NATIONAL GEOGRAPHIC™

8+

WARNING!

Not suitable for children under three years. To be used under the direct supervision of an adult. Choking hazard – small parts can be ingested or inhaled. Cut or stab wounds of the skin by sharp functional edges and points. Instructions for the parents or other responsible persons are included and must be followed. Keep Experiment Set out of reach of children under three years. Keep the packaging and manual because they contain important information!

0-3

MANUAL WITH EDUCATIONAL INFORMATION AND EXCITING EXPERIMENTS

FINGERABDRÜCKE
FINGERPRINTS

BRESSER

NATIONAL GEOGRAPHIC™

General Warnings

- Read these instructions before use, follow them and keep them for reference.
- Keep young children, animals and those not wearing eye protection away from the experimental area.
- Always wear eye protection.
- Store this experimental set out of reach of children under 3 years of age.
- Clean all equipment after use.
- Make sure that all containers are fully closed and properly stored after use.
- Ensure that all empty containers are disposed of properly.
- Wash hands after carrying out experiments.
- Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.
- Do not eat or drink in the experimental area.
- Do not allow chemicals to come into contact with the eyes or mouth.
- Do not replace foodstuffs in original container. Dispose of immediately.

General first aid information

- **In case of eye contact:** Wash out eye with plenty of water, holding eye open if necessary. Seek immediate medical advice.
- **If swallowed:** Wash out mouth with water, drink some fresh water. Do not induce vomiting. Seek immediate medical advice.
- **In case of inhalation:** Remove person to fresh air.
- **In case of skin contact and burns:** Wash affected area with plenty of water for at least 10 minutes.
- In case of doubt, seek medical advice without delay. Take the chemical and its container with you.
- In case of injury always seek medical advice.

Declaration of Conformity

CE Bresser GmbH has issued a ‚Declaration of Conformity' in accordance with applicable guidelines and corresponding standards. This can be viewed any time upon request.

DISPOSAL

Dispose of the packaging materials properly, according to their type, such as paper or cardboard. Please take the current legal regulations into account when disposing of your device. You can get more information on the proper disposal from your local waste-disposal service or environmental authority.

Get exclusive new Experiments – only available online!

Media about this product

You can dowload further media (experiments, manuals, etc.) from the BRESSER website* over the following QR code/weblink.

http://www.bresser.de/download/9130400

* Offer subject to the availability of media.

Write the telephone number of the local poison centre or hospital in the space below. They may be able to provide information on countermeasures in case of poisoning.

In case of emergency dial
Europe 112 | UK 999
USA 911 | Australia 000

Warranty and warranty term extension

The warranty term is two years from the date of purchase. Please keep your proof of purchase. Register at **www.bresser.de/warranty** and fill out a brief questionnaire to get your warranty term extended to **five years**. Registration must be completed within three months of purchase (date of receipt) to validate the warranty. If you register thereafter, the warranty term will not be extended.

If you have problems with your device, please contact our customer service first. Do not send any products without consulting us first by telephone. Many problems with your device can be solved over the phone. If the problem cannot be resolved by phone, we will take care of transporting your device to be repaired. If the problem occurred after the warranty ended or it is not covered by our warranty terms, you will receive a free estimate of repair costs.

Service Hotline: +49 (0) 2872 - 80 74-210

Important for any returns:
Please make sure to return the device carefully packed in the original packaging to prevent damage during transport. Also, please enclose your receipt for the device (or a copy) and a description of the defect. This warranty does not imply any restriction of your statutory rights.

Your dealer:..... Art. No.: .....

Description of problem:.....

Name:..... Telephone: .....

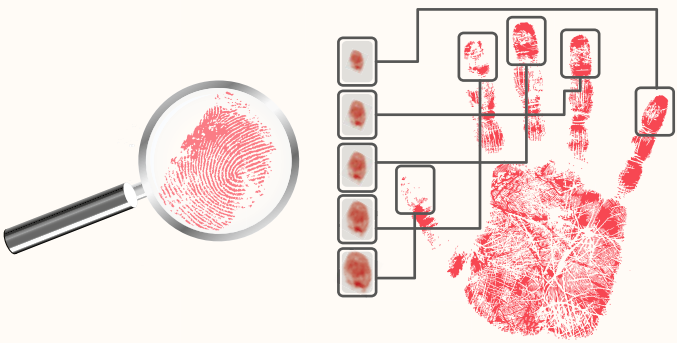
Street:..... Date of purchase: .....

City/Postcode:..... Signature: .....

NATIONAL GEOGRAPHIC™

Kit contents

Description:	Quantity:
1. Fingerprint registration form	10
2. Family tree poster	1
3. Fingerprint stickers	2
4. Fingerprint cards	10
5. Magnifying glass	1
6. Fingerprint charcoal powder	2
7. Fingerprint ink pad (black)	1
8. Bellows	1



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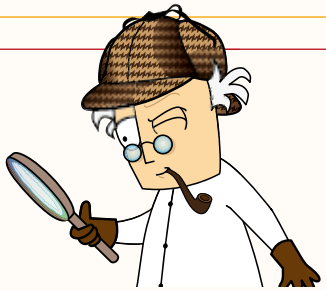


1. Introduction

Each person is a unique combination of hundreds of different characteristics - height, shape, eye colour, skin colour, hair colour, etc. Among many others, all characteristics are determined by **genes**. They are units of inheritance and define our biological identity.

These genes correspond to the specific organisation of our genetic material (DNA - a molecule that encodes all genetic information of all living organisms). Thus, each gene consists of a specific sequence of nucleotides embedded in a section of DNA that codes a specific protein, that has a function in the organism.

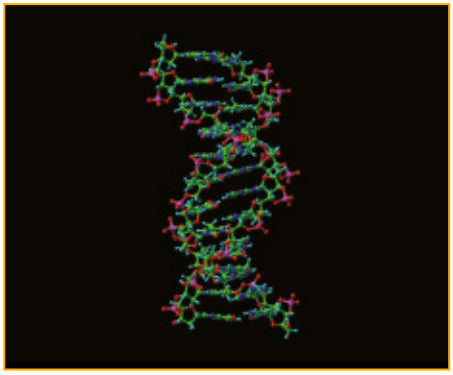


Image 1. Deoxyribonucleic acid (DNA).

But how can we identify a person just by observing these characteristics defined by genes? In fact, until the 19th century there was no scientific process allowing to identify someone based on these unique features. The evolution of science, allowed scientists to discover the unique characteristic of every human being, that's why fingerprints became crucial in **criminal investigations.**

This book will show you some of the main techniques used in criminal investigation and you will be able to become a detective, conducting one of the most used methods - fingerprint identification.

