CSI: Colours in ink  Key stage 3  Lesson Planning

**Scheme of work unit:** Particle theory and separation techniques

**National Curriculum link**

Chemical and material behaviour

The particle model provides explanations for the different physical properties and behaviour of matter

**Learning outcome:**

Decide who could have committed the crime using the results of the investigation (separate out the colours in ink using chromatography)

**Introduction notes:**

- Chromatography is the collective term for a family of laboratory techniques for the separation of mixtures.
- Paper chromatography is an analytical technique for separating and identifying mixtures that are or can be coloured, especially pigments.
- The technique is based on a small concentrated spot of the sample being applied to a piece of chromatography paper about 1cm from the base.
- The paper is then dipped into a suitable solvent, such as ethanol or water.
- The solvent moves up the paper by capillary action. As the solvent rises through the paper it meets and dissolves the sample mixture, which will then travel up the paper with the solvent.
- Different compounds in the sample mixture travel at different rates due to different solubility in the solvent, and are thus separated out on the paper.

**Information:**

- Washable pens are used in this activity because the pigments in the inks are soluble in water.
- Inks may appear to be a single colour, but are often composed of differently coloured pigments. Water can dissolve these pigments to effect a separation and produce a decorative pattern.
- The filter paper functions as a stationary phase on which the separation takes place, whereas the water functions as a mobile phase to carry the pigments through the filter paper.
- Although colours of different manufacturers may appear to be the same, often different pigments and different ratios of pigments are used to produce the same colour. Thus, it is possible to tell what type of pen was used.
Lesson Plan:

Starter

Add a few drops of ink to water. Discuss with the class what happens to the ink. Opportunity to reinforce key words (soluble/insoluble/dissolve/mixture). Could discuss how the ink could be separated from the water again (review filtration evaporation).

Use sticky dots to show mixture of ink in water (blue dots for water particle and another colour for ink particles). Students should use their knowledge of the particle theory to show the arrangements of the particles (the sticky dots) before and after the ink has been added. Use key words to label their diagrams.

Main Activity

Students use chromatography to separate the colours in the ink of two different pens and compare these to the pen used by the thief in order to identify who committed the offence.

Worksheet available with instructions and questions.

Plenary suggestions

Discuss the answer to question 4 and what CSI teams have to consider to convict a suspect. Opportunity to introduce or develop understanding of “How Science Works” key words. Is the evidence enough? Are the results reliable? Accurate? Conclusive?

If sticky dots have been done as a starter: Discuss how they could improve their model now (the idea is that they say they should use more than one colour to represent the ink particles) and how could they model what happened during the chromatography (one coloured dot at a time dissolved in the water).

Discuss other uses of chromatography (examples of use of chromatography: use to see if a blood sample contains alcohol/use to identify the amount of pollutant in a water sample)

Resources required:

- 3 sample containers
  - Containers should ideally be long and thin – we have successfully used sample vials.
- Plastic pipettes
- Filter paper
- Scissors and a pencil
- Water
- A ransom note (labelled as Evidence No: 080)
- 2 different black pens (labelled as Evidence No: 081 & 082)
Health and safety

Caution with glassware

Further Work

A similar practical investigates the colours in food dyes using chromatography.
Link to other separation techniques, such as separating out the pigments in leaves.

Answers for worksheet:

1-3 As observed, depending on pens used
4. No. Pens are pretty common and so it is not definite that they committed the crime.
5. Black ink is made of a mixture of different colours inks.
   Each colour has a different solubility in water.
   The colour most soluble in water leaves the highest mark on the paper as it dissolves first in the water.

- Envelopes with the address “George Bloggs, 4 Anystreet, Anytown”, written on them using one of the pens. This is illustrated on the top of the next page.

The area to be cut from the envelope needs to be of similar size to the filter paper.

The ink should be about 1cm from the bottom of the rectangular piece of paper and there should be plenty of paper above for the ink to travel up.

Labelling the top and bottom in pencil should avoid confusion.