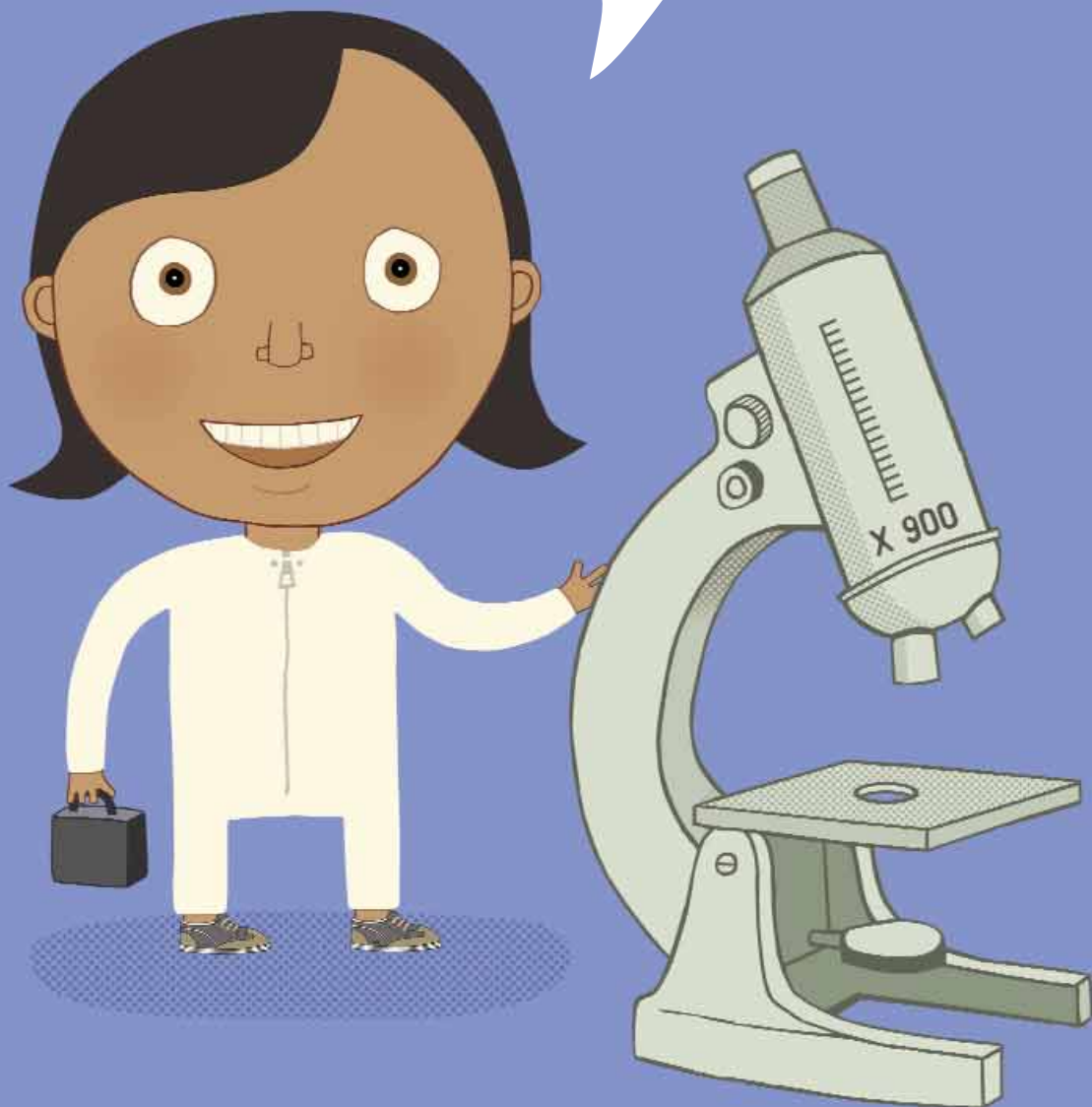


A seven part series exploring the fantastic world of science.