Image 2. Fingerprints.

1.1. Criminal investigation

Whenever a crime is committed, a team of scientists starts searching for evidences in order to identify the perpetrator.

Scientists believe that it is impossible for anyone to commit a crime without leaving any trace. When somebody's trace is found and analysed, scientists then try to find the person who left it. They compare the information from the trace with information of samples of known origin. If they find an accordance with a person, this trace may prove the guilt or innocence of someone.

There are lots of traces that can be used, such as hair, clothing fibres, small traces of chemicals, bullets, fragments of glass and fingerprints.

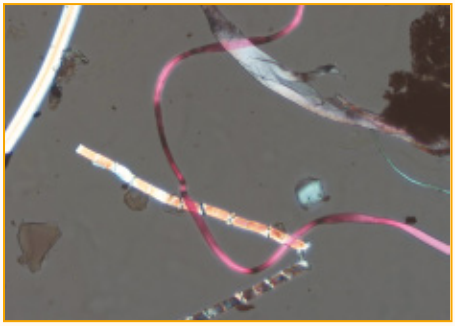


Image 3. Clothing fibres observed under the microscope.

Image 4. Detectives gathering evidences.

All these traces, which may be evidences of a crime, will be collected and then analysed by forensic scientists. Forensic science involves the application of various fields of science, such as physics, biology, chemistry, mathematics and other areas, with the goal of assisting in criminal justice.

DID YOU KNOW...
That the word forensic has its origin in the mid 17th century: from Latin word forensis "in open court, public", in English meaning forum?

In the past, it was impossible to identify a criminal unless the person was not actually caught committing the crime.

Now, more than ever, science is crucial in fighting against crime. As people discover new ways to commit crimes, scientists are continuously developing new techniques and methods to link suspects to crimes.

With this book you may learn about methods that criminologists use to identify the perpetrators of a crime.

You will also have the opportunity to become a real scientist and do your own research by registering fingerprints, which is the most common method in criminal investigation.

2. Criminal investigation methods

Evidence handling

Scientists believe that it is impossible for anyone to commit a crime without leaving at least one trace that can identify the criminal. The challenge is to find these traces at the crime scene!

Traces collected at the crime scene are taken to a laboratory. There, forensic scientists use a wide variety of tests, techniques and equipment to analyse and to identify the trace.

Image 5. Evidence analysis at a laboratory.

Then we are going to show you various specific techniques of evidence treatment.

2.1. Fingerprints

Fingerprints are the prints of the drawings (arches, whorls or abstract figures) of grooves from our skin formed by papillae (elevations of the skin), located on fingertips and left on any surface we touch.

DID YOU KNOW...
That fingerprints help you to pick up objects, which won't slip out of your hands?
If the surface of your fingers was smooth, it would be much more difficult to hold the objects.

When we touch a surface we leave grease residues and sweat, apart from other substances. These residues allow to collect fingerprints. Fingerprints can also be found on moldable materials, such as modelling clay or finger-paintings.

Friction ridges are formed during pregnancy and persist for a lifetime, without significant changes. This characteristic is known as **immutability**.

DID YOU KNOW...
That fingerprints are unique to each individual and even identical twins (who have the same DNA - genes) have different fingerprints?
This fingerprint feature is called uniqueness. This is the reason why friction ridge identification is used as a method of identification since the latest 19th century.

Fingerprints have characteristic points and formations that allow an expert to identify a person quite reliably.

Today, the comparison between the captured fingerprints and those that exist in databases, is made by a computer system.

Image 6. (Mark of a) fingerprint left on a glass.

Their forms, investigated by forensic scientists, are mostly arches, loops and whorls. The loop pattern is the most common and it can be found in 60% of the world's population.

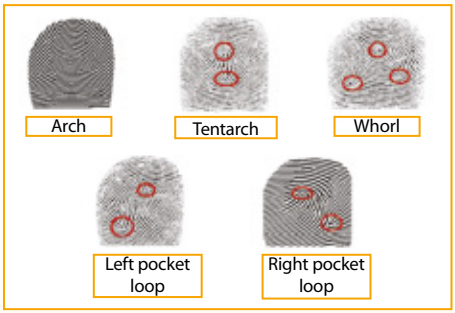


Image 7. Different fingerprints with specific points of comparison (red circles).

At a crime scene, the police must be very careful and not touch anything without gloves. After reviewing the crime scene they collect the evidences and search for fingerprints. In order to collect fingerprints the detectives use powders of different colours, depending on the surfaces' colour. They use a brush to spread the powder over the surface so they can visualise the fingerprints and produce high contrast between the prints and the surface.

The most used powder in latent fingerprint development is graphite powder (the same substance that charcoal pencils are made of). The powder sticks to the grease left by the fingers when in contact with surface. On dark surfaces it is more useful to use white powders, such as lead carbonate powder.

Using powder to develop fingerprints is the most widely used technique and is based on its physical and chemical properties, the type of brush used and also in how the expert performs the investigation at the crime scene.

DID YOU KNOW...

That the method of latent fingerprint development goes back to the 19th century and is still the most widely used method in criminal investigation?

Since the discovery of fingerprints, police and scientists have been using this method as a way of finding criminals!

Image 8. Materials used during fingerprinting.

When the police find fingerprints at a crime scene, the detective specialised in latent fingerprint development collects them with adhesive tape, so that the pattern developed with the powder sticks on the tape.

The adhesive tape is placed on a lamella with the name, time and date of the collected fingerprint.

Finally, the detective analyses the fingerprint to check if there are at least 12 points of comparison. These points of comparison can be the beginning or the end of a "line" or the separation or junction of two lines.

The fingerprinting technique is somewhat limited, because not all surfaces absorb the sweat and grease of the fingers as rough surfaces do. Therefore, if a fingerprint is left on such surfaces, most likely it will be distorted, making it very difficult for detectives to compare it with the ones in the police databases.

Also, it is not possible to reveal a fingerprint left on paper by using these powders.

DID YOU KNOW...
That to develop fingerprints on paper detectives have to make a chemical analysis, during which the paper is exposed to chemical fumes?
However, this method of revealing fingerprints on paper, is not always fast and is quite expensive.

To develop fingerprints on surfaces such as paper, the iodine fuming technique is commonly used, since iodine sublimates when heated, which means that it passes directly from the solid state to the gaseous state (steam).

This fume has a pinkish colour and when it comes into contact with fingerprints, it sticks to the grease absorbed on the paper left by the friction ridges of our fingers (physical reaction).

As you can see, when we develop fingerprints on paper, two reactions are taking place: a chemical reaction (sublimation) and a physical reaction (absorption).

