

# The chemistry of food

Download the teacher notes,  
student workbook, method sheets  
and technician notes  
that accompany this resource at  
[rsc.li/3RGH1cT](https://rsc.li/3RGH1cT).

# Learning objectives

By the end of this session, you will be able to:

- Carry out at least two analytical procedures successfully to obtain reliable results.
- Use a minimum of one set of results to calculate an unknown quantity.
- Summarise at least two careers linked to food that use chemistry.



## Food technology

Food technologists research and develop new foods and drinks. Sometimes they improve the quality of existing products. They may also develop the processing, packaging, storage and safety of food in line with government and industry standards.

Meet Claire, a flavourist and innovation director, who uses her chemistry knowledge to develop flavours and technologies to make new food and beverage products.

**A FUTURE IN CHEMISTRY**  
**MAKING THE DIFFERENCE**

**Flavourist and  
innovation director**



# In this session you are going to be a food analyst

A food analyst performs standardised **qualitative** and **quantitative** tests to find physical or chemical properties of food or drinks. They make sure the products we consume are safe.

Nutritionists use the information provided by food analysts to advise the public, the government and industry on matters of food and nutrition and their impact on health.





## Activity 1

# Identifying food colourings in soft drinks

▶ See student workbook

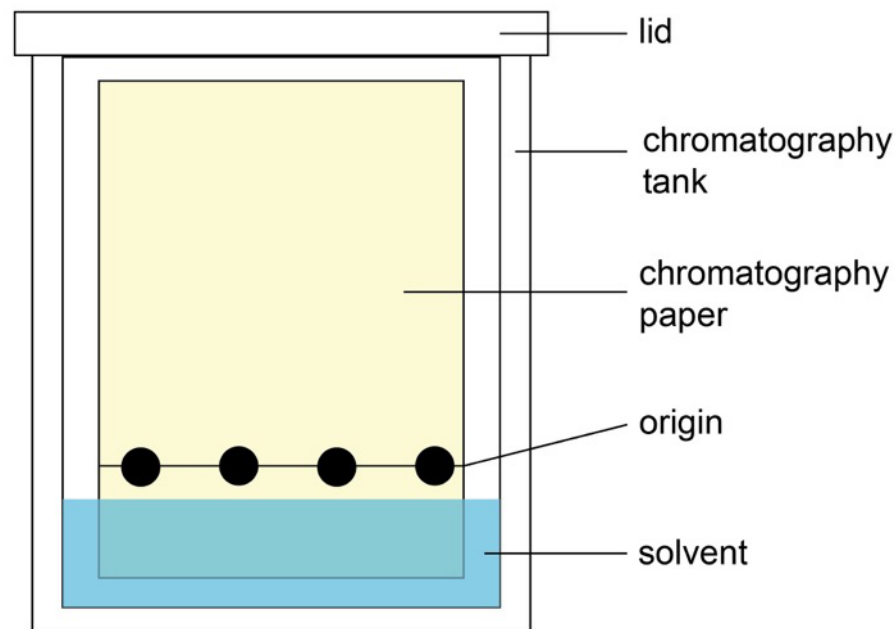
## Thin-layer chromatography (TLC)

Artificial colourings and food dyes are often used to improve the appearance of food and beverage products.

By law, food manufacturers must list any artificial colourings and food dyes used in their products.

Thin-layer chromatography (TLC) can be used to separate and identify the different components in mixtures.