WHAT IS FORENSIC SCIENCE?

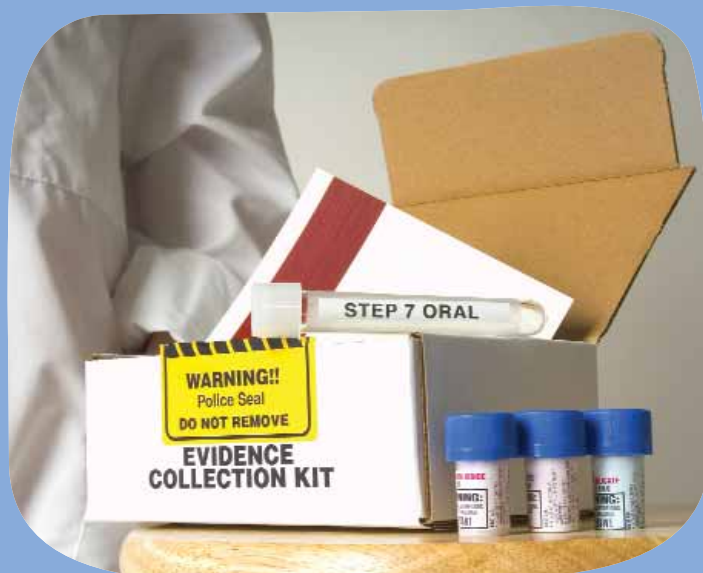


What is forensic science?

Find out what techniques are used by forensic scientists and why they are so useful.

Forensic science is the term given to the use of a range of sciences and scientific techniques to answer questions that are of interest to the legal system.

There are many specialist fields within forensic science. Forensic science can be used to identify and convict criminals, for example by studying DNA profiles, hair samples or fingerprints left at a crime scene. Forensic science can also be used to prove or disprove the claims made by a suspect about an incident.



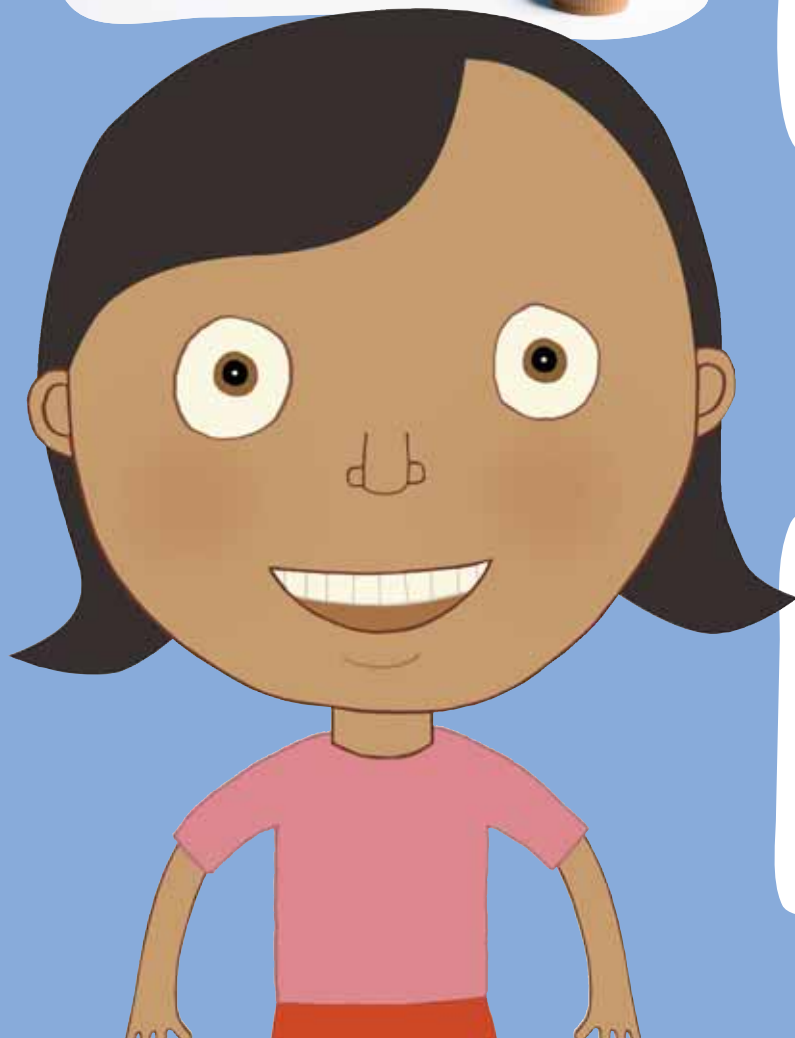
Forensic science uses biology for DNA profiling, chemistry for analysis of drugs and poisons and physics for investigation of road traffic accidents. As well as many other areas of science for example, ballistics examines the use of firearms and handwriting analysis.



