

Pigments

- Your task

You are given a collection of plant materials – leaves, petals, and so on. They are all coloured. Extract the pigments (colouring substances) from them, and decide how many different pigments you have got altogether.

- **HINTS:** Remember that some plants may contain more than one pigment mixed together. Remember, too, that the same pigment may be present in more than one plant, so don't count it twice ... as long as you are sure it really is the same pigment.
- Display your results in a way which will allow people to see how you arrived at your answer.

Based on a suggestion by P. Borrowes.

Time

120 minutes.

Group size

2–4.

Equipment & materials

Eye protection.

General

A range of apparatus for the commonly used paper chromatographic techniques: stoppered boiling tube into which filter paper strip can be inserted, beakers, petri dishes, glass droppers, scissors, paper clips, pencil & ruler (measuring to mm).

Apparatus for extracting pigment from plant materials: pestle and mortar, filter funnel, flasks and beakers, test tubes. Possibly access to a centrifuge. Sand.

Access to water and ethanol and/or propanone. (**NB** It is suggested that distilled water should NOT be used – as this is often acidic, and some pigments are indicators, this may confuse the issue.)

Per group

Students are likely to want large amounts of filter paper, both for chromatography and filtration (a box per group).

The same plant materials, say 5 or 6 different types, including:-

- (i) red-coloured leaves (*eg* copper beech);
- (ii) green leaves (*eg* grass, spinach);
- (iii) red cabbage or beetroot (not pickled);
- (iv) flower petals of at least 2 different colours (*eg* yellow and purple).

Health & Safety notes

This is an open-ended problem solving activity, so the guidance given here is necessarily incomplete. Teachers need to be particularly vigilant, and a higher degree of supervision is needed than in activities which have more closed outcomes. Students must be encouraged to take a responsible attitude towards safety, both their own and that of others. In planning an activity students should always include safety as a factor to be considered. Plans should be checked by the teacher before implementing them.

You must always comply with your employer's procedures and in some cases may decide that a particular activity is inappropriate in your situation. Further information on Health and Safety should be obtained from reputable sources such as CLEAPSS [<http://science.cleapss.org.uk>] in England, Wales and Northern Ireland and, in Scotland, SSERC [<https://www.sserc.org.uk>].

NB Eye protection if propanone is used.

Propanone and ethanol are highly flammable. Keep clear of naked flames and other sources of ignition. Heating is probably not necessary, but hot water from a kettle could be made available for a water bath if requested.

If pupils are collecting their own plant material be careful they do not collect anything dangerous such as yew or deadly nightshade.

It is the responsibility of the teacher to carry out a suitable risk assessment.

Curriculum links

Chromatography.

Possible approaches

The judges will need to run a 'control'. With grass, it should be possible to separate chlorophyll and xanthophyll, but you are unlikely to get more than one yellow and one green band. With copper beech leaves it should be possible to detect a red and a green pigment – but is the green pigment the same as that in grass? 13–14 year olds are not likely to be familiar with Rf values *, but some may make qualitative judgements (eg by similarity of colour) based on 'fair test' comparisons.

$$* [Rf = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent front}}]$$

Evaluation of solution

Credit could be given for:

- 1 Evidence of a systematic approach.
- 2 Quality of display.
- 3 Each correctly identified pigment.
- 4 Some evidence of 'fair testing', controlling variables, Rf values or equivalent *etc.* DEDUCT credit for each wrong pigment, or if same pigment counted twice.

Extension work

Find out about synthetic dyes (1850s onwards).

Credits

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Health & safety checked May 2018

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