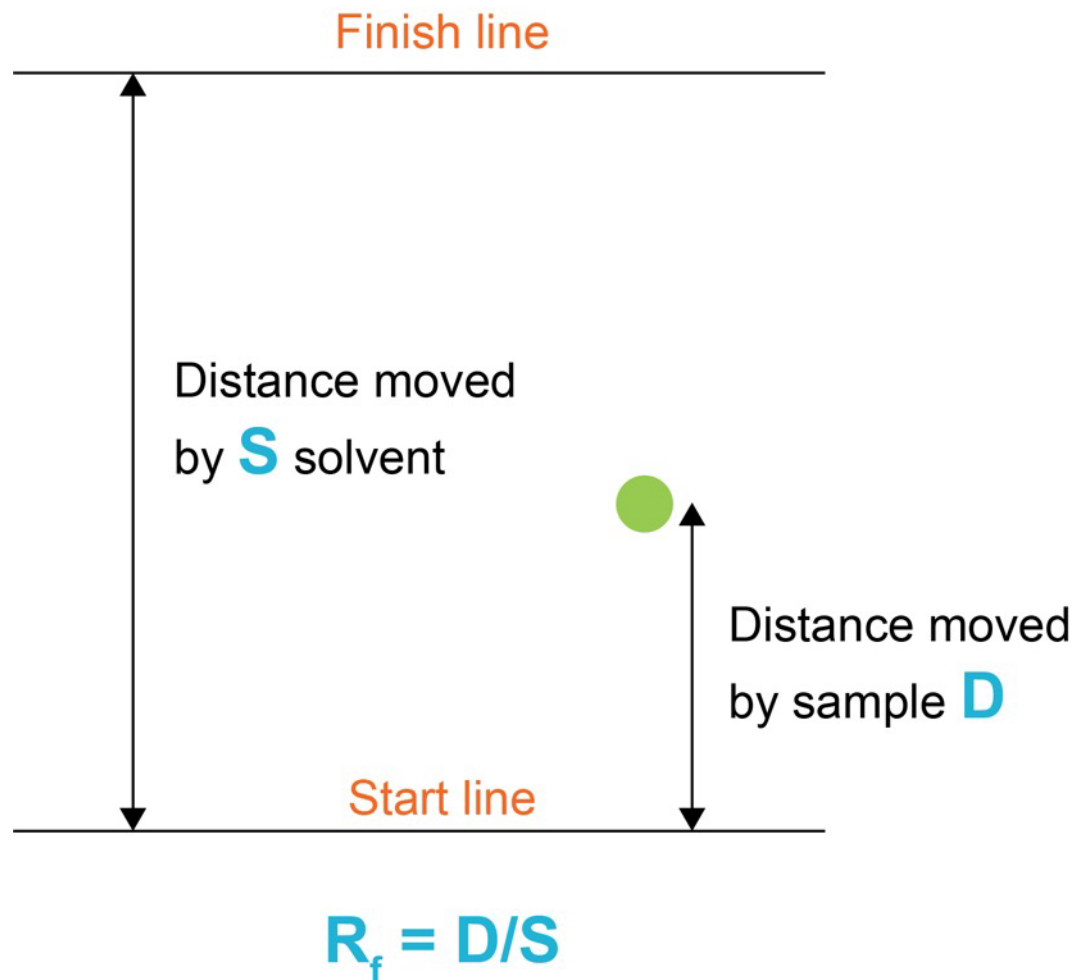
Compounds move through the solvent on a TLC plate at different rates, so substances in a mixture can be separated.



# Identifying food colourings in soft drinks

In this activity, you will firstly use thin-layer chromatography (TLC) to determine the retention factor ( $R_f$ ) values of seven artificial food colourings.

You will then use TLC to separate and identify the food colourings used in soft drinks by comparing  $R_f$  values.



## Research and development

Meet Giorgia, a research and development team leader, who uses her chemistry skills and knowledge to improve food safety and reduce food waste.

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Research and development  
team leader







## Activity 2

# Finding the vitamin C content of fruit juice

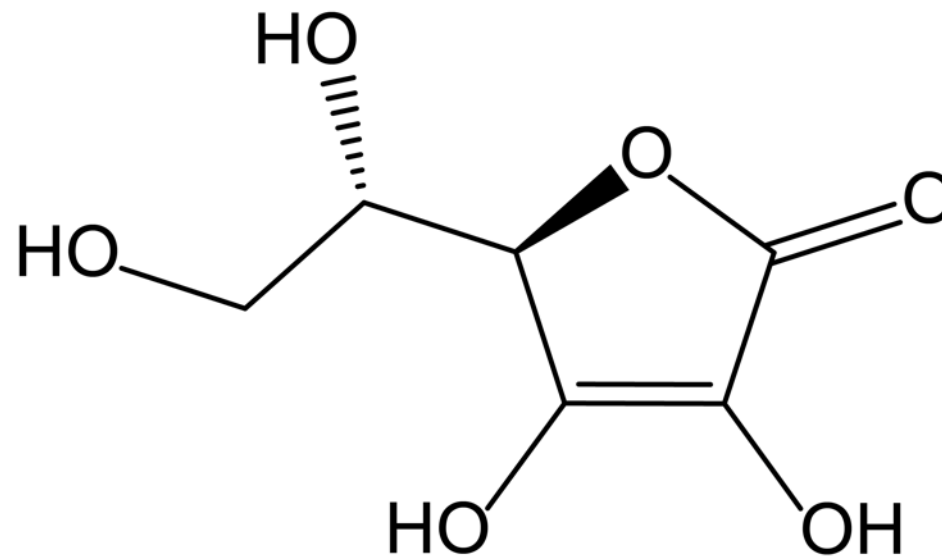
▶ See student workbook

## Vitamin C

Vitamin C (ascorbic acid) is needed in the diet for the growth and repair of tissues in all parts of your body.