Dr Edmond Locard

Dr Edmond Locard was one of the first forensic scientists in the early 1900s. Locard proposed that 'every contact leaves a trace', by which he meant that when any two objects come into contact with one another a transfer of material will occur and evidence of this will be left behind.

So, even the most careful criminal will often leave behind traces of their presence at a crime scene. It is the job of forensic scientists to gather this evidence to enable the police to catch the criminals.



Fingerprints.

Discover the types of patterns fingerprints leave behind and why each persons fingerprints are different.

Formation of fingerprints

Your fingerprints are formed even before you are born. In fact your fingerprints are fully formed by the time you are 24 weeks old. How much you moved around inside your mother and how fast you grew all help to determine the pattern of ridges of your fingerprints.

The way in which fingerprints are formed explains why everyones fingerprints are unique. Even though there are 6.5 billion people in the world, no two people share the same fingerprints. Not even identical twins have the same prints.



Leaving fingerprints behind

A fingerprint can be left on virtually any surface. When investigating a crime scene, forensic scientists can visualise fingerprints by using specific chemicals and powders. The fingerprints can then be recorded as evidence by taking photographs or lifting them. A fingerprint, whether it is full or partial, that is found at a crime scene is known as a mark. The mark can then be compared to full sets of fingerprints taken by the police known as prints.



Identification using fingerprints

Fingerprinting has been used for over 100 years as a reliable method of identification. The skin on the palms of your hands, and the soles of your feet, is different from the skin on the rest of your body. It is covered in ridges called elevations and furrows called depressions. These ridges form patterns that are known as ridge characteristics.

Fingerprint Patterns

There are three main pattern types.

A loop pattern is characterised by a ridge that enters from one side, rises and curves and then exits on the same side it entered from.

An arch pattern is characterised by a ridge that enters from one side, rises and curves and then exits on the opposite side it entered from.

A whorl pattern is characterised by ridges that are usually circular.



loop



arch



whorl

Have a go!

Have a look at the patterns on your own fingerprints. Do you have any loops, arches or whorls? If you look closely you will see that each of your fingerprints is different.

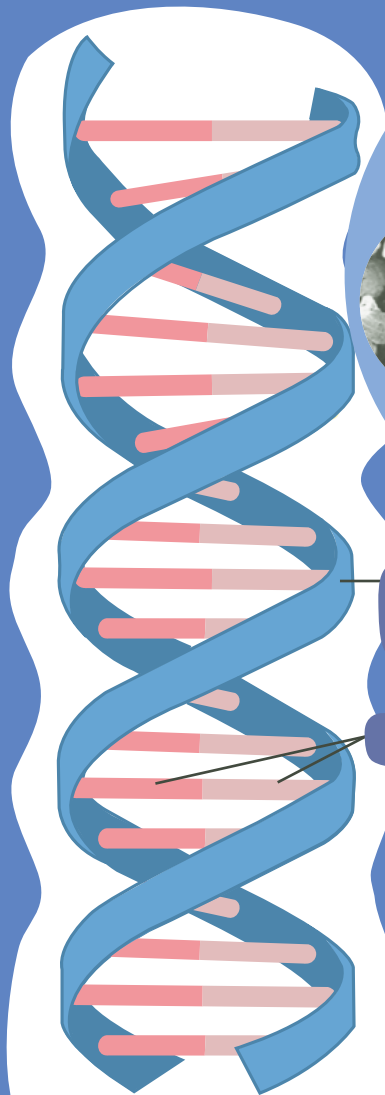
Under the microscope.

