Fingerprints & Print Analysis

Humans have known about the unique characteristics of fingerprints for thousands of years. Babylonians left fingerprint impressions in soft clay to prevent forgeries. The ancient Chinese and Japanese used fingerprints as their signatures. Canadian Aboriginal Peoples possess artifacts which depict fingerprint patterns.

Even though there are more than 7 billion alive on our planet today, no two people have the exact same fingerprints. Even identical twins do not have the same fingerprints! Our fingerprints begin to develop when we are an 11 week old fetus. The ridges on our fingerprints remain unchanging throughout our lives. In the 1930's, criminals like bank robber John Dillinger famously tried to remove their fingerprints using acid, but the ridges grew back, and in combination with the acid scars, actually made their prints even easier to identify! Other criminals have tried other tactics to remove their prints (one guy in police custody tried to chew off his fingerprints!), but to no avail. Nothing worked, and the prints always grew back.

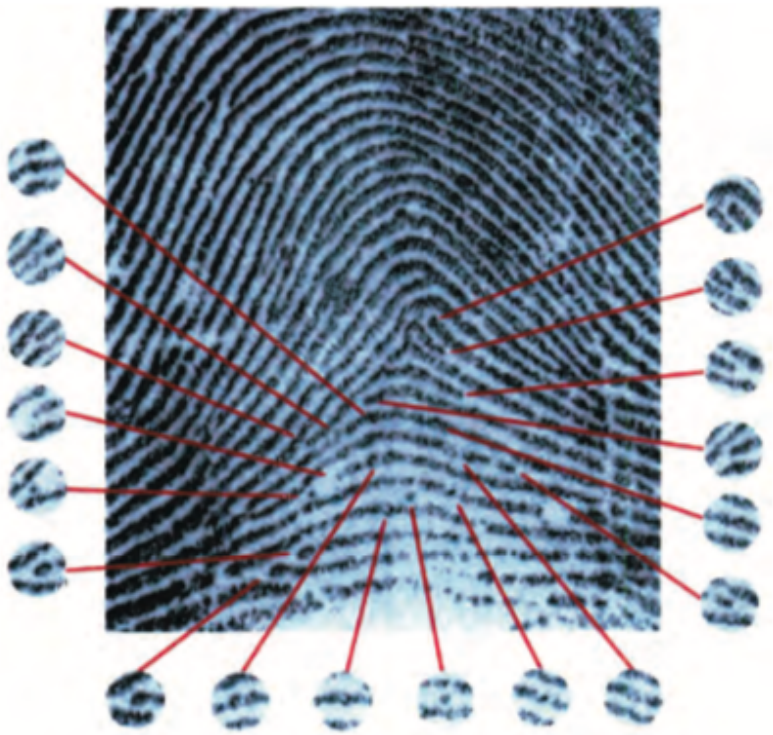
The first time fingerprints were used as proof of guilt in the US was in 1910. September 19th, Mary Hiller was awakened in the middle of the night by a noise coming from another room. She woke up her husband Clarence, who went to investigate. He found an intruder, and after a struggle, the intruder shot and killed him. As he was running away, he touched the wet paint on their railing, leaving behind 4 fingerprints. A man named Thomas Jennings was arrested by police a short time later, and his fingerprints matched those found in the wet paint at the crime scene. That fingerprint evidence was used to convict him of murder.

The Calgary Police Service Identification Section began taking fingerprints of people charged or convicted of a serious offence, in 1913. The fingers are inked and then the finger is rolled onto a fingerprint card. Rolling the print gives it a square appearance and makes it easier to read. If you look at the ends of your fingers with a magnifying glass, you can see the ridges that make your fingerprints. These ridges are called friction skin and allow us to hold onto smooth objects.

When the ridge pattern found on the fingertips is transferred onto another object, it creates a fingerprint. No two fingerprints are alike, not even those of identical twins. If you look closely, you will see that even your own fingerprints are different, though some of them may look similar. Fingerprints that look similar are said to have the same pattern. There are ten pattern types used in fingerprint classification, though the possible variations are endless.

Fingerprints have been studied for hundreds of years and have long been recognized as a possible means of identification. Scientists eventually proved that fingerprints were unique to a person and did not alter over time. Thus a set of fingerprints is a permanent record of a person's identity. Fingerprints were rarely used by police departments until a practical method of classifying them was established by Sir Edward Henry in 1900.

Before fingerprints were successfully classified, a fingerprint technician had to compare every set of prints available to the new set just received. Even in 1913 this would have involved comparing thousands of print cards. Today it would be an impossible task. The Henry Classification System is still taught to police recruits today, though the search for a possible matching set of prints is done by computer. The final comparison is still done manually by a fingerprint expert.



Method of FBI fingerprint analysis

Fingerprinting is still the most common method used by the police to positively identify a person. Before a person can begin classifying fingerprints, they should first be able to recognize the five basic patterns. Some of the rules for determining the print pattern are complicated and it takes a great deal of practice before a person can correctly

identify every pattern.

FINGERPRINT EVIDENCE

Scientists classify fingerprint evidence as belonging to one of three types: patent, plastic, and latent.

Fingerprints are sometimes visible, such as when a person gets a substance (such as blood, ink, or something like pudding) on their fingertips and then they touch a surface. These types of visible fingerprints are known as ***patent*** fingerprints.