It helps the body to make collagen, an important protein used to make skin, cartilage, tendons, ligaments and blood vessels.

Vitamin C is also needed for healing wounds and for repairing and maintaining bones and teeth.

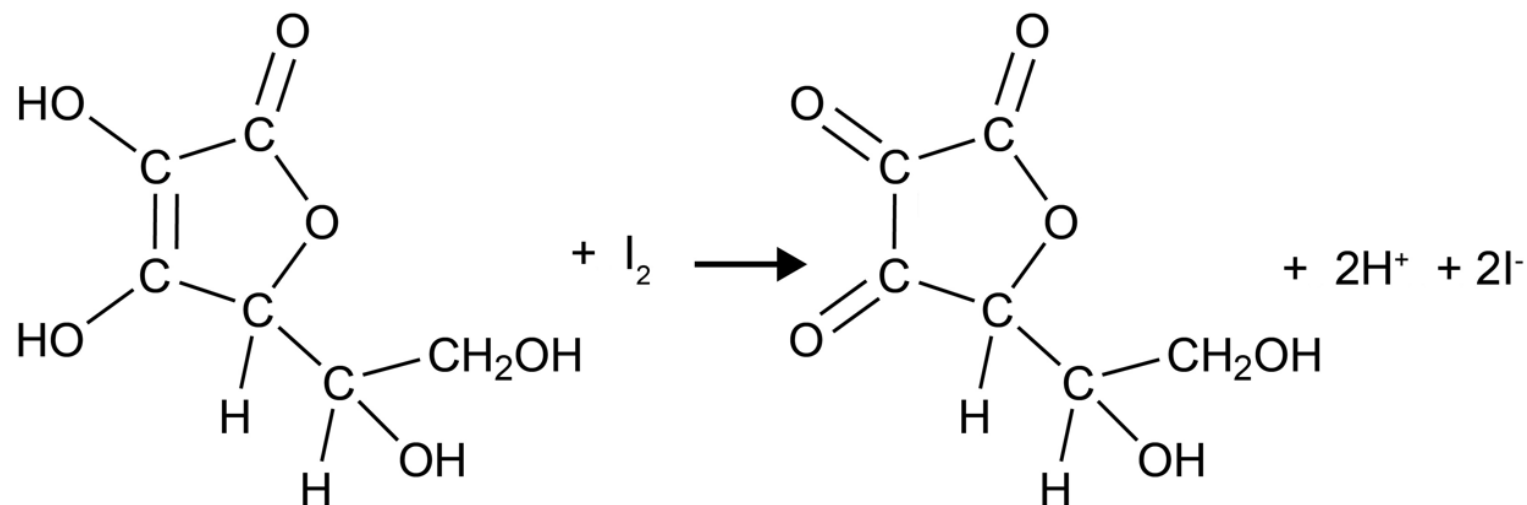


Vitamin C



## Finding the vitamin C content of fruit juice

Iodine reacts with vitamin C (ascorbic acid) in a 1:1 ratio as shown below.



- When all of the vitamin C has reacted, the iodine will remain unreacted.
- Unreacted iodine can be detected using starch as an indicator.
- Starch reacts with iodine solution to produce a blue-black colour.