Image 9. Sublimation of iodine.

Usually, to heat iodine crystals (solid state), scientists put them into a glass container (Erlenmeyer) along with the surfaces they want to analyse.

Finally, scientists use a heating plate to warm up the crystals, which consequently transform into steam.

But beware, this vapour is toxic! The glass container (Erlenmeyer) is only opened in open spaces.

Also, after performing this technique, the detectives compare the fingerprints found at the crime scene with those existing in the police databases through specific computer programs.

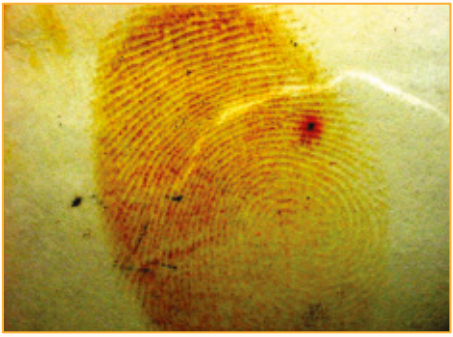


Image 10. Fingerprint collected by the iodine vapour technique.

2.2. Other methods

a) Genetic "fingerprints" (DNA fingerprinting)

The human body is formed by trillions of cells. Each of these cells contains in its nucleus a genetic code that determines how we are and how we develop, in other words, they contain all living beings genetic information passed on from one generation to the next.

The code is presented in the form of long strands of deoxyribonucleic acid molecules and commonly referred as DNA. The DNA segments containing the genetic information are called genes.

The other segments have a structural or regulatory role on the genetic information.

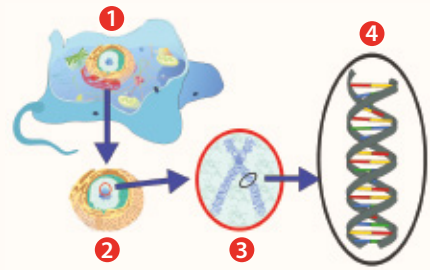


Image 11. Structure and organisation of genetic material. 1 - Cell; 2 - Nucleus; 3 - Chromosome; 4 - DNA.

Often, at crime scenes, it is possible to find evidences that may contain traces of DNA. For example, clothing stained with drops of body fluids (blood or saliva), and even hair, may turn out to be good enough for DNA analysis.

In order to get DNA for analysis we need to extract it from the nucleus of the respective cells.

During this process, the material, a piece of clothing for example, is wet so that any other body cell present in it may come out into the liquid.

The DNA extraction technique requires first the use of a specific detergent that destroys the cell walls and the nucleus, releasing the DNA.

Then alcohol is used to allow the DNA to precipitate, which is then collected and preserved for later use in other scientific studies.

Cold alcohol is added to cause the precipitation of DNA molecules, for these are not soluble in alcohol at low temperatures.

After the DNA extraction, it is common to study genetic fingerprints, that is, the pattern present in DNA after the electrophoresis process.

Electrophoresis consists in applying an electric current, flowing through a gel from one end to the other, causing the DNA fragments to move on the gel according to their size (smaller bands move faster than higher bands), in the direction of the electric current.

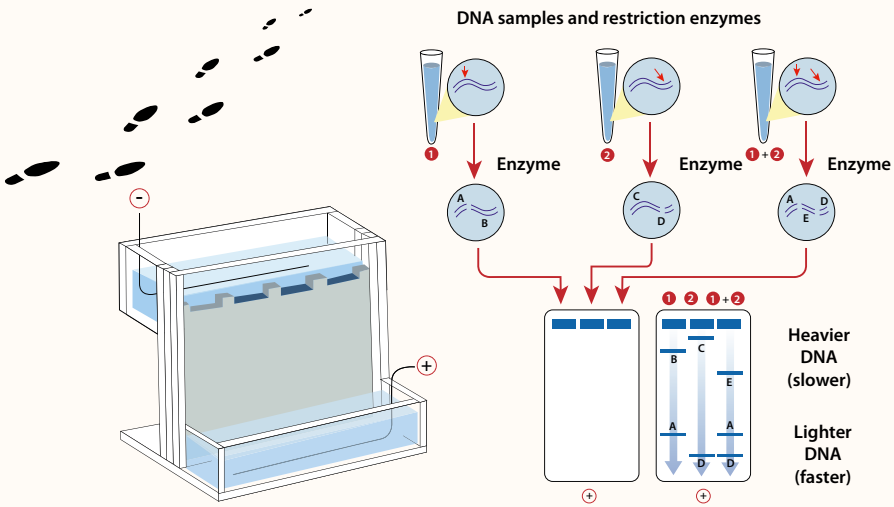


Image 12. Equipment to perform the electrophoresis.

The pattern of DNA bands is transferred to a nylon membrane, which is processed to make the DNA radioactive. When the film is placed over the nylon membrane for some time and it is chemically revealed, the DNA bands appear as dark strips of different thickness in the film, as you can see in the image below (13).

Image 13. Genetic "fingerprint". At the left side, the result obtained from the study of a DNA sample found at the crime scene and at the right side the suspects. The result shows that the profile found at the crime scene and the one from suspect 2 match.

The genetic "fingerprint" is unique, that's why it is considered an effective evidence in court proceedings. However, it should not be forgotten that DNA samples are more difficult to get at a crime scene than fingerprints.

b) Blood analysis

Blood is a very important proof in crime investigation, for it helps identifying the person to whom it belongs.

There are four blood types (**ABO** system - blood types A, B, AB and O) which are determined by the DNA of each person.

So, when a blood sample is found, the first thing to check is to which blood type the sample belongs to.

With this test it is possible to confirm if the blood sample found is of the same blood type of the victim or suspect.

However, blood type alone is not considered a sufficient evidence, because as mentioned before, there are only 4 blood types.

Blood can also be tested according to the Rhesus factor (Rh). This factor can be positive or negative and is determined by the presence (Rh+) or absence (RH-) of a specific type of proteins (enzymes).

This test also consists in the use of electrophesis process, through which the blood sample is dissolved in water and then placed in a dish covered up with gel.

Then, an electric current is applied to the gel, so that the enzymes move along the dish towards the electric current. According to their structure different enzymes reach different distances.

Afterwards the electric current is turned off and the gel is illuminated with ultra-violet rays (careful not to look directly at the UV rays!), in order to lighten up the bands of the corresponding enzymes.

This pattern is compared to the suspect's one to see if it matches. Although the blood type and the Rhesus factor are not enough to accuse a suspect, these are still valid evidences that may be used, during the criminal investigation.

Antibodies are essential proteins in our immune system, they are responsible for recognising and eliminating strange molecules in our body.