If the fingerprints make a 3-D impression in a soft material, such as clay or wet paint, they are known as ***plastic*** fingerprints. A great way to do this is to push your finger into a glob of silly putty or slime.

Latent fingerprints are those that are not readily visible to the naked eye. The word latent means *hidden*. These fingerprints are left behind every time you touch an object!

Latent Prints and Dusting

Fingers sweat continuously and it is for this reason that they leave their mark on anything that is touched. Fingerprints left on objects are called latent prints. Something is called *latent if it is invisible but has the potential to become visible*. When detectives search a crime scene for evidence they look for smooth flat surfaces near the place of entry and exit and for objects that appear to have been handled by the perpetrator. (The perpetrator is the person who actually committed the crime. An accused is someone charged with committing the crime but not yet proven guilty in court). Fingerprints on smooth surfaces like glass and metal can sometimes be seen with the naked eye. Fingerprints on plastic, paper, and wood are not so easily seen.

Identification detectives use various methods to enhance latent fingerprints so they can be seen. Different coloured powders can be gently brushed over the fingerprint ridges. If the fingerprint is found on a dark background, then a white or grey powder is used. This procedure is called dusting for prints. The powder makes the fingerprint visible and then the print can be photographed. Fingerprints on plastic, tin foil and paper are treated with special chemicals that

react with sweat and oil and cause the ridges to turn a different colour from the background. The fumes given off by Super Glue, for example, are used to develop fingerprints on a porous or uneven surface. Scientists are continually adopting new methods and chemicals that will allow them to develop fingerprints on just about anything, including cloth and skin.

When a fingerprint is found, the location of the print is photographed and then a close-up is taken. Detectives must first prove that the print was actually found at the scene of the crime. They must then show whom the fingerprint belongs to. If the resultant photograph is clear enough, it can be magnified with a photographic enlarger so that comparison with a suspect print is easier.

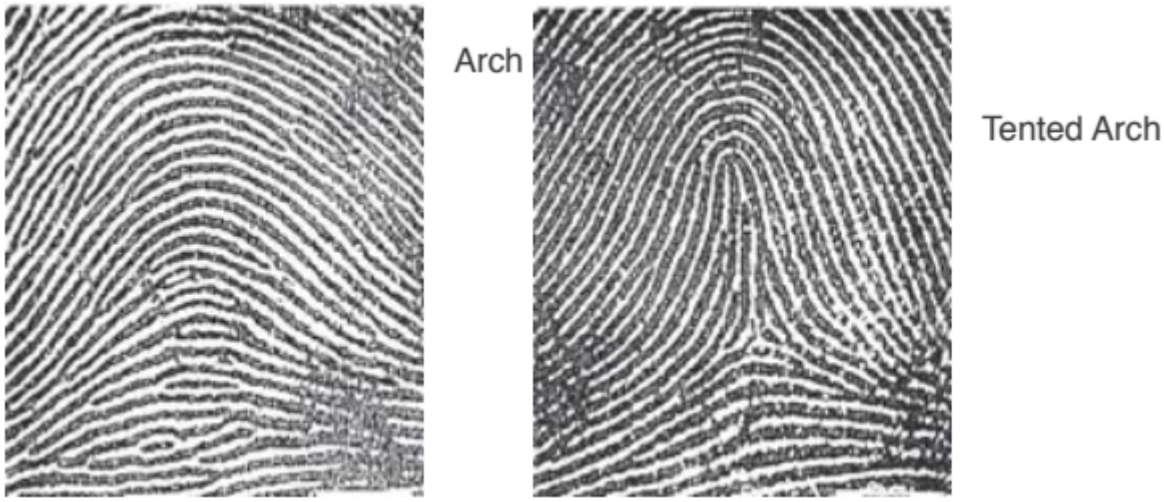
If a good photograph cannot be made of the fingerprint or if the print is on an immovable object, the latent print may be lifted from the object. Early lifters were made of white or black rubber and had an adhesive surface. The sticky side is carefully placed over the print and then lifted off. A transparent cover protects the print. Lifting removes the print from the object and forces the detective to prove that the fingerprint was actually on the object in the first place. Also, using a lifter may smudge the fingerprint, rendering it useless. It is always preferable to leave the print on the object and obtain a photograph.

Elimination prints are taken of family members, shopkeepers and anyone else who may have had legitimate access to the crime scene. These prints are compared to the latent found at the scene. Any latents that do not match an elimination print are assumed to be those of the suspect.

In 1932, the Calgary Police Service made their first conviction based on fingerprint evidence. Latent fingerprints at this time were useful if the police had suspects. Latents could prove a suspect’s guilt or could prove that a suspect was innocent. If there were no suspects, however, it was almost impossible to match a latent print when a single technician had to search through thousands of fingerprint cards. Matching a latent print could still take days. Today, a computer does the search in minutes.