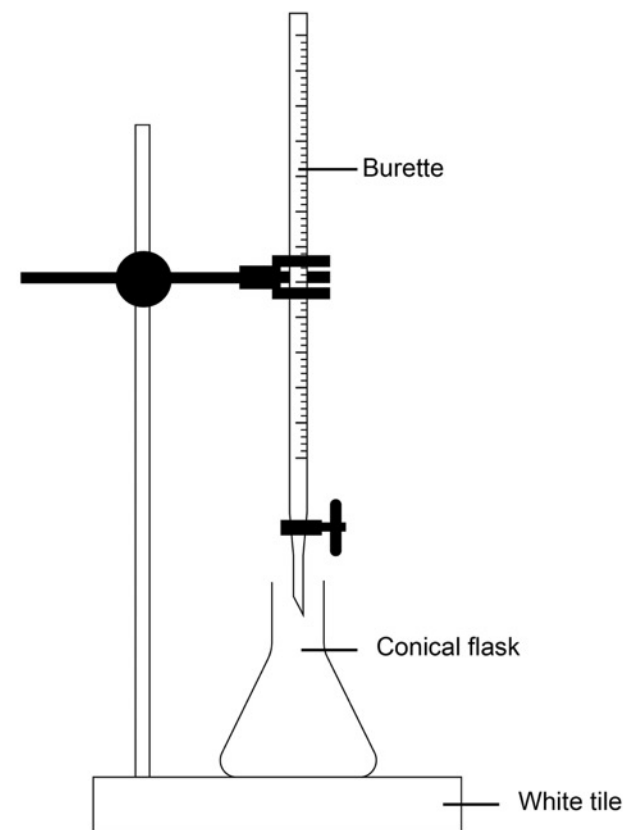
## Finding the vitamin C content of fruit juice

A juice manufacturer claims that their juice contains at least 25 mg (0.25 g) of vitamin C in every 100 cm<sup>3</sup> of juice.

In this activity, you will use the method of titration to test this claim by determining the amount of vitamin C present in the fruit juice.

You will add iodine from the burette to the fruit juice and starch mixture inside the conical flask.

The endpoint of the reaction happens when there is no more vitamin C available to react with the iodine, and the unreacted iodine reacts with the starch in the fruit juice to produce a blue-black colour.



## Associate principal scientist

Meet Robert, an associate principal scientist, who builds computer models to predict the effect of different chemicals on the taste and texture of sweet foods.

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Associate principal scientist



# Activity 1 and 2 answers

**Activity 1:** identifying food colourings in soft drinks

- Relentless apple and kiwi extract contains E142, E110 and E133.
- Powerade extract contains E133 and E131.
- Irn Bru extract contains E110 and E127.

**Activity 2:** finding the vitamin C content of fruit juice

3. (a)  $C_6H_8O_6$

(b)

Name of atom	Number of atoms present	Relative atomic mass ( $A_r$ )	Total mass (number of atoms $\times A_r$ )
Carbon	6	12	72
Hydrogen	8	1	8
Oxygen	6	16	96
Relative formula mass ( $M_r$ ) of vitamin C			176





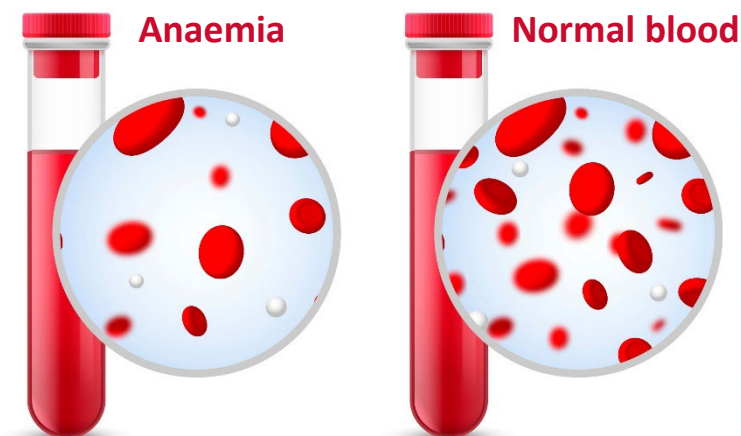
## Activity 3

# Finding the iron content of food

▶ See student workbook

# Iron

- Most of the iron in our body is found in haemoglobin, a protein in red blood cells used to carry oxygen to the body's tissues.
- A shortage of iron can increase your risk of anaemia.
- In anaemia, there are fewer red blood cells able to carry oxygen around the body, causing symptoms such as tiredness, breathlessness and a lack of energy.
- The risk of anaemia can be reduced by increasing the amount of iron in your diet.





# Iron

- Foods that have a high iron content include:
  - red meat, pork and poultry
  - seafood
  - beans and peas
  - dark green leafy vegetables, such as spinach
  - dried fruit, such as raisins and apricots
  - iron-fortified cereals, breads and pasta.
- Vitamin C helps your body to absorb dietary iron.