Discover more about the techniques used by forensic scientists and why they are so useful.

It is really important that scientists thoroughly investigate a crime scene and collect samples of any fibres, hairs or bodily fluids that they find. These samples can then be analysed in the laboratory and compared to any potential suspects.

Under a microscope, scientists are able to tell what type of material a fibre has come from. Have a look for yourself at the images of different fibres below.

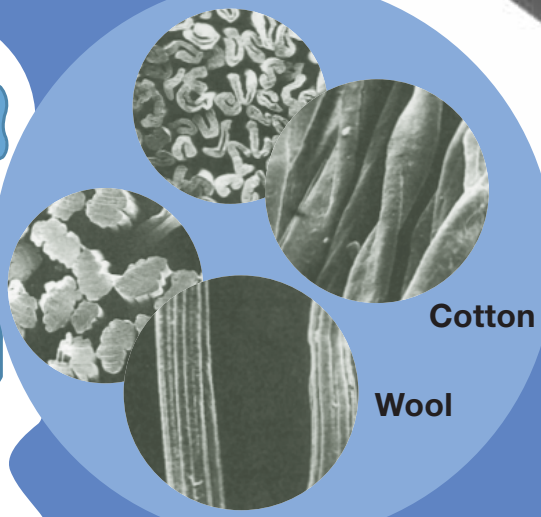
If a hair sample is found at the scene of a crime, scientists can do lots of different tests. Not only can they tell what colour the hair is, they can also tell if the hair has been coloured or treated in any way. In addition, the scientists can also extract DNA from the hair sample, which can be used to positively identify a person. The hair sample can also be used to test for any drugs or poisons that the owner may have taken.



Sugar
Phosphate
Backbone

Base pairs

Structure of DNA



Cotton

Wool

DNA is the code for life. Your DNA is unique. You inherit half your DNA from your mother and half from your father. DNA can be broken down into smaller units called genes. Genes carry all the instructions for making your body. For example, genes tell your body what colour your hair should be.



As everyone's DNA is unique to them, it makes it an excellent way for police to identify suspects or victims from hair or blood samples found at the scene of a crime. The picture on the left shows a scientist analysing DNA samples.

Handwriting analysis.

Discover when handwriting analysis is used and why it is so useful.

Forensic scientists can analyse handwriting so that written documents can be used as evidence. Scientists can try to answer a number of questions, for example, who wrote it? When was it written? Perhaps scientists are analysing a ransom note or a forgery.

When analysing a handwriting sample, forensic scientists are looking at the following characteristics:

Form

The shape of the letters, the slant of the writing, the angles and curves of letters and the connections between letters.

Lines

The quality and thickness of the line made by the writing instrument and the amount of pressure the person used when writing.

Arrangement

The layout of the writing on the page. Scientists look at the spacing of letters and words. They also make note of the alignment and any unique punctuation.

Content

The spelling, grammar and punctuation are all analysed. Scientists are particularly interested if a person always misspells a word.

Handwriting

Here are some examples of different styles and slants of handwriting.

*This is a
SAMPLE OF
LARGE WRITING*

Large.

*This is a sample of small
handwriting*

Small.

*this is a sample of
right slanting script*

Right slanting script.

*This is a sample of
handwriting that slants
to the left.*

Left slanting script.

*THIS IS A SAMPLE OF
VERTICAL WRITING,
WITHOUT SLANT.*

Vertical without slant.