Antigens are molecules recognised by the antibodies, which can trigger an immune response in order to eliminate antigens.

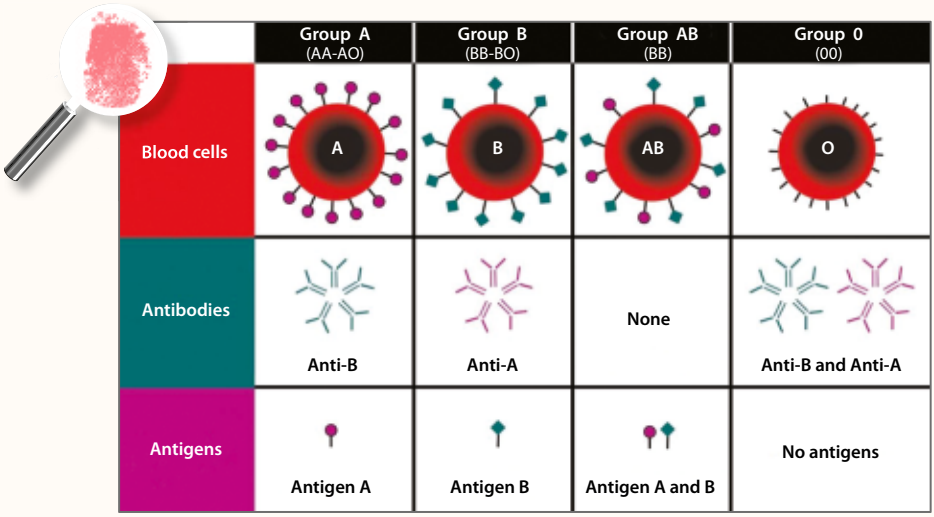


Image 14. Different blood types and respective antibodies and antigens.

Image 15. Protein electrophoresis.

DID YOU KNOW...
That people with blood type AB Rh+ can receive all blood types and people who have O Rh- blood type can donate to all people of all blood types?

c) Dental record

The field of forensic science that studies dental impressions is Forensic Dentistry.

Teeth have their own dental impressions, which are unique to each person.

There are various techniqhes to make dental impressions. One example is a radiograph (X-Ray). When you go to the dentist you can experience taking a radiograph (X-Ray) of your teeth - if you haven't done it yet.

Dental impressions change over time: teeth change their shape because of tooth decay (caries) and deseases and also teeth can break in accidents.

If food is found at the crime scene, and it's bitten off, it becomes a piece of evidence, because of its bite impression.

As bite marks change or shrink, the first thing to do is to take its impression.

Teeth are also useful to identify a corpse. Its size may indicate if the body belongs to a male or a female person and its condition helps to estimate the person's age.

Such as fingerprints, teeth marks are also compared with registered records from databases (of radiographs). As mentioned before, denture can change with time so it is quite difficult to find a correspondence between a mark of teeth from a crime scene and the records, even if the person is already registered.

Image 16. Dental impression on food left at a crime scene.

d) Impressions (tyres, footprints, tools)

When an impression is found at a crime scene it's first photographed and then pressed into a pad of silicone. When the silicone solidifies the result is a mould of the impression.

DID YOU KNOW...
That tyres also produce unique marks (cuts and stones) and that by passing on a soft ground, its pattern is pressed into the floor?
When analysing the track pattern, scientists can tell in which direction the vehicle was traveling and if it stopped at a place for some time.

Image 17. Tyre track impression on the soil.

So that a tyre track can be an item of evidence, it needs to be photographed first. The flash of the camera is pointed at that depressions in order to create shadows to show the pattern more clearly.

Then a ruler is placed next to the wheel track so that the precise measures are registered on the photograph. First the ground is sealed, so that the fast-setting plaster doesn't infiltrate into the ground. When the fast-setting plaster is solid, it is removed showing the tyre track print on it.

Shoe sole printing is collected using the same method as in the tyre tracks. It´s quite useful because it provides clues about the size, weight and movement (if it was running, for example) of the person who left it.

Image 18. Comparison of a shoe sole with a shoe-print collected at a crime scene.

e) Soil, seeds and pollen

Some plants, such as their seeds and pollen, only grow in certain places and over a specific time of the year. Traces of plants, seeds and pollen are often found on the suspects clothing, which helps to prove that they were at the crime scene.

If the plants have been sprayed with pesticides and traces of the same pesticide are found on the suspect's clothing, the detectives enhance the accusation.

Soil can also get stuck to shoes and as it differs from place to place a similarity between the soil from the crime scene and the soil found on the suspect 's shoes, adds further evidence against a particular suspect.

The suspect 's clothing is taken to the laboratory, where it is cleaned with a brush, a vacuum or adhesive tape and all the particles found are duly examined.

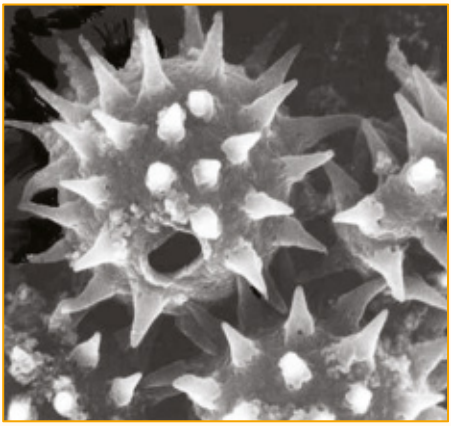


Image 19. Pollen (magnified 6 thousand times).

f) Dead body changes and insects

When a living being dies, a series of natural changes occur, such as its temperature, stiffness and body colour.

When a human being dies, the chemical activity of the body decreases until it stops and the body cools down (about 33.8ºF/1ºC per hour).

The heart stops beating and consequently the blood ceases to be pumped and accumulates in the lower parts of the body (due to gravity). After a while, red blood cells pass through the walls of blood vessels into the surrounding tissues and blood colour appears on the skin.

These changes also cause a muscle stiffness (up to 12 hours) which gradually disappears.

DID YOU KNOW...

That some organisms feed on dead creatures?

For example, blowflies look for dead animals to lay their eggs. After 1 or 2 days, the larva feeds on the decaying body and develops until it becomes an adult blowfly.

When entomologists (insect specialists) find insects on a dead body, they can determine approximately how long ago the death occurred. This is due to the fact that the egg laying process and development is well known and is common among all the species found.

Image 20. Blowfly.

g) Water

Water from different places contains different chemicals and organisms. If water is part of a crime scene evidence, a sample is collected for analysis.

DID YOU KNOW...
That if water is found inside a dead body it means that the victim was alive when entering the water?

