A FUN AND INFORMATIVE BOOK THAT INTRODUCES BUDDING YOUNG INVESTIGATORS TO THE WORLD OF FORENSIC SCIENCE!

Every crime scene has clues if you know where to look. Examining these clues using forensic methods can help you solve even the most mysterious crimes. In this book, you will learn from forensic experts how to analyse all sorts of evidence, from fingerprints and knots to unknown materials and substances.

Filled with colourful illustrations, hands-on activities and true crime cases, **DISCOVER FORENSICS 2** is your best guide to thinking like a forensic scientist. By applying the correct techniques and inquiry-based principles – and avoiding the myths that are commonly depicted on TV – you might just uncover the truth of what happened!

The Forensic Experts Group (TFEG) is a team of accomplished forensic scientists with more than 80 years of combined experience and specialised knowledge. The first private and independent forensic laboratory in Singapore, TFEG serves as a one-stop centre for a wide spectrum of forensic services. TFEG's forensic scientists have worked on hundreds of cases, including many high-profile ones. Through its Discover Forensics Series™ of workshops, talks and learning journeys, TFEG is bringing forensic science literacy to a new generation of young minds.

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Contents

WELCOME!

Hello again!

Welcome to yet another adventure-filled journey of discovery! We hope that you're thrilled to begin further exploration into the amazing world of forensic science.

In this book, you will get to uncover interesting facts about fingerprints, shoeprints and knots. Find out how the uniqueness of one's fingerprints or how one's habit of tying knots in a certain manner can be of evidential value to a case in the chapters **Leaving a Trail of Prints** and **Unravelling Tangled Evidence**.

Have you ever heard about the Black Dragon Fire that occurred in 1987? Did you know that some gases are silent killers? Find out how forensic science can help provide vital clues in investigations involving fires and gas asphyxiation in the chapters **Up in Flames** and **Take My Breath Away**.

The chapters **All That Glitters Is Not Gold** and **What's This White Powder in My Letter?** will demonstrate how the science learnt in your classroom is being applied by forensic scientists in their work. You will also find out more about the various techniques employed by forensic scientists in analysing different types of evidence.

Have you ever wondered how an item from a crime scene eventually ends up as forensic evidence in court – the finale of the forensic process? The last chapter, **In the Courtroom**, will provide the answer to this question. On top of that, you will gain an understanding of our judicial system and learn what goes on during a court trial, the parties involved and their respective roles.

We've also included lots of cases from both Singapore and abroad, as many of our readers have requested. So go on, turn the page and get started on a new journey of discovery, investigation and crime-busting!

Chapter 2

LEAVING A TRAIL OF PRINTS

Various types of prints and impressions such as fingerprints, shoeprints and tyre marks may be left by a criminal at a crime scene. Two-dimensional marks are known as **prints**, while three-dimensional ones are known as **impressions**. **Visible** (patent) prints and impressions can be seen by the unaided eye, whereas **latent** prints require physical or chemical enhancement methods to render them visible.

Fingerprints

What is it about fingerprints that allows for the identification of individuals?

The inner surfaces of our hands contain friction ridge skin with features or patterns that are unique to each individual. These unique patterns are established before birth and remain the same until decomposition after death. It is because of this uniqueness and persistence that fingerprints can be used as a means of identification.

History of Fingerprint Analysis

Fingerprints have a long and rich history of being used as a means of identification. In ancient China, fingerprints were used to seal legal documents and contracts. There are examples from as early as 221 BC of documents being sealed with clay seals bearing the fingerprint of the author impressed on one side of the seal.

Since then, there has been enormous progress in the field of fingerprint examination and research, resulting in their widespread application in crime investigation and the field of security. Have you noticed that electronic devices around us can now be unlocked with our fingerprints?

Fingerprint Patterns

Fingerprint patterns can be broadly classified into three main types:

Loops

60-65% of all fingerprint patterns

Whorls

30-35% of all fingerprint patterns

Arches

5-15% of all fingerprint patterns

Pioneers of Fingerprint Analysis

1858 Sir William Herschel
- A British administrator serving in India
- Credited with the first known official use of prints
- Implemented the first large-scale use of fingerprints by requiring the local population to affix their fingerprints onto contracts in order to combat fraud

1880 Dr Henry Faulds
- Scottish medical missionary in Japan
- Proposed that fingerprint characteristics could be of value in identifying individuals at crime scenes

