Sugar rainbows

Focus group: Comprehensive school pupils

Length: 30 – 45 min

Motivation: This colourful experiment introduces pupils to science and working in a laboratory. Pupils will learn how to use laboratory equipment (scale, pipettes, and test tubes) and the basic principles of density.

Aim: The aim of this experiment is to inspire and introduce the students to the world of chemistry in an exciting and colourful way. This experiment can also be used with older pupils to explain the concept of density.

Key words: Density – Weight – Easy – Everyday chemistry – Inspiring

SAFETY AND WASTE DISPOSAL

- The reagents used in this experiment are safe. However, food dyes can stain clothing. Therefore, wearing a laboratory coat is recommended while working.
- All solutions can be disposed of by pouring them down the drain.

INTRODUCING QUESTIONS

Imagine throwing a rock and a piece of wood of the same size into water. What will happen and why?

BACKGROUND

The sugar rainbows are based on the concept of density. In this experiment students make solutions by dissolving different amounts of sugar in the same amount of water. The more sugar the solution contains, the denser it is. If the solutions of different densities are carefully stacked on top of each other starting with the densest solution and ending with the least dense, they will not mix. A beautiful rainbow is formed if the solutions are coloured with food dyes before stacking.

REAGENTS

- Sugar
- Water
- Food dyes

EQUIPMENT

Small sugar rainbows

- Pipettes
- Test tubes
- Beakers
- Scale or tablespoons

Large sugar rainbow

- Beakers
- Scale or tablespoons
- Large measuring cylinder
- Tube

- Funnel

INSTRUCTIONS

Preparation of the sugar solutions:

Measure 50 ml of warm water in the beakers and colour the water in each beaker with a different food dye. Dissolve the right amount of sugar in the water (see table below). Note that the amount of sugar can be measured using a scale or with a tablespoon. If tablespoons are used, make sure that the spoonfuls are the same size.

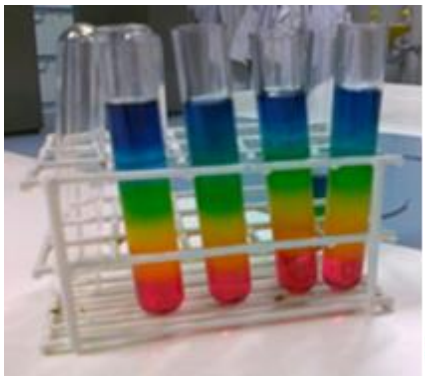
Colour	**Instructions**
Red	50 ml water and 55 g or 5 tbs of sugar and food dye
Orange	50 ml water and 44 g or 4 tbs of sugar and food dye
Yellow	50 ml water and 33 g or 3 tbs of sugar and food dye
Green	50 ml water and 22 g or 2 tbs of sugar and food dye
Blue	50 ml water and 11 g or 1 tbs of sugar and food dye
Violet	50 ml water (no sugar) and food dye

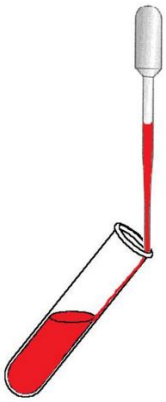
Small sugar rainbows:

Arrange the solutions from densest to least dense.

Using a pipette, carefully add a small amount of each solution into a test tube.

> **Hint:** It is best to hold the test tube at an angle and the pipette straight up when pipetting the solutions. This way the solutions will slide down the side of the test tube and are less likely to mix with the lower layers.





Large sugar rainbow:

Attach a funnel to one end of a flexible tube and put the other end in the large measuring cylinder. The tube should reach the bottom of the measuring cylinder. Pour the solutions into the measuring cylinder using the funnel and the tube in the order of increasing density; start with the least dense solution. The least dense layers will rise as you proceed.

> **Hint:** Make sure that you don't get air bubbles in the tube between the different solutions, because bubbles escaping the tube might mix the solution layers! This can be avoided by adding the next solution in the funnel before the first solution has completely flown through it (squeeze the tube to stop the flow of liquid while you do this). By squeezing the tube, you can control how fast the liquid flows through it.

CONCLUDING QUESTION

Which solution is the densest? Why? How can you tell?

Compare the volumes of the solutions. What do you notice and how might you explain your observation?