Lesson Plan on Paper Chromatography

Lesson Plan and Teacher Notes

OBJECTIVE

To introduce the process of paper chromatography and why scientists use it in crime scene investigations. Students will separate the pigments from pretend urine samples. Based on color, the student will identify the pigment (solute) in each color band. For each sample, the student will calculate the Rf value, which can be compared with known chromatography results.

LEVEL

Biology or Chemistry

TIME FRAME

50 minutes

MATERIALS For each group:

Chromatography paper 5 cm x 7 cm.

5 different pretend urine samples: 2 or 3 mixed food colors in 5 different test tubes.

Toothpicks

Scissors

Ruler

Water

TEACHER NOTES

Aliquot food color mixtures into small centrifuge tubes.

Day 1 – Engage students by asking questions:

(1) What kind of evidence can be found in the crime scene?

(2) How are samples collected from the crime scene?

(3) What are pigments?

(4) What are dyes?

(5) What is the difference between them?

(6) Where are dyes found?

Answers

(1) Most dry items of evidence must be collected into clean paper containers such as packets, envelopes, and bags. Moist or wet biological evidence like blood and bodily fluids from a crime scene must be collected into clean, unused plastic containers. These must be transported back to crime scene lab in less than two hours to prevent contamination of other evidence.

(2) Pigments – substances in animal tissues or cells that give them color. Some are dry substances that do not dissolve in water. They must be dissolved in organic solvents.

(3) (4) Pigments are mixed with liquids to make dyes.

(5) Dyes can be found in fabrics, plastics, paint, food, etc.

Teacher discussions:

Talk about how different pigments (and dyes) stick to fabrics differently – How could a scientist use this knowledge to design an effective stain remover?

If time is available and the discussion could expand into attraction between variously charged molecules of pigment and paper, the electromagnetic spectrum, absorption of light energy at various wavelengths, reflection of light, capillary action, cohesion and adhesion.

Present concepts about paper chromatography

Ask questions:

(1)What is chromatography?

* the separation of mixtures into individual components (or parts)

(2) How do scientists use chromatography?

* To find out what components are in a mixture, such as:
* pollution in a stream
* inorganic ions in wine
* drugs in a urine sample

(3) How can paper chromatography be used to identify plant pigments?

* Rf values – scientists calculate Rf values to determine what molecules are in a given substance
* Rf = distance traveled by pigment divided by the distance traveled by solvent
* The resulting values can be compared to a chart of known values.
* In discussing the “solvent front and solute front”, which are the points to which the pigment and solvent have traveled.

**Lab activity**

Working in pairs or groups of 2, students conduct the lab according to the instructions in TI-Nspire calculators. Ample time should be given for the students to try and figure out on their own how to go through all of the steps.

Students observe the development of the chromatography paper, and discuss with the lab partners what they are seeing, and which pigments they think they have separated just based on color. The students will calculate the Rf values. These can be compared to known values from the crime scene.

Students discuss their results with each other, calculate Rf values, and answer the questions at the end of the lab activity. Students then take a quiz to evaluate the understanding of the process.