*This is mixed or a
variable type of
writing slant*

Mixed or variable writing slant.

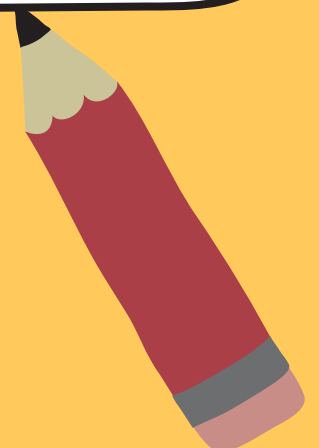
Did you know?

Everyone has their own unique style of writing. So, even if a criminal tries their best to disguise their handwriting, it will still exhibit some of their unique characteristics.

Forensic scientists are also interested in the type of writing instrument used. For example a quill and ink, a pen or a pencil. They also analyse the type of paper written on.

Have a go!

Have a go! Try analysing different types of ink by using a scientific technique called chromatography. Copy the worksheet and carry out your own forensic investigation.



Cracking codes.

Learn about different types of codes and what they are used for.

Codes and Ciphers

A code is when you swap the whole word or phrase with a different word or symbol and is ideal for short messages. A cipher is when you change individual letters of a word in the message. The letters can either be jumbled up or swapped for other letters or symbols. When using a code or a cipher it is really important that only the people using the codes know what they are, otherwise anyone would be able to read the message.

Caesar's cipher

There are reports that Julius Caesar used encryption to communicate with his generals. The method, which was known as Caesar's cipher, involved moving each letter in the message forwards or backwards by a fixed number. This meant that secret battle plans could not be read by the enemy.

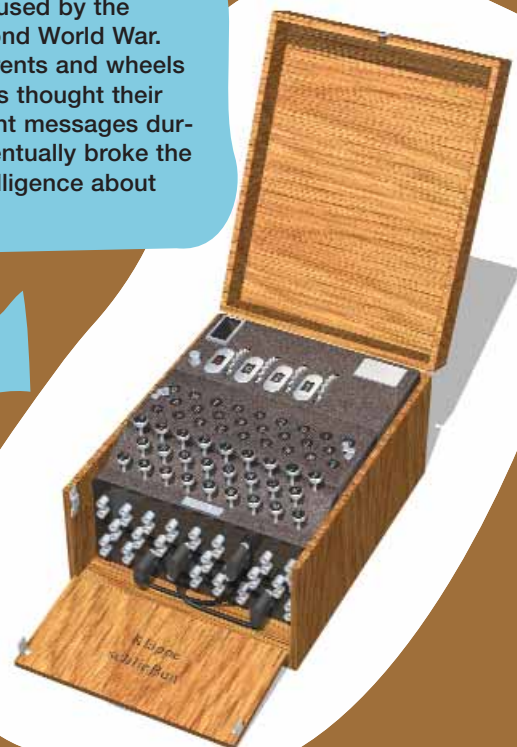
What is encryption?

Encryption is the process of encoding information in such a way that only certain people or computers with the key can decode and understand it.

Encryption is still used today when sending personal or sensitive information between computers. For example, when you are internet shopping, you do not want other people to know your bank account details. So these are encrypted before being sent to another computer.



Enigma was an encryption machine used by the Germans, especially during the Second World War. Enigma used adjustable electric currents and wheels to jumble the message. The Germans thought their code was unbreakable and freely sent messages during the War. However, the British eventually broke the enigma code giving them useful intelligence about the German forces.



Babington cipher

Whilst imprisoned, Mary Queen of Scots substituted symbols for letters to encipher messages plotting with her conspirators to murder Queen Elizabeth I. The cipher became known as the Babington cipher, as Mary's correspondence was to her former page, Anthony Babington. Eventually, Queen Elizabeth's spies deciphered the cipher and all those involved in the plot to murder the Queen were executed.

Have a go!

Ink chromatography.

Copy this sheet and follow the instructions to carry out your chromatography experiment.