If a dead body is found in water, it is important to know if it was still alive when entering the water.

If it was, water gets into the lungs and is then carried by the blood into the rest of the body.

Water can be detected through chemical analysis of body fluid.

If no water is found inside the body, consequently the person must have been dead before entering the water.

h) Hair and fibres

When the clothing of a suspect matches the description of the witness, that outfit is taken to the laboratory for analysis.

With an adhesive tape all the fibres that don't belong to the clothing are pulled out.

Through the fibres analysis, scientists may find out if the fibres are from the crime scene and to which object it belongs to.

If two identical fibres, one from the crime scene and the other from the suspect, are found, they are analysed chemically to determine if they belong to the same object.

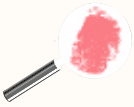


Image 21. Analysis of the suspect's clothes.

Spectrophotometry is another laboratory analysis method which consists in directing white light through fibres causing light dispersion into a visible spectrum of colours.

This method is apllied by using a device called spectroscope, which measures the spectrum's colour intensity. Spectrophotometry relies on the fact that different fibres produce different spectrums.

With regard to hair, the matching analysis is not that simple, because there are just a few hair types.

However, it is possible to distinguish human hair from other body hair parts or from animal hairs (fur).

It is also possible to determine if the hair fell naturally or was uprooted.

With hair colour, by the use of bleaches or dyes, it is also possible to achieve a match between the evidence and the suspect.

DID YOU KNOW...
That a human hair can support up to 3 kilograms?

i) Objects

When a glass is broken, for example at a crime scene, glass pieces are spread over a large area. If the glass (window, bottle, etc.) is rebuilt (like a "puzzle") it's possible that a piece may be missing. This piece can be found on clothing or in the suspect's shoes and then placed in the "puzzle".

If that piece fits and if the stretch marks (caused by intense heat used when handling the glass) and the coefficient of refraction (light bending ability) match, it is most probably the missing piece.

Image 22. Broken glass at the crime scene.

Other traces can be found in the suspect's clothing or tools, such as: car paint chips, torn wallpaper, etc.

j) Documents

Documents such as ransom notes, blackmails or daily notes can also be crime evidence. Documents can be divided into 3 categories: handwritten, typewritten and printed documents.

Experts in handwriting, graphologists, can determine if a handwriting note is genuine by the way the letter is shaped (handwriting flows smoothly), or if it is a fake, when there are marks where the writer stopped and restarted or went back to change something.

With the help of different coloured lights it is possible to investigate the impressions left on the paper. Thereby different lights emphasize different pen impressions.

The paper can also be analysed. It can match the type of paper found in the suspect's house or a torned piece of paper can fit in the suspect's notebook.

Another test to analyse a document is EAD (Electrostatic Document Analysis) test, which allows you to see what has been written on a paper by analysing the paper sheet that was directly below.

In this test, the paper sheet is placed on a wire mesh or metal sheet which is covered with a plastic film. The wire mesh is charged with electricity and the current is transferred to the paper and to the plastic film. When the black powder is spread all over the plastic film, some of it sticks to places which have been written on previous paper.

Image 23. Electrostatic document analysis.

k) Firearms

When you fire a firearm, it leaves specific marks on the bullets. Every firearm leaves a different mark. The marks on the bullets found at the crime scene are then compared with the bullet marks of the seized firearm.

The marks are left by grooves inside of the firearm's barrel causing the bullet rotation. These grooves leave a unique pattern on the bullet (as if they were its fingerprints) and allow the identification of the firearm that fired it.

DID YOU KNOW...
That firearm experts also can determine how close the firearm was when it was fired and as well as in which direction the bullet went?

Image 24. Firearm.

l) Fire

Fire, whether accidental or provoked, destroys various evidences at a crime scene (documents, photographs, fingerprints, etc). However, some tracks remain intact.

When the forensic scientist arrives at the crime scene, he first smells the air to detect if flammable substances were used. The residual scents of those substances remain in the air even after the fire has been extinguished.

Image 25. House burning down.

When the smell of flammable substances is detected, it means that debris of absorbent materials contain traces of those substances found in the crime scene.

The scent comes from the vapour of the flamable substances. In order to identify these substances scientists take a sample of the vapour by aspiring the smelling debris with a gas that does not react with vapour, such as nitrogen, helium or argon. Then the substances of this vapour are separated, detected and identified using a laboratory technique called chromatography.

For this, the gas with vapour is pumped into a tube containing fibres. Fibres cause the separation of the different substances in the vapour (according to their size and structure). As the gas with the vapour is pumped, after a while the separated substances appear at the end of the tube, where they are processed by a detector.

The detector triggers a pen that registers the substances in a graphic. In order to find out which substances were burned, scientists compare this graphic with graphics of substances they already know.

DID YOU KNOW...
That fire is a combustion reaction? Combustion occurs only if 3 things are present:
Fuel - substance that produces heat energy during a combustion;
Oxidant - environment or gas required to burn the fuel. Generally this gas is oxygen;
Activation energy - a heat source.
A match for example.

m) Explosives

When there is an explosion, the work of the expert is to find out the cause.

An explosion caused by a gas leak causes a "pushing" effect around the explosion area, and the energy is released simultaneously throughout the cloud.

Image 26. Damaged building after an explosion.

In a bomb explosion, the shock wave propagates with immense strength and then starts decreasing while advancing.

The position of the debris also provide important clues. A forensic scientist measures the distance of the debris from the suspected explosion site and estimates the aproximate speed at which they flew off.

If the speed is approximately 2237 mph (1000 metres per second), the most propable cause is a bomb explosion. Scientists always examine the debris carefully.

For example, after having concluded that the cause of the explosion was a bomb, scientists look for pieces of the bomb to try to understand what type of mechanism was used.

n) Facial composite drawing

If there is an eyewitness to a crime, which also saw the face of the perpetrator, there is the possibility to create a facial composite based on the recollection of the eyewitness. There are several computer based systems to create facial composites. Sometimes these composites are made by the witnesses' selection of facial feature drawings from hundreds of noses, eyes, mouths, etc.

Photographs of facial features are also used to create facial composite. Normally a trained artist creates the composite by drawing, sketching, or painting in consultation with the witness.

Sometimes there are just skeletal remains of a person. An option for its identification is the use of **facial or plastic reconstruction techniques**. Thereby the reconstruction of the skull can be compared with photos of missing people.

Image 27. Reconstruction steps of the head of an unknown victim.

Thanks to research, scientists know the thickness of the skin at certain points of the face. To indicate the thickness of further layers they cut wood pieces to the required length and place them at the scull to the according points.