1891 Juan Vucetich
- Argentinian statistician working with a police department in Argentina
- Formulated his own classification system, known as the Vucetich system
- Recorded the fingerprints of prisoners for identification purposes – the first practical use of fingerprint science by law enforcement

1892 Sir Francis Galton
- British anthropologist
- Devised the first scientific method of classifying fingerprint patterns into loops, whorls and arches
- Pointed out ridge characteristics which are known today as “Galton details”

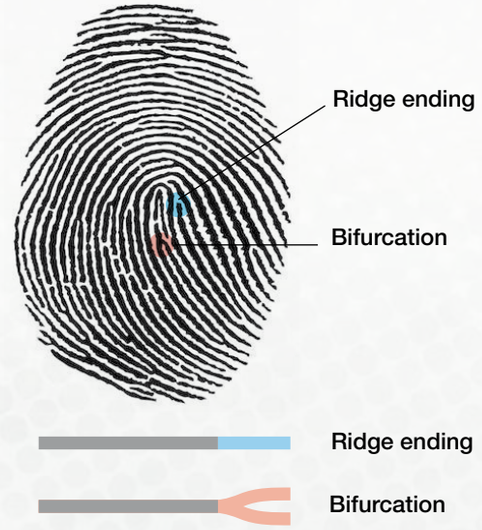
1901 Sir Edward Henry
- Assistant Commissioner of Scotland Yard
- Developed the Henry System, a manual fingerprint classification system that is still in use today

Find Out More!

Which famous scientist was Sir Francis Galton related to?

Ridge Characteristics

In addition to classifying fingerprints into three broad categories according to their patterns, ridge characteristics are also used to describe the prints. Two of the most commonly used ridge characteristics are **ridge endings** and **bifurcations**.



Can criminals remove their fingerprints to evade capture?

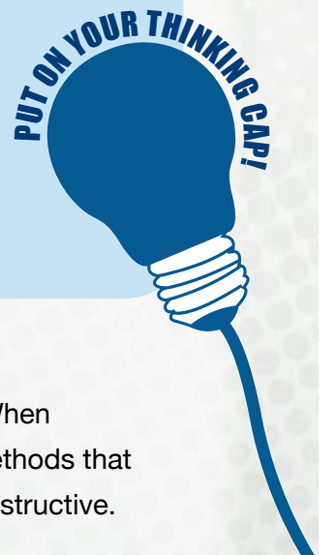
Visualisation and Development of Fingerprints

Visible prints at crime scenes can be seen with the unaided eye because they have been stained, either with oil, blood or other visible foreign substances. Such prints can often be photographed without any enhancement.

Latent prints require development methods that work by reacting with or adhering to the constituents of sweat or other contaminants in the fingerprint to make it visible.

Development methods can be destructive and irreversible. Before proceeding with such methods, here are some questions to consider:

- **What type of surface is the print deposited on? Is it a porous or a non-porous material?**
- **Will the development method affect further examinations such as DNA or trace evidence analysis?**



Methods of Visualisation

There are numerous methods of developing latent prints. When deciding on which method to use, one should start with methods that are non-destructive before progressing to those that are destructive.

Optical Methods

Examination with oblique or low-angle illumination, or using light of different wavelengths, are non-destructive methods that can prove effective in detecting a latent print.

Physical and Chemical Methods

Some processing methods require the use of chemicals that are destructive to the item examined, e.g. permanent staining of a document. Hence, careful consideration has to be given when selecting the processing method.

Here are some of the more common approaches to developing a latent print.

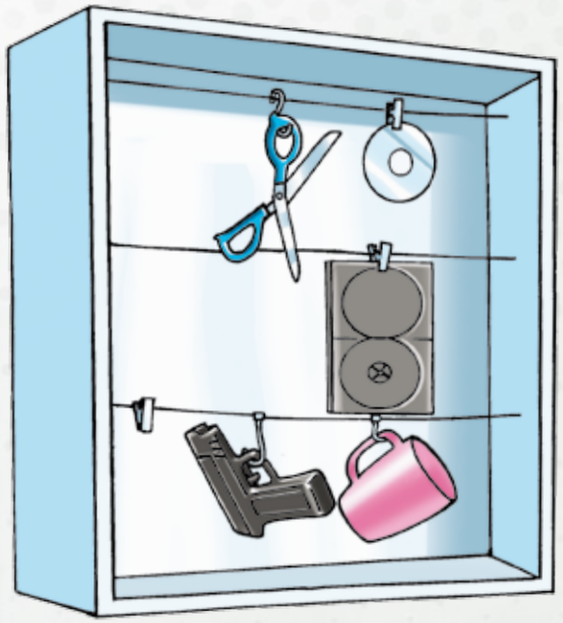
Fingerprint Powders

Dusting of prints is a physical method that relies on the fingerprint powder adhering to the residue left behind by the fingerprint.