## Visible absorption spectroscopy

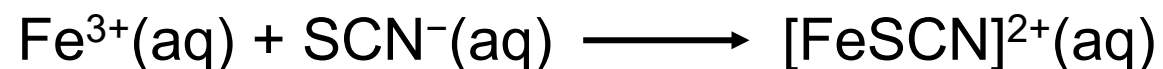
Visible absorption spectroscopy is used to find how much of a particular molecule is present in a sample.

Molecules absorb light. A spectrophotometer shines a beam of light through a sample and measures how much is absorbed. This provides a measure of how much of a certain molecule is present in a sample.



## Finding the iron content of food

- In this activity you are going to use ultraviolet and visible absorption spectroscopy to determine the iron content in a range of foods.
- Iron(III) ions in solution react with thiocyanate ions ( $\text{SCN}^-$ ) to form an intense red-coloured complex ion as shown below:



- You can use this reaction to determine the concentration of  $\text{Fe}^{3+}(\text{aq})$  in solution, using a spectrophotometer.



## Using an automatic pipette

An automatic pipette (or Gilson pipette) is used to dispense small quantities of liquids accurately and reproducibly.

They come in different sizes and can be set to dispense different volumes.



# Market development manager

Meet Vikki, a market development manager, who uses her chemistry skills and knowledge to develop food packaging materials that make food last longer, are more sustainable and help to reduce waste.

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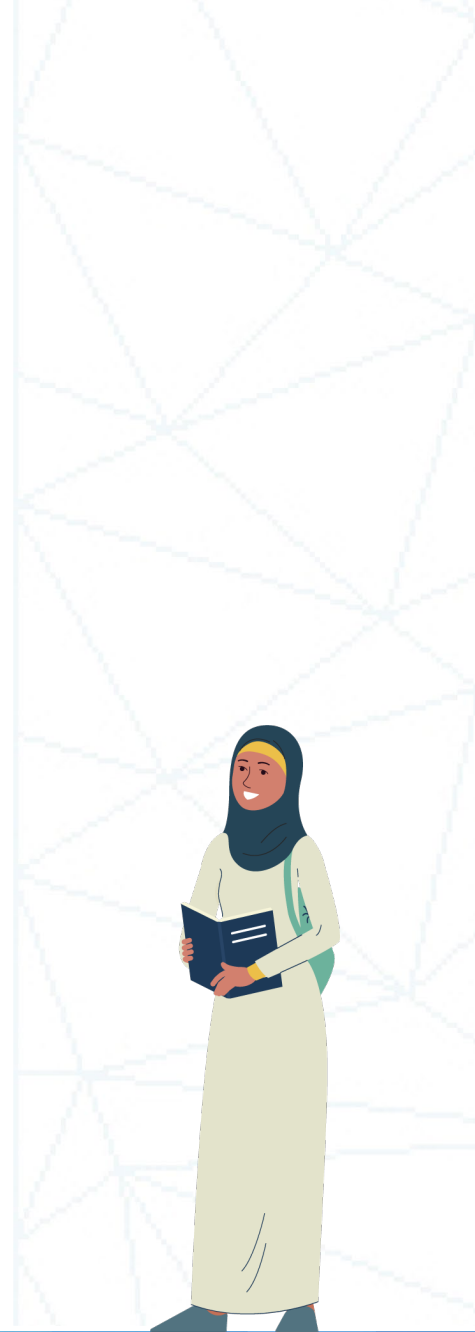
Market development manager





## Activity 3 answers

1. The blank cuvette should contain everything that is in the solutions being measured apart from the  $\text{FeCl}_3$  solution (that is, KSCN at the same dilution with distilled water).
2. Learner dependent so answers may vary.
3. (a) The girl is only eating 8.96 mg in her daily diet so she is not taking in the recommended daily amount.  
  
(b) Answers may vary but the girl should be taking in a good combination of different food types including high iron content food such as lentils, nuts, wholemeal pasta and lean beef.



# Acknowledgements

This resource was originally developed by Liverpool John Moores University to support outreach work delivered as part of the Chemistry for All project.

To find out more about the project, and get more resources to help widen participation, visit our Outreach resources hub: [rsc.li/3CJX7M3](https://www.rsc.li/3CJX7M3).

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