The skull is then covered up with layers of muscles and skin made of clay until the pieces of wood are completely covered. To finish the reconstruction, scientists use teeth, false hair and eyes, as well as a more realistic skin colour, to obtain a result as close to reality as possible.

DID YOU KNOW...
That there is still another portrait that can be made?
In this case, the detective imagines how the criminal suspect may look like. Through other evidences the detective can know other information of that person: such as height, weight, skin colour, age, etc.

A psychological profile is also added to this mental image. An expert looks at the crime scene and searches signs of the criminal's feelings, such as anger, frustration and standard behaviour.

3. The use of computers in Forensic Science

Solving a crime consists in a process that gathers and separates several information that can be used to identify a criminal. The computers ability to quickly process large amounts of information, turned out to be essential for the fight against crime.

There have been developed various computer programs to process and analyse the information stored in their electronic memory.

These programs are simplifying and accelerating a lot of processes, such as the fingerprint identification.

Before there were computers, fingerprints from a crime scene had to be identified by someone that compared these with all the existing fingerprints filed.

Image 28. Digital fingerprint.

DID YOU KNOW...
That in 1961, for six months, six police officers compared a fingerprint found at the crime scene with others that were on file?

A police investigation of a serious crime is a huge and complex operation. The statements of the witnesses (testimonies) and many other people connected to the criminal case have to be evaluated. During such a procedure easily a lot of information is gathered.

These statements may contain all the necessary clues to solve the crime and to identify the perpetrator.

Nevertheless, it is difficult and a lot of time is spent analysing all information and separating irrelevant information from useful facts.

Fortunately, computers can analyse all the information very quickly.

For example, if the police believes that a person responsible for a crime, lived or worked in a certain city area and that this person is a sports fan, the computer can search all statements and find all the information that matches these requirements.

Many professionals of different industries fear automation, because it is a mean that can replace people by machines.

However, computers will never replace police officers and forensic scientists because computers can only do what they are programmed for.

Its usefulness is due to the fact that they can perform tasks with incredible rapidity.

The imagination and versatility of police officers and scientists will always be needed to develop and prove new theories and techniques.

Computers and other equipments are simply tools that provide the police with quick and vital information and enables scientists to perform their work faster than ever.

4. Experiments

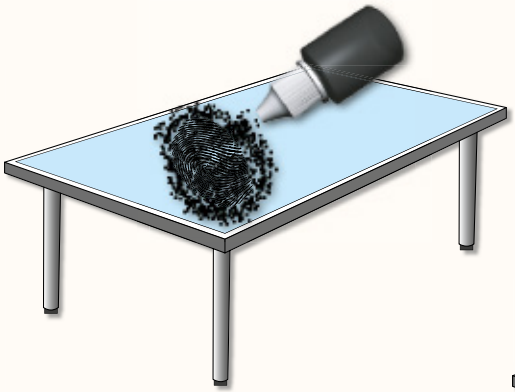
Experiment 1
Fingerprint detection

Use the magnifying glass to find fingerprints on smooth and shiny surfaces, such as tables, glass or mirrors.

You must pay attention, because often you'll just find smudged or blurred patterns.

When you find a fingerprint, spread a bit of graphite powder over it. Be careful not to touch the print with your fingers, because otherwise you will erase it.

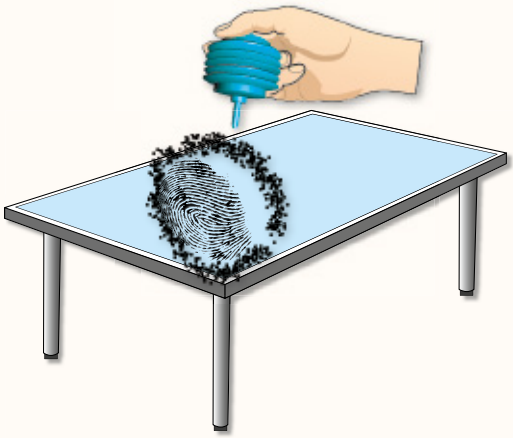
Warning: the powder is black and can stain, so be careful and don't let it fall over carpets, towels or clothes!



Experiment 2
Making fingerprints visible

Use the small bellows to blow the excess powder, so that the fingerprints become visible.

Warning: be very careful and do not press the bellows too hard to prevent the powder to go into your eyes and mouth.



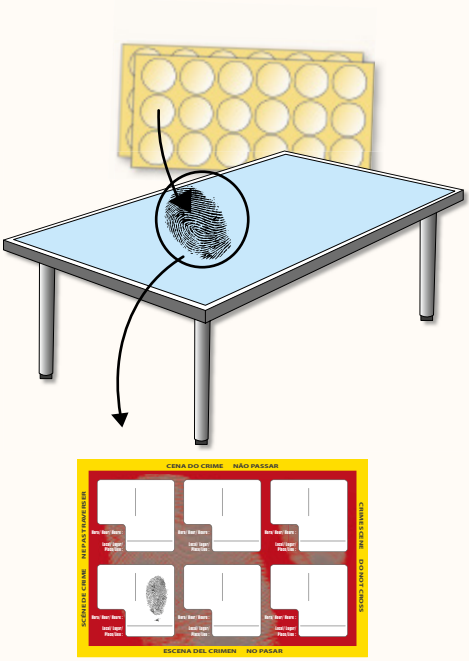
Experiment 3
Gathering latent fingerprints

After the previous experiments, you should now have a good fingerprint. If you want you can collect it and fix it on the fingerprint card.

So take a fingerprint sticker from the kit. Stick it over the fingerprint area where you applied the powder and press it down. Then, carefully pull off the sticker and the fingerprint will appear the sticker.

Next, place the sticker with the fingerprint on one of the free spaces of the collection card. Don't forget to note the date and the location.

Warning: wash your hands when you are finished!



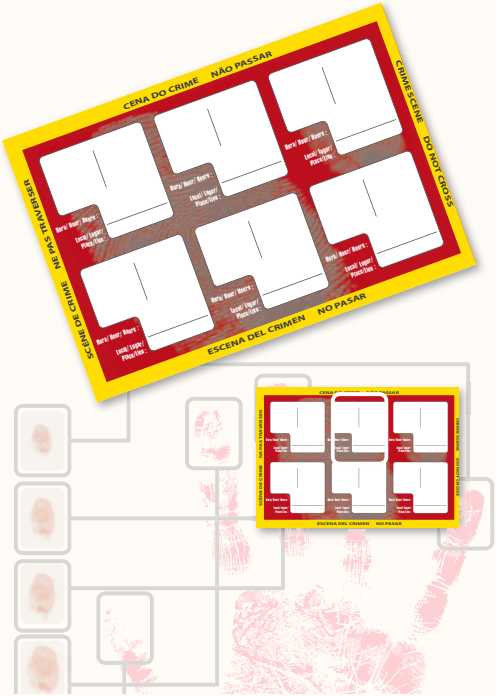
Experiment 4
How to make fingerprint database/ file

You can make a fingerprint registration form for you, your family or for your friends.