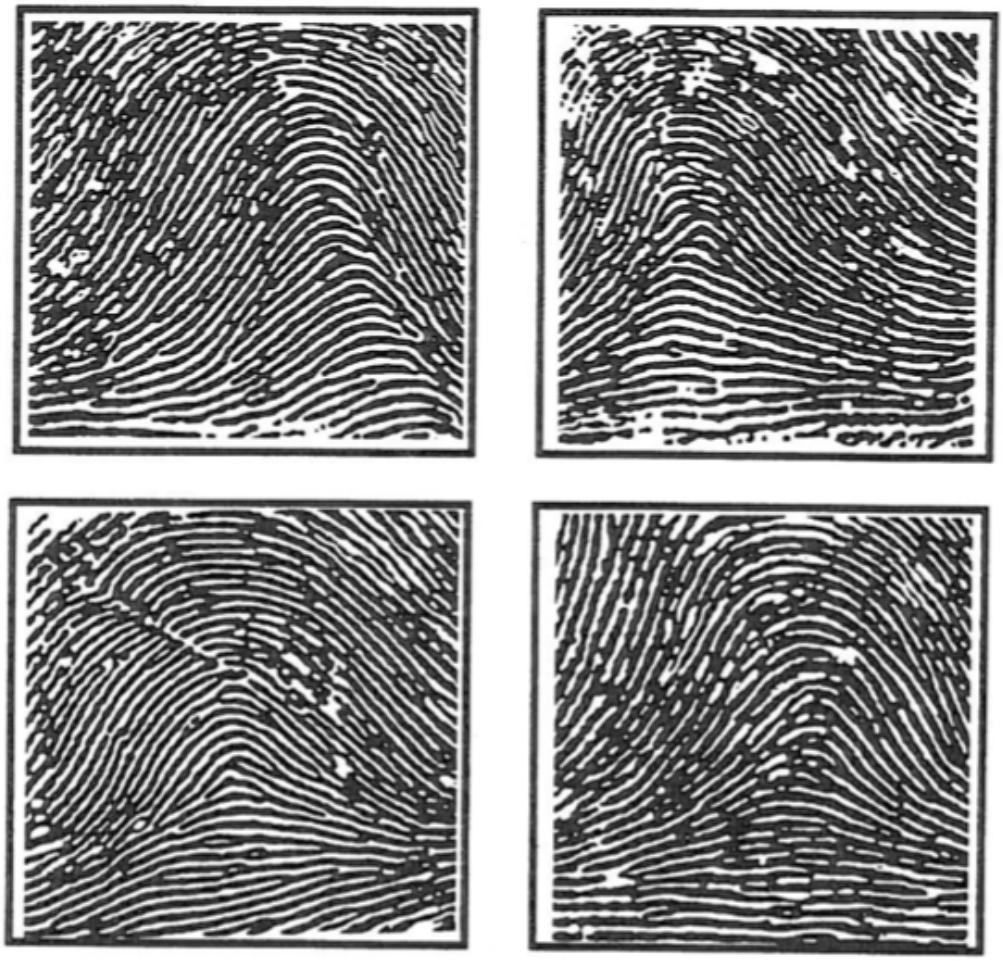
FINGERPRINT CLASSIFICATION

The **ARCH** pattern is characterized by a general upward curving trend starting from one side of the page, followed by a downward slope that ends on the other side of the page. All of the ridges in an arch pattern follow the same course though some of the ridges may end before reaching the opposite side. An imaginary line traced from one of the ridge endings should follow the same path as the complete ridges.



The **TENTED ARCH** differs from the arch because some of the ridges do not follow the general arch pattern. Instead, some of the ridges abruptly thrust upwards forming a tent. An imaginary line traced from one of these ridges will not follow the general arch pattern. If you look closely at the tented arch, you can see that a triangular pattern forms where the ridges thrust upwards. This area is called the **delta**. All fingerprints except for the arch have at least one delta. The point of delta forms when the two innermost parallel ridges suddenly diverge to form the overall pattern. The first ridge or ridge particle directly in front of the divergence is the point of delta. The point of delta also occurs where a single ridge separates to form the overall pattern, when this ridge lies between the two innermost ridges that run parallel and then diverge. The point of delta in the tented arch always forms part of the up thrust. Approximately 6% of people exhibit this pattern.

Arch - The arch pattern of finger print is like a wave or a hill. The ridges enter on one side of the print, rise in the middle and exit on the opposite side of the print. The arch print has no delta.



There are two kinds of loops, the **RADIAL LOOP** and the **ULNAR LOOP**.