Name: _____

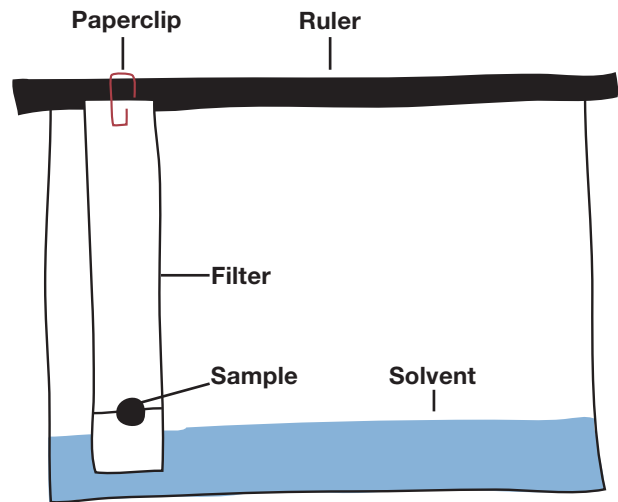
Chromatography is the process of separating small amounts of substances from a mixture by the rates at which they travel through a medium. Ink is a mixture of coloured dyes, so chromatography can be used to separate the mixture of dyes.

Your task

Ask a friend to write a note using a black water soluble pen and leave a dot as evidence on the bottom of some filter paper. Can you identify the pen that was used to write a note?

You will need the following equipment:

Several varieties of black water soluble pens, including a sample of the evidence
Coffee filters cut into 2 cm wide strips
A ruler
A container
Some paper clips
Some water (solvent)



What you need to do:

- 1 Fill the container with 2 cm of water (solvent).
- 2 Use a 2 cm wide strip of your evidence and hang it from the ruler (using a paperclip to secure). Allow the end of the paper to touch the solvent. However, do not let the ink get wet. Using a pencil clearly label the sample at the top.
- 3 For each of the suspect pens, place a spot of ink about 3 cm from the bottom of the filter paper strip. For the best results, allow the ink spot to dry and repeat. With a pencil clearly label each of the strips.
- 4 Secure each of the filter paper strips to the ruler with a paperclip. Ensure that the bottom of the paper just touches the surface of the solvent and that the ink spot does not get wet.
- 5 Allow the ink spots to separate for 15 minutes.
- 6 Examine the patterns of each ink sample. Can you determine which of your known suspect pens is the pen used to write the note.

How does it work?

When the ink sample comes into contact with certain solvents, the coloured dyes dissolve and can be separated. By placing the filter paper with the ink sample into a solvent, the ink spreads across the paper when it is dissolved. The different coloured dyes within the ink move at different rates along the filter paper.

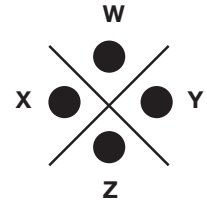
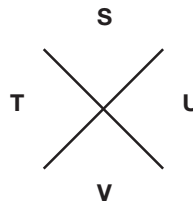
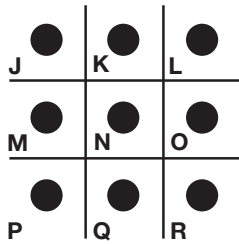
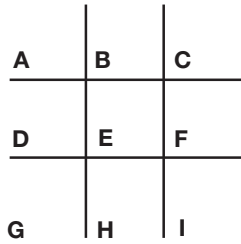
Have a go!

Cracking codes.

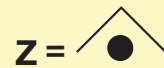
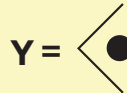
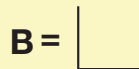
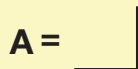
Copy this sheet and try to crack the code!

Name: _____

The pig pen code was first used in the 16th century. The cipher uses symbols to replace the letters in the message, as shown in the diagram below.



Examples



Using the pig pen cipher can you crack the following code?

Now try making your own code using the pig pen cipher and see if a friend can crack your code.