This way, you can compare the fingerprints you've collected by placing them in a certain category, and you'll be able to see to whom they belong to.

To create a fingerprint registration form, you write down the name and the age of the person you've chosen the current date and also if the fingerprints were taken from the left or the right hand.

To do this registration, use the pad with black ink from your kit.

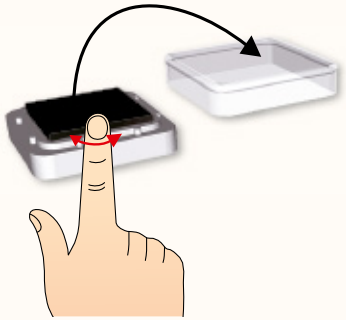


Experiment 5

How to collect a good fingerprint

First, the person from whom you're going to collect the fingerprints, must wash and dry their hands thoroughly. Then, you start to collect the fingerprint of the index finger.

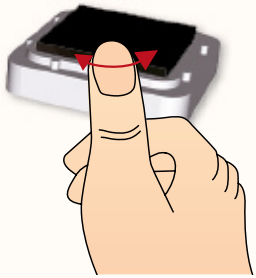
Remove the cover of the ink pad and gently roll the index fingertip on it.



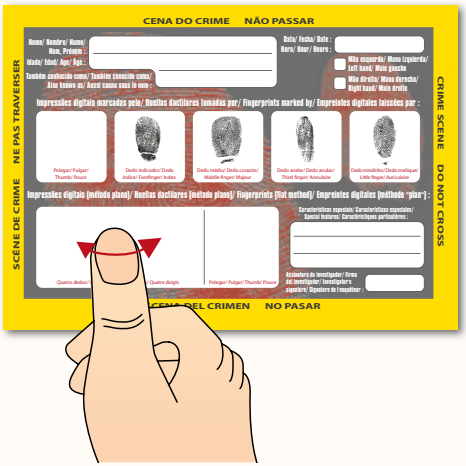
To transfer the fingerprint to the registration form, first, place the left side of the index fingertip in the indicated area and roll it slightly to the right.

Now, apply the same procedure for the middle finger, ring and little finger too.

Finally, repeat the previous steps with the thumb.



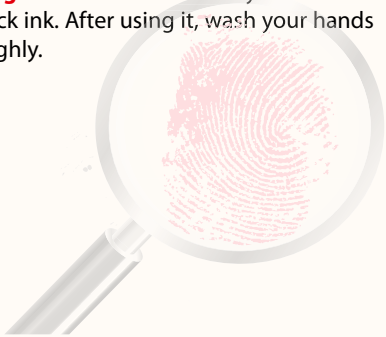
That way, you can create a fingerprint registration form of the right or the left hand fingerprints for any person.



Then, use the magnifying glass to search for particular characteristics in the fingerprints. If you do, you can write it down in the "special features" field indicated in the registration form.

In order to protect the fingerprints on the registration form, you can place a fingerprint sticker over each fingerprint.

Warning: be careful not to stain yourself with the black ink. After using it, wash your hands thoroughly.



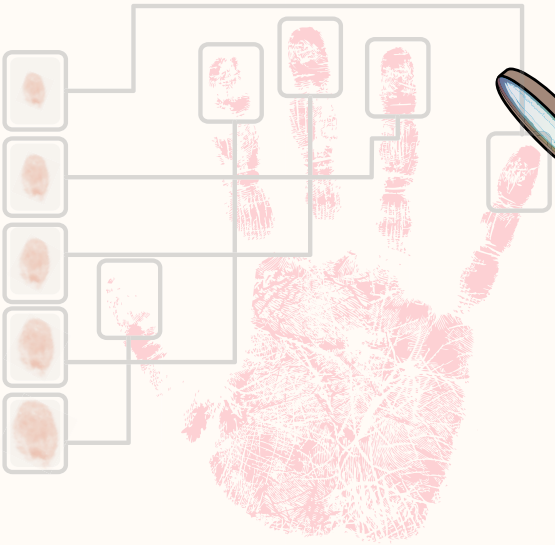
Experiment 6
Another method to collect a good fingerprint

Instead of using the previous method of rolling your fingers, you can also use the flat method. You just have to press a finger on the registration form (don't roll it) to transfer the fingerprint.

You can use both methods to take fingerprints for the registration form. However, the rolling method collects only the fingertip.

Use the respective space on the card for the flat method and try to make fingerprints of a larger area of the finger.

Now that you have your fingerprint registration form, you can compare the fingerprints with the ones at the collecting form and you may figure out to whom they belong to.



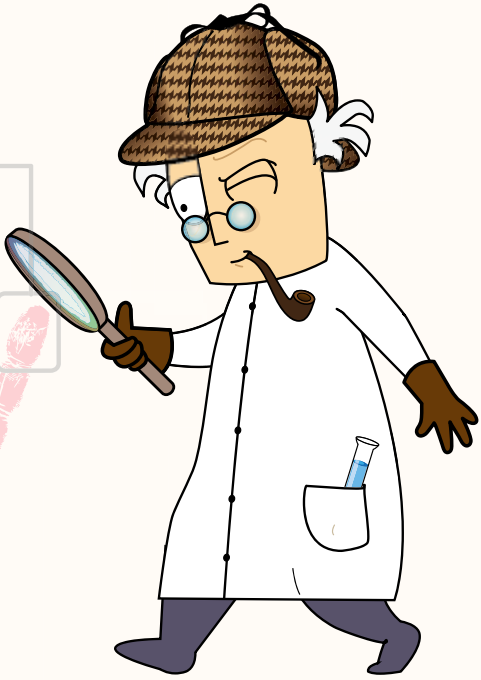
Experiment 7
Game: find out the criminal

You can use the **Fingerprint Kit** for the "Find out the Criminal" game.

Make fingerprint registration forms for all the children with who you'll play the game with and collect their prints into a fingerprint card.

Next, search for fingerprints at the "crime scene" and collect them as explained in experiment 1, 2 and 3.

Then you can compare the fingerprints you've collected with the ones on your registration form and see who the "criminal is".



Experiment 8
Make your own fingerprints family tree

Do you know what a family tree is?

It is a chart depicting the generations of a family and the relationships of the family members. In family trees are often used photographs with the names (and the date of birth) of the familiy members.

