

Student Sheet

In this practical I will be:

- Carrying out and carefully observing the results of the practical.
- Using my knowledge of **emulsions**, **mixtures** and **surface tension** to explain my observations.
- (Extra)- Observing the results of the demonstration- drawing links between carmine's colour change, temperature and the amount of oxygen dissolved in a solution.

Introduction:

As an ancient Egyptian science-artist, you are always on the lookout for interesting phenomena. For example earlier, you accidentally cut yourself. Some drops of blood fell into in your milk. Then one of the servants dropped some soap solution into the blood milk mix. Something very interesting occurred. Like all good science-artists, you decide to investigate further...

Equipment:

- 1 clean shallow tray, 30 cm x 20 cm
- 1 litre each of different types of milk
- 100 cm³ water
- 10 cm³ good quality washing-up liquid
- 1 bottle each of red, blue, green and yellow food colourings
- 5 eyedroppers, 1 for each of the colourings and 1 for the washing-up liquid solution
- 1 beaker (100 cm³)
- 1 stirring rod
- 2 cotton buds

Wear disposable plastic gloves

Method:

1. Make sure there are no traces of washing up liquid in the tray and the tray is placed on a flat, even surface.
2. Pour the milk into a clean shallow tray so that it covers the bottom to a depth of (approx.) 1 cm.
3. In a 100 cm³ beaker put measure 50 cm³ of water.
4. Add a good squirt of washing-up liquid to the water.



5. Stir the mixture to dissolve the washing-up liquid in the water.
6. Using an eye dropper carefully add 5 drops of one of the food colourings to the top quarter of the surface of the milk in the tray.
7. Repeat with another food colouring in the next quarter on the surface of the milk.
8. Repeat until you have 4 separate pools of colour in the tray.
9. Take one of the cotton buds and place the cotton end into the washing-up liquid solution.
10. Gently shake the cotton bud to remove any drops adhering to it. Make sure you don't shake the cotton bud near the prepared tray!
11. Now place the wet end of the cotton bud onto the middle point between the colours on the surface of the milk.
12. Record what you observe by drawing a picture, taking a photograph or writing about it.
13. Using an eye dropper add a drop of washing-up liquid solution to the central point of each colour.
14. Describe what happens and record your results by drawing, taking a photograph or writing about it.
15. Repeat the whole procedure using other types of milk in the tray, such as semi-skimmed milk, skimmed milk or even goats milk.
16. Try to explain what has happened in each investigation.

Theory:

Tie Dye Milk

In milk, the butterfat (**dispersed phase**) is held in suspension and dispersed throughout the water-based solution (**continuous phase**). Milk is an emulsion, or colloid, of butterfat in a water-based solution. The liquid butterfat is a very small molecule within the range of 1 nanometre and 1 micrometre.

The surface of liquids is like stretched, elastic 'skin'. We can think of it as similar to the surface of a blown up balloon. The 'skin' of a liquid holds together because of the attraction of the molecules for each other. This is called **surface tension**. In this case the attraction is broken by soap molecules coming in between the 'skin' or surface tension of the water. The molecules in the food colouring that were being held back by the surface tension of the water are then able to escape.

So when washing-up liquid is put onto the surface of the milk, it dissolves in the water and breaks the **surface tension** of the oil and water emulsion. This allows the molecules of colouring to mix with each other, making swirl.



Traffic light demonstration

Indigo carmine is an indicator and can exist in a number of forms depending on whether it is oxidised or reduced. In the oxidised form the structure is different from that in the reduced form and that in the intermediate stage. Each structure absorbs a different colour of light. In the oxidised form it is green and in its reduced form it is yellow. So as it changes from the oxidised to reduced form it changes from green through red to yellow.

When the mixture is first poured into the beaker oxygen mixes in as well and the indigo carmine is exposed to this oxygen which oxidises it. As it stands it reduces and changes colour.