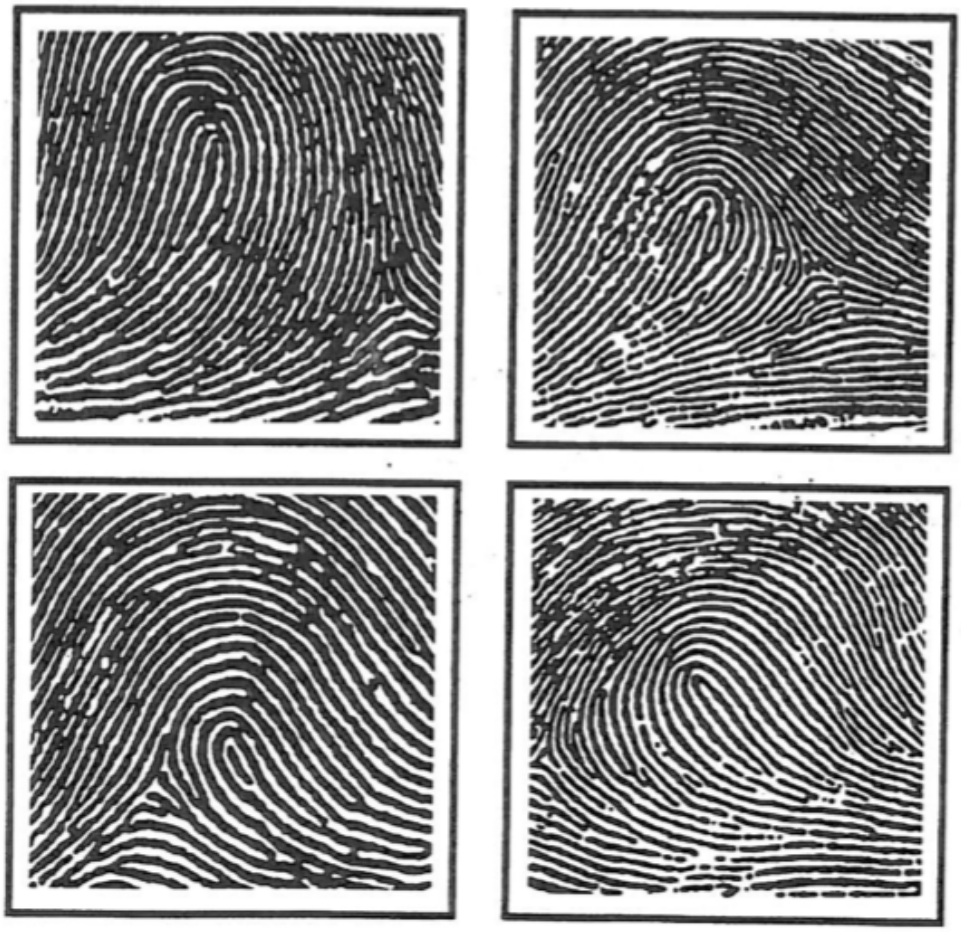
Radial Loop

Ulnar Loop

Loops are termed as such because at least one of the ridges recurves or loops back in the direction from which it came. This means that the general pattern of the loop starts on one side of the page (or finger) and ends on the same side. The difference between a radial and an ulnar loop is not determined by how the pattern looks on the fingerprint card so much as how it looks on the finger itself. Radial loops curve back towards the radius bone in the arm, which joins the hand on the same side as the thumb. Ulnar loops curve back towards the ulna bone in the arm, which joins the hand on the same side as the little finger. The ulna bone is the protruding bone on the outside of the wrist.

Simple loops have one separate point of delta. This means that the delta does not form a part of the loop itself, as the delta in the tented arch forms a part of the tent. Approximately 60% of people exhibit this pattern.

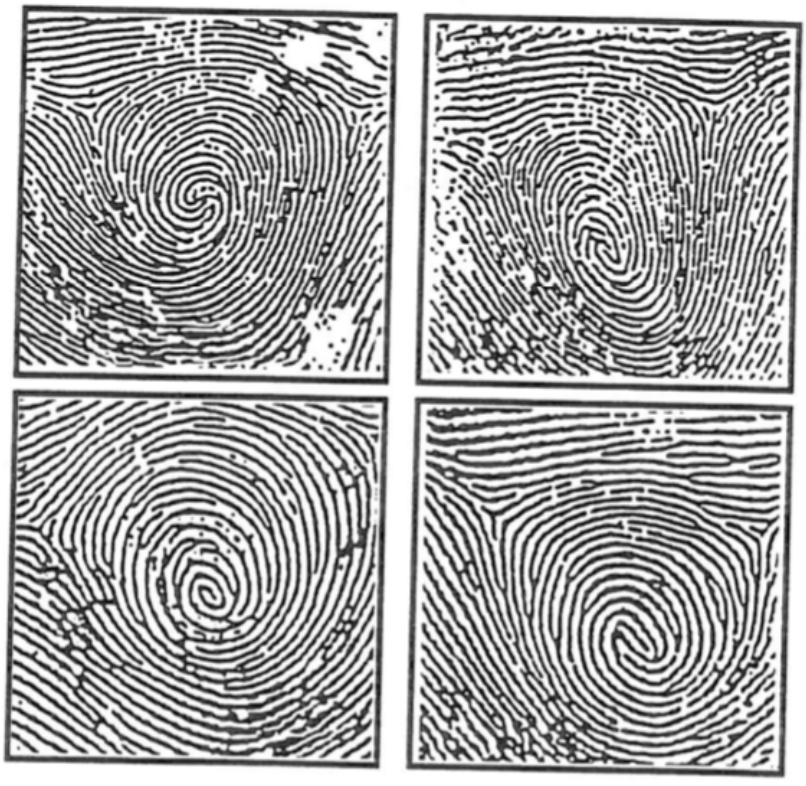
Loop - The loop is the most common fingerprint type. The loop looks like a loop. The ridges enter one side of the print, go up to form a loop, then the ridges exit the same side of the print that they entered. It has one delta.



