

Color Changing Milk

Materials

- Dinner plate
 - Food coloring (red, yellow, green, blue)
 - Dish-washing soap (Dawn brand works well)
 - Cotton swabs
1. Pour enough milk in the dinner plate to completely cover the bottom. Allow the milk to settle.
 2. 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.
 3. 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. Go ahead and try it.
 4. 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. Look at that burst of color! It's like the 4th of July in a bowl of milk!
 5. 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. Notice that the colors in the milk continue to move even when the cotton swab is removed. What makes the food coloring in the milk move?



Repeat the experiment using water in place of milk. Will you get the same eruption of color? Why or why not? What kind of milk produces the best swirling of color: skim, 1%, 2%, or whole milk? Why?

How does it work?

Milk is mostly water but it also contains vitamins, minerals, proteins, and tiny droplets of fat suspended in solution. Fats and proteins are sensitive to changes in the surrounding solution (the milk).

When you add soap, the weak chemical bonds that hold the proteins in 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. When the micelles and fat droplets have dispersed throughout the milk the motion stops, but not until after you've enjoyed the show!

There's another reason the colors explode the way they do. Since milk is mostly water, it 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!