Then repeat the same procedure and put your fingerprint into the family tree. You can use other kind of painting colours (like gouaches) as well.

Put some of the ink on a plate, press your finger in it and then press it on your place in the family tree. Ask your family members to do the same. Your family tree will be unique and colourful.

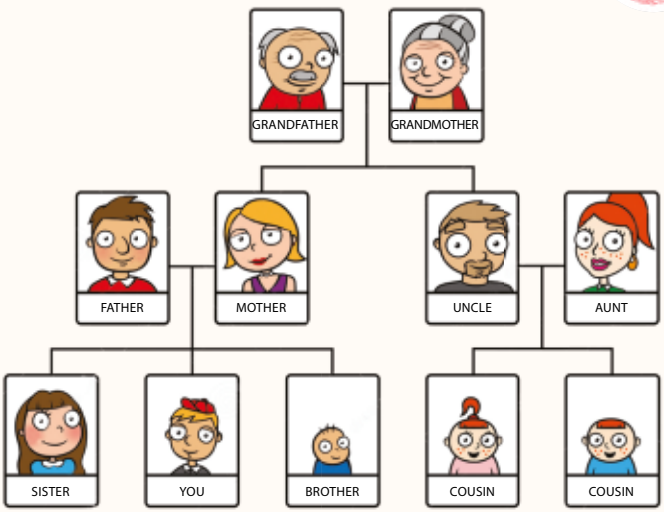


Image 29. Family tree.

You can also use the **Fingerprint Kit** and make your family tree with fingerprints!

Use the black ink pad in the kit to put the fingerprints of your family (parents, grandparents and siblings) into the family tree poster that you can also find in the kit and write the name of each family member below.

If you want to repeat this experiment or include more family members, draw your own family tree. Take as an example the design of the provided family tree poster and then do the fingerprinting.

Experiment 9
A colourful investigation

In this experiment you can simulate what happens at a crime scene, when the criminal has blood or painting colour stained on his hands and touches a surface leaving his fingerprints.

Using paints that you have at home, for example gouaches, you can create fingerprint registration forms like you did before but now with the colours you want.

Put some gouache (or any other kind of paint) on a small dish and press your finger in the paint. Then, press your finger on a paper sheet or a cardboard.

You may also ask your family and friends to do the same, creating a colourful fingerprint registration form. Underneath the fingerprints you can write the name to whom they belong to.

Now try to identify to whom belongs each fingerprint by using your colourful fingerprint registration form.

After you have fingerprint registration forms of your family and friends you can ask them to use the gouache leaving their fingerprints randomly on a new sheet or cardboard without you looking to the place where they put it on.

Instead of comparing the fingerprints with those on your colourful registration forms, you can also compare them with the ones on the fingerprint collection form that you used in experiment 5. You can also compare the fingerprints with your family tree fingerprints and discover to whom they belong to.

Try to make your palmprint (printing the palm of your hand)! You just need to put some ink on the palm of your hand and press it on a paper sheet or cardboard. You can even make a colourful palmprint! Use a brush to apply different colours at different parts of the palm of your hand.

Image 30. Palmprint.

Experiment 10
Fingerprint painting

Image 31. Painting made with colourful fingerprints.

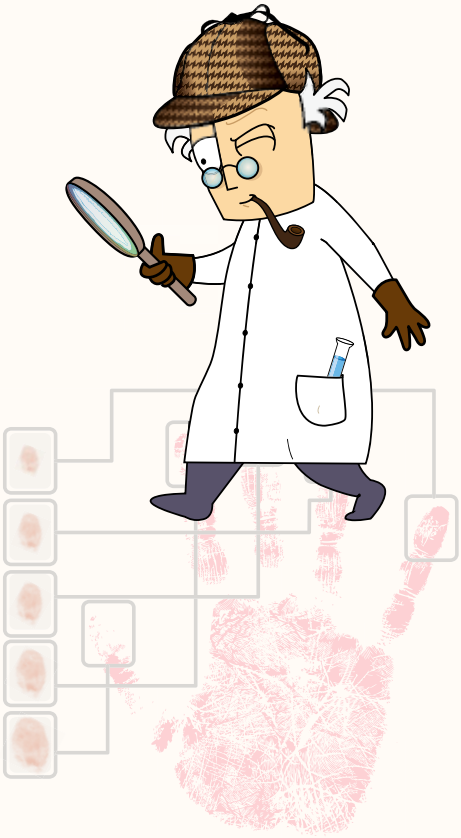
Using coloured inks that you might have at home, you can create paintings, just like the one on image 31.

Put different paints on a dish and press your finger into them. Then press your finger on a paper sheet or cardboard as if it was a stamp and create any shape you want. If you like, you can also use pens or markers to complement your drawings.

You better have a wet cloth to clean your fingers whenever you want to change the colour.

You can also use more than one finger. For example, for larger prints you can use your thumb and the little finger for smaller images.

In this experiment, you can use your imagination and creativity to make cute and "scientific" paintings and give them as a present to those you like the most. Impress your family and friends with your fingerprint artworks!



5. Quiz

1. Fingerprint shapes can be:

a) Whorls, arches and lines
b) Arches, loops and whorls
c) Swirls and loops

2. The uniqueness of fingerprint patterns means that...

a) They are unique for each individual
b) They are round
c) They are unique for each individual with the exception of identical twins

3. When a gas leakage causes an explosion...

a) The debris fly off at approximately 3280 fps (1000 m/s)
b) Generates a "pushing" effect on the building
c) The building remains intact

4. The characteristics that are taken into consideration during glass evidence comparison are...

a) Streaks and refractive index
b) Streaks and colour
c) Colour and refractive index

5. Which of the following is the most accurate, concerning the methods used by criminologists to find out who is responsible for a crime?

a) Dental record, footprints and fingerprints
b) Hair and fingernails
c) Fingernails and tyre tracks

6. If water is found inside of a dead body, this means...

a) The victim could swim
b) The victim wasn't alive when entered the water
c) The victim was alive when entered the water

7. Which of the following insects can provide information about when the death has occurred?

a) Bees
b) Blowflies
c) Spiders

8. Tyre track can be a crime scene evidence because...

a) Tyres leave almost no tracks on the ground
b) Tyres have unique tracks (cuts and small stones)
c) Tyres have different colours

9. The detectives of a crime scene are called...

a) Police
b) Medics
c) Criminologists and forensic scientists

10. Computers are important to the crime scene investigations because...

a) Can replace the detectives
b) Quickly provide clues to forensic scientists
c) They are slow and often malfunctioning

Answers:
1-b) 2-a) 3-b) 4-a) 5-a)
6-c) 7-b) 8-b) 9-c) 10-b)

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