The **WHORL** pattern has two points of delta, generally obvious at a glance. The whorl is made up of one or more recurving ridges that 'whorl' or revolve around a central axis. A line drawn between one point of delta to the other will cross or bisect one or more of the whirling ridges. Approximately 34% of people exhibit this pattern.

WHORL

Whorl - The whorl is like a spiral. The pattern circles around like a whirl pool. It has two deltas.



A **COMPOSITE** print is composed of two or more separate patterns. A composite may look like a twinned loop but if a line is drawn from one point of delta to the top or cap of its pattern it will not cross any of the ridges that form the other pattern; it will only cross ridges forming its own pattern. The cap of a pattern is also the point of recurve. If an arch appears to be present as part of the pattern this does not make it a composite since there will be an arch-like quality to all patterns. Composites will have two or three deltas.

Composite - The composite pattern is a combination of patterns such as a whorl and arch, a loop and an arch, or a whorl and a loop.

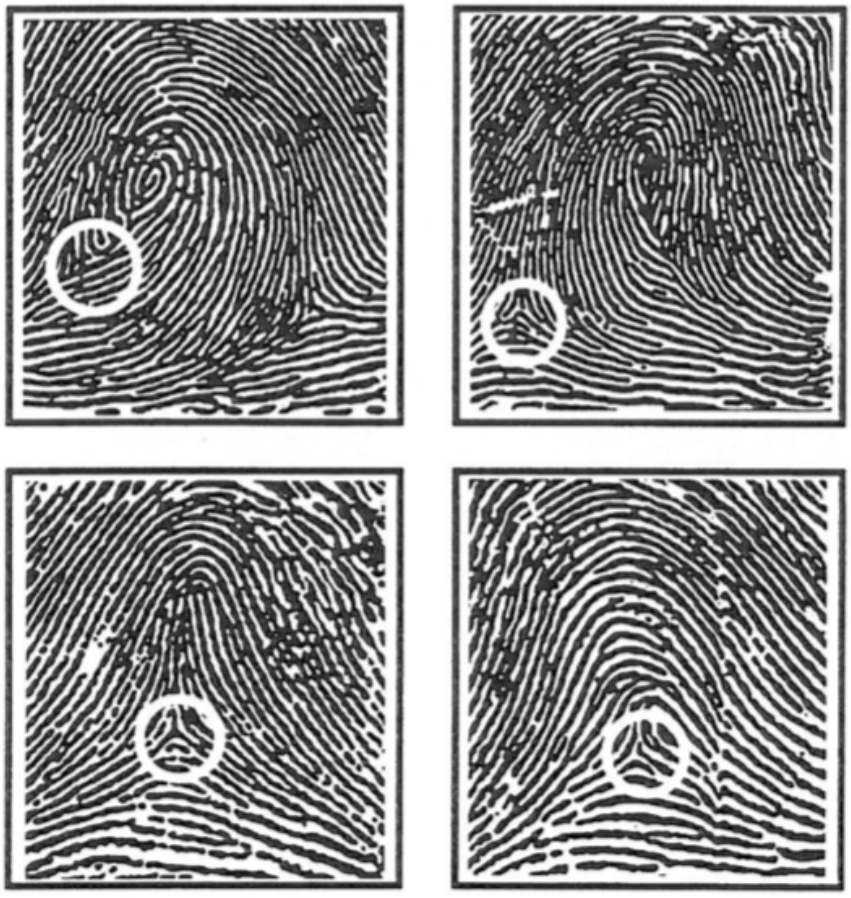
The rarest pattern of all is the **ACCIDENTAL**. The accidental generally has a small pattern area. The accidental also contains two patterns, but these patterns combine together rather than remain separate. The pattern area possesses the combined characteristics of two patterns. Again, the arch is not considered in the pattern combination. An accidental will have two points of delta.

Practice - Identifying Fingerprint Types

Ridge Characteristics

The black impressions caused by the inked fingerprint are called ridges. Ridge characteristics are what make the fingerprint unique. If you look at any fingerprint you will notice that some of the ridges form small islands, some form small lakes and some split into two ridges. These characteristics, along with the points where ridges end, will be used to compare one arch with another. Since ridge characteristics never appear in the same sequence on two different fingerprints, only one person in the world will have this arch pattern on their finger.

Deltas - help us to classify the finger prints. A delta is a triangular pattern on the finger print as shown in the picture below.



When the police identify fingerprints, the first thing they do is look at the pattern of the print i.e., loop, whorl, arch or composite. Once they have a matching pattern type, they look for unique features of a print to help them match a suspect to the fingerprints found at the scene of a crime. In order for the print to be considered "a match" they must have a number of ridge characteristics in common. The following are four ridge characteristics they look for in a finger print:

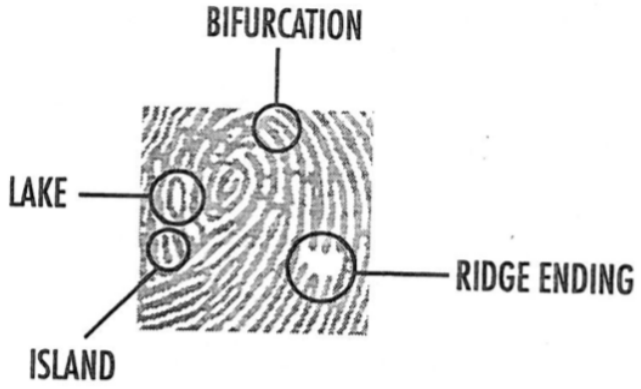
Bifurcation (fork) - One ridge splits to form two ridges and then rejoin to one ridge again, forming a shape like a lake.

