Follow the procedure on the first page.

Explore the evidence

- **Ask:** What did you observe when you added soap to the milk?
- **Ask:** What questions do you have now?

Teacher tip: Avoid answering the students' questions. Let students freely brainstorm to get them thinking about related ideas and future research.

Apply reasoning

What is the science?

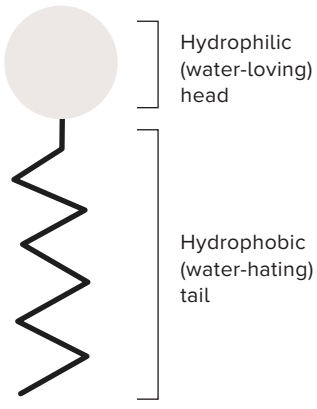
Ever wonder what keeps a bowl of liquid together? All of the molecules in a liquid are attracted to each other—a property called **cohesion**. Molecules at the surface of a liquid are more greatly attracted to the liquid in the container than to the air, causing the molecules to pull together and create a "skin" that is stronger and resists external forces.

Milk is a special type of liquid called a **colloid**. Milk is mostly water, but fat and protein molecules are evenly distributed throughout it.

Soap is made from long molecules called **surfactants**. These molecules have a "head" that is attracted to water molecules, and a "tail" that is repelled by water but attracted to fat molecules. When soap is added to milk, the surfactants reduce the milk's cohesion, which also reduces the surface tension. Suddenly, the food coloring is free to expand across the milk!

But what about the swirling colors? The tail parts of the surfactant molecules are attracted to the fat molecules in the milk. As a result, soap molecules surround the fat and send the fat flying across the bowl! This is also how soap breaks apart grease or fat that gets on our hands and allows it to be washed off.

Surfactant molecule



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Take it further

Draw a model

- Have students, preferably in small groups, draw a model of what happened to cause the soap to break up the fat in the milk.
- Have students examine each others' work and make any necessary revisions to their own models.

Explore deeper

- Test different liquids with the food coloring and soap, such as vegetable oil, water, soda, tea, or coconut milk.
- Have students lower a paper clip into a calm bowl of water or milk slowly, using a fork. While the paper clip is floating, add a drop of dish soap. It will disrupt the surface tension and cause the paper clip to sink.

Teacher tip: Avoid telling students what to draw. Instead of showing them what model you would use, ask them questions like, "What do you think?" or "Do your team members have some ideas?"

If learning away from school, search online for images of "milk soap chemistry model" and have students compare their model to some of the different results.

Keep exploring

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