At a crime scene, each fingerprint brush can only be used once. Why?

Cyanoacrylate Fuming

Independently discovered in the late 1970s by researchers in Japan, the United Kingdom and Canada, this chemical method quickly gained popularity in crime laboratories as it is effective on almost all non-porous surfaces and is relatively inexpensive.



The item to be fumed is suspended in a chamber and exposed to vapours or fumes from the heated cyanoacrylate esters. These vapours form a white residue with the latent print, rendering it visible.

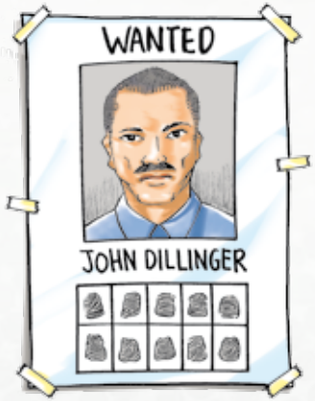
Did You Know?

In Japan, the discovery that cyanoacrylate fuming could be used to detect latent fingerprints was made by a latent print examiner, Masato Soba. He learned from his colleague Fuseo Matsumura, a hair and fibre expert, that his own fingerprints were being developed on glass slides while he was mounting hairs with cyanoacrylate for microscopic examination.

Ninhydrin

In 1954, Swedish scientists Svante Odén and Bengt von Hofsten reported the use of ninhydrin to develop latent fingerprints. They had previously observed that amino acids reacted with ninhydrin to produce a purple colouration. They figured that since the sweat in fingerprint residue contained amino acids, perhaps ninhydrin could react chemically with the latent fingerprint to form a visible purple-coloured print. Their hypothesis worked and now this chemical enhancement method is widely used to develop latent fingerprints on porous materials such as paper.

True Crime



John Dillinger (1903–1934) was a criminal responsible for many daring bank robberies, shootouts and prison breaks in Depression-era United States. Having been declared a “public enemy” by the FBI, his name, face and fingerprints were printed on “Wanted” posters throughout the country. To avoid capture, he turned to plastic surgery and even tried to erase his fingerprints with acid! Did it work? Alas, faint ridge markings on his fingertips were still visible after the burns had healed. In fact, the scarring introduced on the fingers makes identifying the criminal an even quicker and simpler process!

Did You Know?

Humans are not the only ones who have fingerprints. Some animals have them too! Gorillas, chimpanzees, as well as koalas have friction ridges on their hands and feet. The friction ridges allow them to grasp and grab objects – in the same way humans do.

Analysis and Comparison of Fingerprints

After the fingerprints found at a crime scene have been documented and preserved, it's time for analysis and comparison. In the past, fingerprint examiners were required to manually classify and file collected prints. Any new prints recovered from the crime scene would have to be searched against these records, which was definitely no mean feat! It was labour-intensive, time-consuming and stretched examiners to the limit.

As the number of records grew, an automated computerised approach was required to speed up the comparison process. This led to the birth of AFIS – the Automated Fingerprint Identification System.

AFIS has dramatically reduced the time required for the comparison of fingerprints. The automated system provides a list of possible

matches based on algorithm inputs. A qualified fingerprint examiner then manually verifies if any of the preliminary matches identified by AFIS is an actual match. Although AFIS is unable to make the final judgement call on a match, this limitation pales in comparison to the significant operational improvements that AFIS brings to fingerprint analysis.

Did You Know?

The Automated Fingerprint Identification System (AFIS) began as a project in the 1960s and developed into a full-fledged system used by law enforcement agencies throughout the world. AFIS obtains prints by scanning them from a fingerprint card or from a photograph. It is also able to acquire scans directly from the finger, just like what happens when you go through an immigration counter! Besides image acquisition, AFIS also uses algorithms to process, enhance and match any incoming prints against its database.

From the Vaults – Crimes from Singapore's Past

Oriental Hotel Murder

6 June 1994. Abdul Nasir Amer Hamsah and Abdul Rahman Arshad had arrived at the Oriental Hotel, Singapore, to apply for jobs. After their interviews, they spotted a group of Japanese tourists about to check in and decided on the spur of the moment to rob them.