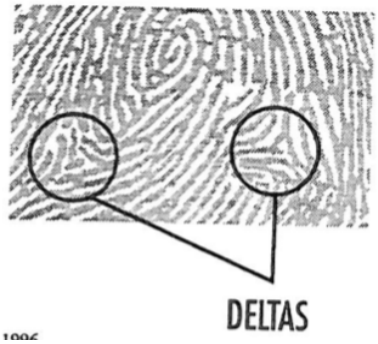
Ridge Endings - A ridge ends.

Island - A very short ridge in the print pattern is not connected to any other ridge, much like an island floating by itself.

Lake - A ridge in the shape of a circle/oval.

Teachers may wish to stress that when matching fingerprints using ridge characteristics, students are making "observations". When a fingerprint has a large number of ridge characteristics in common, we "infer" the person is a suspect.





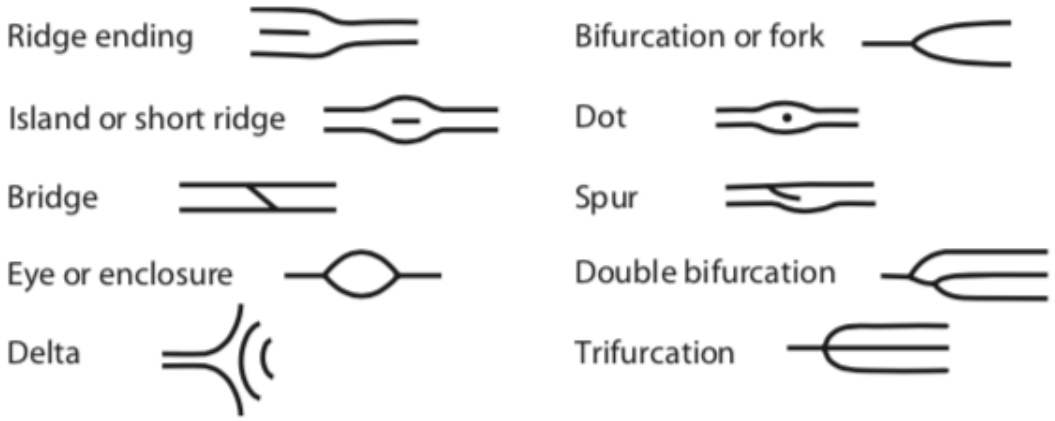
