

Chromatography – curriculum information

This document accompanies [Practical chromatography](#), from *Education in Chemistry*, March 2017, where Dorothy Warren and Kay Stephenson discuss ideas for enhancing chromatography practical work

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Key stage 3

Programme of study

Pupils should be taught about:

- the concept of a pure substance
- mixtures, including dissolving
- simple techniques for separating mixtures: filtration, evaporation, distillation & chromatography
- the identification of pure substances

AQA KS3 Science Syllabus

(An approach to teaching the programme of study)

Know:

- A pure substance consists of only one type of element or compound and has a fixed melting and boiling point. Mixtures may be separated due to differences in their physical properties.
- The method chosen to separate a mixture depends on which physical properties of the individual substances are different.

Skill: Use techniques to separate mixtures

Keywords: solvent; solute, dissolve, solution, soluble (insoluble), solubility, pure substance, chromatography

Key stage 4

Programme of study / subject content

Students should be taught about:

- distinguishing between pure & impure substances
- separation techniques for mixtures of substances: filtration, crystallisation, chromatography, simple & fractional distillation

GCSE subject content (biology/chemistry/physics)

Specifications should require students to:

- explain what is meant by the purity of a substance
- recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases
- interpret chromatograms, including measuring R_F values
- suggest chromatographic methods for distinguishing pure from impure substances

AQA GCSE Chemistry (8462)

4.8.1.3 Chromatography

Chromatography can be used to separate mixtures and can give information to help identify substances. Chromatography involves a stationary phase and a mobile phase. Separation depends on the distribution of substances between the phases.

The ratio of the distance moved by a compound (centre of spot from origin) to the distance moved by the solvent can be expressed as its R_F value

$$R_F = \frac{\text{Distance moved by substance}}{\text{Distance moved by solvent}}$$

Different compounds have different R_F values in different solvents, which can be used to help identify the compounds.

The compounds in a mixture may separate into different spots depending on the solvent but a pure compound will produce a single spot in all solvents.

Students should be able to:

- explain how paper chromatography separates mixtures
- suggest how chromatographic methods can be used for distinguishing pure substances from impure substances
- interpret chromatograms and determine R_F values from chromatograms.

Required practical 6

Investigate how paper chromatography can be used to separate and tell the difference between coloured substances.

Students should calculate R_F values.

Edexcel GCSE (9-1) Chemistry

2.7 Explain the experimental techniques for separation of mixtures by: (e) paper chromatography.

2.9 Describe paper chromatography as the separation of mixtures of soluble substances by running a solvent (mobile phase) through the mixture on the paper (the paper contains the stationary phase), which causes the substances to move at different rates over the paper.

2.10 Interpret a paper chromatogram:

- to distinguish pure and impure substances
- to identify substances by comparison with known substances
- to identify substances by calculation and use of R_F values

2.11 Core practical: Investigate the composition of inks using simple distillation & paper chromatography.

OCR GCSE (9-1) Gateway Chemistry A

C2.1 Purity and separating mixtures

Summary: In chemical terms elements and compounds are pure substances and mixtures are impure substances. Chemically pure substances can be identified using melting point. Many useful materials that we use today are mixtures. There are many methods of separating mixtures including filtration, crystallisation, distillation and chromatographic techniques.

C2.1g describe the techniques of paper and thin layer chromatography.

C2.1h recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases

C2.1i interpret chromatograms, including measuring R_F values

C2.1k suggest chromatographic methods for distinguishing pure from impure substances (to include paper, thin layer and gas chromatography)

PAG C3 Using chromatography to identify mixtures of dyes in an unknown ink.

OCR GCSE (9-1) Twenty First Century Science Chemistry

C5.1 How are chemicals separated and tested for purity?

Summary: Chromatography is used to see if a substance is pure or to identify the substances in a mixture. Components of a mixture are identified by the relative distance travelled compared to the distance travelled by the solvent. R_F values can be calculated and used to identify unknown components by comparison to reference samples. Some substances are insoluble in water, so other solvents are used. Chromatography can be used on colourless substances but locating agents are needed to show the spots.

C5.1.4 recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases

C5.1.5 interpret chromatograms, including calculating R_F values.

C5.1.6 suggest chromatographic methods for distinguishing pure from impure substances **PAG3**

Including the use of:

- paper chromatography
- aqueous and non-aqueous solvents
- locating agents

WJEC GCSE in Chemistry

1.1 The nature of substances & chemical reactions

Learners should be able to demonstrate and apply their knowledge and understanding of:

- atoms/molecules in mixtures not being chemically joined and mixtures being easily separated by physical processes such as filtration, evaporation, chromatography and distillation
- chromatographic data analysis and R_F values

WJEC EDUQAS GCSE (9-1) Chemistry

1. Pure substances and mixtures

Learners should be able to

- f) recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases
- g) interpret chromatograms, including measuring R_F values
- h) suggest chromatographic methods for distinguishing pure from impure substances

Specified practical work

SP1B Separation of liquids by distillation, e.g. ethanol from water, and by paper chromatography

Key stage 5

GCE AS & A-level subject content

Modern analytical techniques: the use of mass spectrometry, infrared spectroscopy, nuclear magnetic resonance spectroscopy and chromatography in analysis, including techniques for the elucidation of structure

WJEC GCE AS/A Level in Chemistry /

WJEC Eduqas GCE A Level in Chemistry

4.8 Organic synthesis and analysis (OA4 in Eduqas)

Learners should be able to demonstrate and apply their knowledge and understanding of:

(g) use of chromatographic data from TLC/paper chromatography, GC and HPLC to find the composition of mixtures

Specified practical work

Paper chromatography separation, including two-way separation

AQA A-level Chemistry (7405)

3.3.16

Chromatography can be used to separate & identify components in a mixture. Types include: thin-layer (TLC), column (CC), gas (GC). Separation depends on the balance between solubility in the moving phase & retention by the stationary phase. Retention times & R_F values are used to identify different substances.

Students should be able to: calculate R_F values from a chromatogram; compare retention times and R_F values with standards to identify different substances.

Edexcel A-level Chemistry (9CH0)

Topic 19C Chromatography

- Know: chromatography separates components of a mixture between a mobile & a stationary phase.
- Calculate: R_f values from 1-way chromatograms.
- Know: high performance liquid chromatography, HPLC, and gas chromatography, GC:
 - are types of column chromatography,
 - separate substances by different retention times,
 - may be used in conjunction with mass spec, in, for example, forensics or drugs testing in sport.

OCR A-level Chemistry (A spec; H432)

6.3.1 Chromatography & qualitative analysis

- Interpretation of 1-way TLC chromatograms in terms of R_f values
- interpretation of gas chromatograms in terms of:
 - (i) retention times,
 - (ii) the amounts and proportions of the components in a mixture.

OCR A-level Chemistry (B spec; H432)

Learners should be able to demonstrate and apply their knowledge and understanding of:

What's in a Medicine? (WM)

(e) techniques and procedures for making a solid organic product and for purifying it using filtration under reduced pressure and re-crystallisation (including choice of solvent and how impurities are removed); techniques and procedures for melting point determination and thin layer chromatography

PAG6: the technique of thin layer chromatography (TLC), location of spots and interpretation

Polymers and Life (PL)

(a) (ii) techniques and procedures for paper chromatography (context = amino acids)

PAG6: the technique of paper chromatography

Colour by Design (CD)

(n) the general principles of gas-liquid chromatography