

## Magic Milk and Marbled Paper



### Supplies:

Milk (the higher the fat content, the better)

Food color

Dish liquid

Cotton balls or Q-tips

Container (I used a 13x9 baking pan)



For the Marbled Paper:

Watercolor paper or printer paper



**Directions:**

1. Pour milk into container. You don't need a lot of milk; just enough to cover the bottom of the container.
2. Add drops of food color across the surface of the milk. You can use any colors you want.
3. Saturate a cotton ball or Q-tip with dish liquid. Place in the milk, next to a drop of food color and watch what happens!

### **The Science Behind It:**

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 food coloring, you can see that it does not mix up in the milk (like it does if you add it to water). The molecules on the surface of the milk have a strong connection to the molecules surrounding them and together they form a "film" on the surface on the milk. This film is like a little wall holding your food coloring drops on the surface. This phenomenon is called Surface Tension.

Soap is made up of two sides:

- one side is hydrophilic, meaning that it is attracted to water.
- the other side is hydrophobic, meaning that it dislikes water, but is attracted to fat and oil.

Soap works by grabbing oils on its hydrophobic side and bonding with water on its hydrophilic side. When the soap is washed away with water, it takes the oils and fats along with it.

You've probably seen this when washing greasy dishes. When you just add water to your plate, nothing happens. The grease stays there and does not mix up with the water. But as soon as you add your dish liquid, the grease and the water can start mixing up and you can clean your plate!

When dish soap is dropped into milk, there is a swirl of activity because the soap molecules are finding and bonding with fat molecules in the milk. With millions of molecules swirling around, the food color droplets in the milk get all mixed up. It looks like the milk is erupting for several seconds!

As the soap becomes evenly mixed with the milk, the action slows down and eventually stops. Try adding another cotton ball or Q-tip with dish soap to see if there's any more movement. If so, you discovered more fat molecules that haven't yet bonded with the soap.

Try this experiment using milk with different fat content - fat-free, 1%, 2%, whole - to see the difference in the explosion of colors. What happens with a higher fat content vs a lower fat content?

### **For the Marbled Paper:**

When the swirling of colors stops, place a piece of paper on the surface of the milk mixture and leave for a few seconds. Lift the paper off and set on a

newspaper or paper towel to dry. Once fully dry, fold the paper in half to create a pretty greeting card!