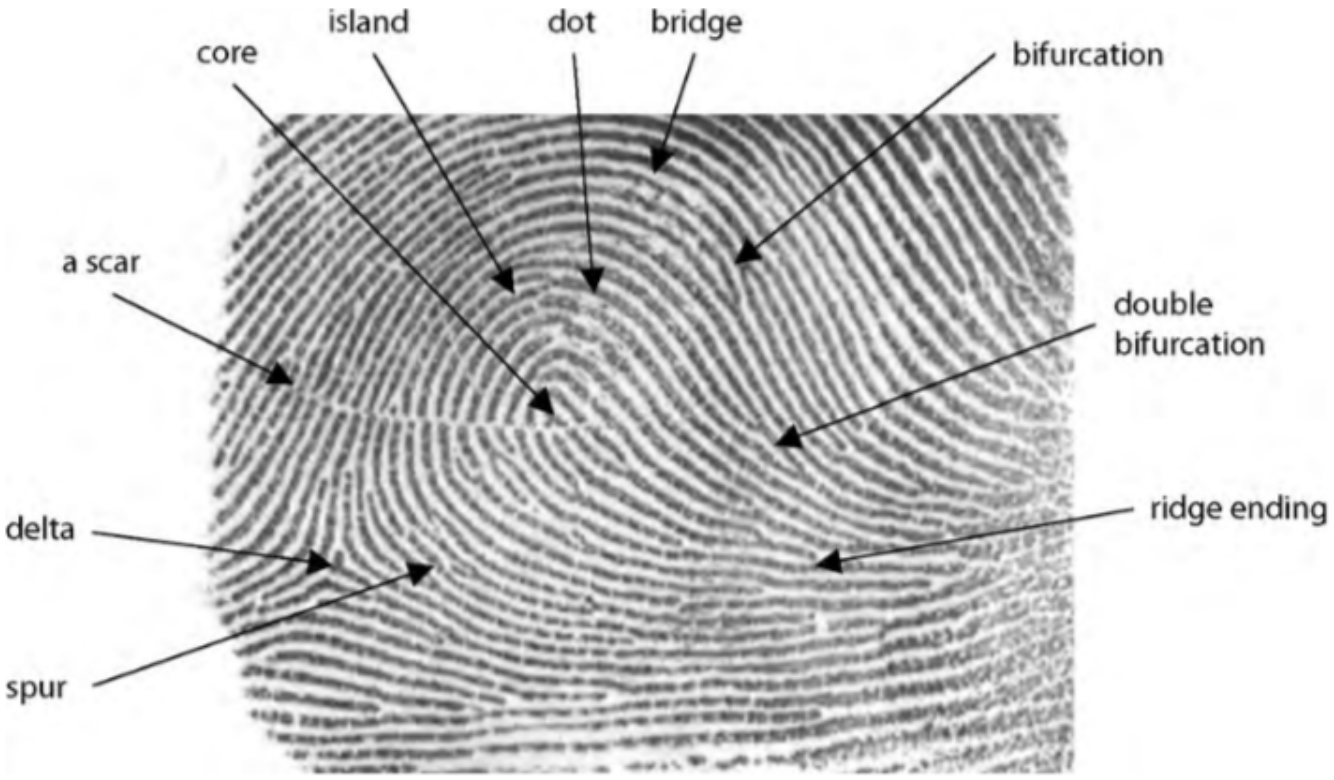
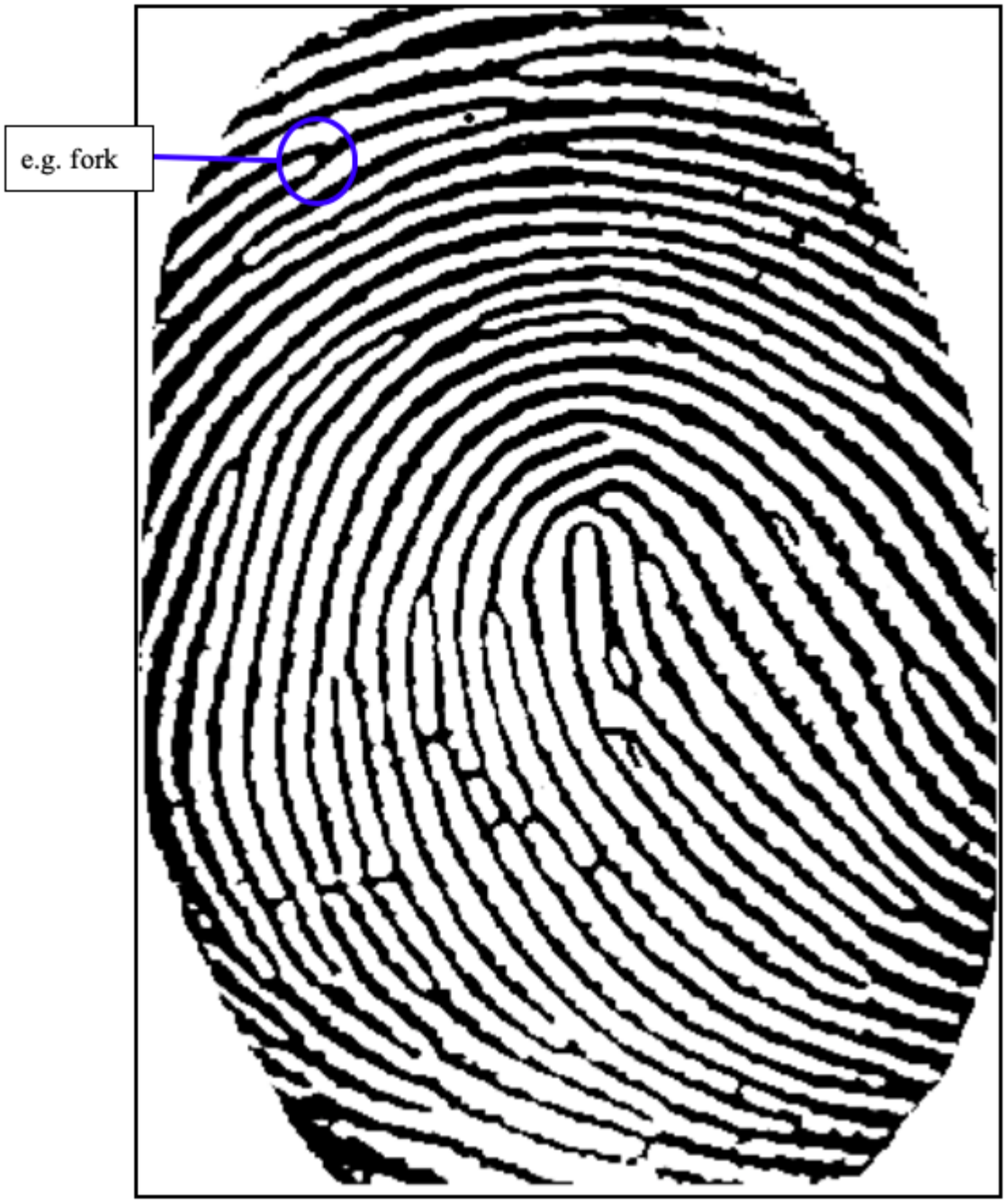


Figure 4.7 Individual ridge characteristics



Identify the 15 points in Figure 4.9 on the handout from your teacher. What type of print is this?

Look at the image below. Like in the example, circle and label AT LEAST 2 of each of the fingerprint characteristics.



What kind of a fingerprint is this?

TASK: That's A Print

During her investigation of a robbery at the Duke mansion, Detective Mary Sams fingerprinted all of the servants employed there.