Fujii Isae and Takishita Miyoko were members of a Japanese tour group on a company-sponsored tour to Singapore. Having checked in, the two women took the lift to their room on the ninth floor. Unbeknownst to them, the two men had trailed them to their room and were waiting for an opportunity to pounce.

With their room door open and unsure what to do with the room key card, Fujii approached the two men for assistance. The men made use of this moment to push their way into the room and assaulted the two Japanese, robbing them of their personal belongings and cash.

Pretending to have fainted, Takishita was able to escape severe injuries. After the robbers left, she alerted the hotel porter, who duly informed the hotel duty manager. The police were alerted and an ambulance was called for Fujii. Unfortunately, Fujii's injuries were too severe and she was pronounced dead on the same day.

An island-wide search for Abdul Nasir and Abdul Rahman was launched by the police. However, the perpetrators were not caught until close to a year and a half later when Abdul Nasir was arrested in a separate robbery attempt. His fingerprints were found to match the fingerprints lifted at the scene of the Oriental Hotel murder.

Abdul Rahman was also subsequently found, having already been imprisoned for other theft charges.

In January 1996, both men were charged for the murder of Fujii. Abdul Rahman was sentenced to 10 years' prison with 16 strokes of the cane while Abdul Nasir was sentenced to 18 years' prison with 18 strokes of the cane.

Level Up! -- Collect Your Fingerprints

Find an ink pad and press your right thumb onto the inking surface. Lightly press your ink-coated thumb over the printing card below, and there you have it, your first print! Now do the rest of your fingers!

Name:
Collected on:

Right thumb	Right index	Right middle	Right ring	Right little

Left thumb	Left index	Left middle	Left ring	Left little

Now that you have obtained all your prints, identify the fingerprint pattern on each of them. How many of your fingerprints are loops, whorls or arches?

Shoeprints

Like fingerprints, shoeprints may be left behind at a crime scene. Bloody fingerprints, shoeprints and footprints are often found at violent crime scenes involving bloodshed. The recovery and analysis of shoeprints can provide important clues to the identity of its wearer.

Recovery and Preservation

Shoeprints
When shoeprints are encountered at the crime scene, they are photographed together with a ruler. For dust prints, electrostatic lifting can be used to collect the shoeprint onto a lifting film.

Shoe Impressions
For three-dimensional shoe impressions in soil, casting is used to preserve the impression for further analysis. This is carried out by setting up a boundary wall around the impression, followed by pouring the casting material and waiting for it to dry and harden.

Shoeprint Analysis

Shoes are mass-manufactured products. Therefore, there can be many pairs of shoes of a particular size and design. How then can we determine if a shoeprint was made by a suspect's shoe?

First, class characteristics such as size, sole patterns and brand logo, if any, must match. Next, forensic scientists will look at characteristics that are unique to the shoe. These unique characteristics may have resulted from wear and tear due to usage, or damage such as cuts or cracks in the sole of the shoe.

Level Up! – Where Did They Come From?

Can you match the shoeprints left at the crime scene to their respective shoes?

Shoe A

Shoe B

Shoe C

Print A

Print B

Print C

Answers:
Print A – Made by Shoe C
Print B – Made by Shoe A
Print C – Made by Shoe B

Would you be able to link a shoeprint to a specific shoe if all the suspects' shoes were similar in size and design?

From the Vaults – Crimes from Singapore's Past

A Robbery Gone Wrong

24 December 2005. Kamal, Malik and Hamir had been drinking alcohol for several hours in Kamal's room in Geylang Road when the three of them, together with another man, Benedict, decided to leave the room and walk towards Kallang. Along the way, they hatched a plan to rob someone as they were broke.

They spotted a man walking alone along Sims Way and decided to make him their target. The four of them followed Thein Naing, a Myanmar national, to a footpath near Block 19 Upper Boon Keng Road, where they brutally attacked and robbed him. Thein Naing was kicked and punched by Kamal, Malik and Hamir, while Benedict kept a look-out a short distance away. Thein Naing retaliated with a knife he was carrying but that same knife, instead of assisting in his escape, was used against him, resulting in a stab wound to his chest.

The immediate cause of death, however, was a severe head injury Thein Naing suffered as a result of the attacks. In his autopsy report, the forensic pathologist reported a bruise on the deceased's left forehead which resembled a shoe impression. Comparisons made by the forensic scientist using the photographed shoe imprints and the shoes seized from the assailants indicated that the imprint left on the deceased's forehead was similar to the outsole pattern of Kamal's track shoes.

Kamal, Malik and Hamir were given the death penalty for causing the death of Thein Naing.