			
Print 1	**Print 2**	**Print 3**	**Print 4**

1. Match each employee with their fingerprint:
    a. John (the butler) - an ARCH print:
    b. Sarah (the nanny) - a LOOP print:
    c. Alice (the cook) - a COMPOSITE print:
    d. Jane (the maid) - a WHORL print:

2. What characteristics are common to each type of fingerprint?
    a. Arch:
    b. Loop:
    c. Whorl:
    d. Composite:

Detective Sams was able to take clear fingerprints from many surfaces in the mansion.

3. Describe (in your own words) the method that she would likely use to get prints from surfaces:

Some surfaces yielded clear fingerprints, while others did not.

4. What types of surfaces would yield the clearest fingerprints? Why?

5. What types of surfaces would not yield clear prints? Why?

Detective Sams found that some places in the mansion had so many prints on top of one another that it was impossible to lift individual prints.

6. She inferred that the reason for the number of prints was:

7. Name 5 places in a home that might be covered with numerous fingerprints:
    a.
    b.
    c.
    d.
    e.

8. Look at the prints below. As an expert fingerprint analyst, would you feel confident in telling detectives that their suspect did or did not commit this crime? Why/why not?

<table>
<tr>
<td> 
Known left thumbprint from suspect</td>
<td> 
Known right thumbprint from suspect</td>
</tr>
<tr>
<td> 
Recovered print from burglary scene</td>
<td><u>The five steps in analysing and comparing fingerprints:</u>
Step 1: Identify the general type of the central area of the fingerprint.
Step 2: Match fingerprint ridgeline details.
Step 3: Compare the unknown print and the known print, point by point, feature by feature, to see if they match.
Step 4: Evaluate whether the unknown print matches the known print or not.
Step 5: A second examiner verifies the results.</td>
</tr>
</table>

9. Looking at close ups of each of the fingerprints below, circle the characteristics that you identified to help you come to that decision. You can resize the images to help you see them more clearly if you need to!

Report

Known left thumbprint from suspect

Known right thumbprint from suspect

Recovered print from

burglary scene

Final Practice - Can you match this latent print lifted from the crime scene to any of the suspects' prints below? First try to determine the main type, and then try to match the details. Label as many reference points as you can. Circle characteristics on both the crime scene print and the suspect prints.

Crime scene print

Suspect A

Suspect B

Suspect C

Suspect D

Suspect E

Suspect F

Suspect G

Suspect H

Sticky Fingers – Fingerprint Analysis Assessment

Three weeks ago a local bakery was robbed at gunpoint. The thief wore a mask, so even when the police found a suspect the bakery owner couldn't make a positive ID. However, as the CSI processing the scene, you collected several fingerprints from various parts of the bakery.

The police have identified a suspect, but he says he's never been to that bakery. It's your job to see if the suspect's fingerprints match any of those recovered at the scene of the crime.

1. Identify what type of fingerprints have been found:

From Cash Register #1	From Display Case	From Cash Register #2	From Door #1	From Door #2

Suspect Right Thumb	Suspect Right Index	Suspect Right Middle	Suspect Right Ring	Suspect Right Pinkie

Suspect Left Thumb	Suspect Left Index	Suspect Left Middle	Suspect Left Ring	Suspect Left Pinkie

2. Do any of the fingerprints left at the crime scene belong to the suspect? If so, which ones?

3. Do any of the fingerprints left at the scene of the crime NOT belong to the suspect? If so, who might they belong to?

4. Choose one of the prints found at the crime scene that matches a print left by the suspect. Analyze it carefully, and explain what characteristics you found in the prints to be sure that they matched. Use your highlighter to show the characteristics directly on the fingerprint, and label the characteristics that you've found.

5. Do you think this suspect committed the crime? Explain why or why not?

STICKY FINGERS

Evidence from Case #4589241-B

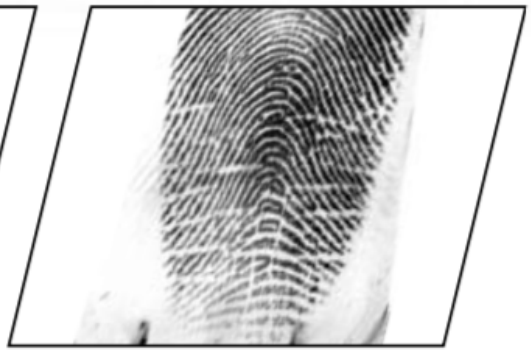
Fingerprints from Crime Scene

From Cash Register

From Display Case

From Cash Register

From Door



From Door

Suspect's Fingerprints

Right Hand

Thumb | Index | Middle | Ring | Pinkie

Left Hand

Thumb | Index | Middle | Ring | Pinkie

Video	Link
Fingerprint Patterns and Characteristics	https://www.youtube.com/watch?v=XDKzz4in7Xg
How Reliable is Fingerprint Analysis?	https://www.youtube.com/watch?v=fd8reN4uoBM
How to Lift Fingerprints - Dusting for Prints	https://www.youtube.com/watch?v=PibZmHVEz2c
How To Compare Fingerprints - The Basics	https://www.youtube.com/watch?v=IrpTqKkgygA
Further Watching Playlist	https://www.youtube.com/watch?v=fd8reN4uoBM&list=RDQM6hylpspMb-Y&start_radio=1