



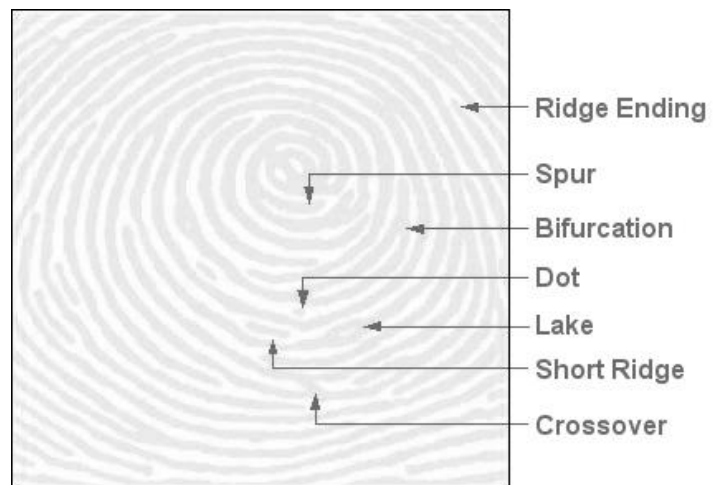
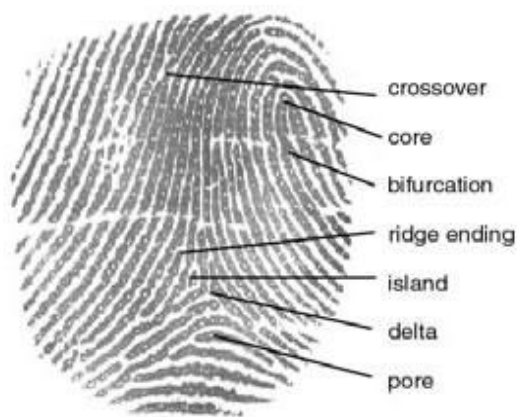
## Fingerprint Analysis - The Basics

### Friction Ridges

Every person has minute raised ridges of skin on the inside surfaces of their hands and fingers and on the bottom surfaces of their feet and toes, known as “**friction ridge skin**”. The friction ridges provide a gripping surface - in much the same way that the tread pattern of a car tire does. Friction ridge skin is also the only skin on the body without hairs.

Friction ridges do not run evenly and unbroken across our fingers, hands, toes and feet. Rather, they display a number of characteristics known as minutiae (Min-oo-sha). The principle categories of minutiae are as follows:

- ridge ending - a ridge that ends abruptly;
- bifurcation - a single ridge that divides into two ridges;
- lake or enclosure - a single ridge that bifurcates and reunites shortly afterwards to continue as a single ridge;
- short ridge, island or independent ridge - a ridge that commences, travels a short distance & then ends;
- dot - an independent ridge with approximately equal length and width;
- spur - a bifurcation with a short ridge branching off a longer ridge; and
- crossover or bridge - a short ridge that runs between two parallel ridges.



### The Principles of Fingerprint Identification

There are two fundamental principles underlying the use of fingerprints as a means of identifying individuals - immutability and uniqueness.

*Immutability.* More than a century of accumulated fingerprint study and experience has demonstrated that friction ridge patterns do not change naturally during the life of a person. The pattern of minutiae starts developing in the third month of pregnancy and is fully formed by the fourth month. During a person's lifetime, the pattern remains the same, apart from changing in size or by accident, mutilation or skin disease, until death. In fact, the friction ridge patterns will remain after death until the body decomposes.

*Uniqueness.* Friction ridge detail forms in a purely random manner during fetal development in the womb. There is sufficient variability in the arrangement of minutiae to ensure that no two friction ridge patterns are identical, whether they are on different fingers of the same person or on the fingers of different people. (The same principle covers all friction ridge skin.) While this principle is difficult to prove empirically, no two fingerprints have ever been found to be identical in over a century of the use of fingerprinting. And the number of people to have been fingerprinted worldwide is now in the hundreds of millions. Additionally, studies have demonstrated that while identical twins share the same DNA profile markers, they can nevertheless be differentiated by their fingerprints.

Friction ridges contain rows of sweat pores. Sweat mixed with other body oils and dirt produces fingerprints on smooth surfaces.

The individuality of any fingerprint is based not upon the general shape or pattern that it forms, but instead upon its ridge structure and specific characteristics (also known as minutiae). The recognition of these ridges, their relative number, and the approximate location of them, on the observed print, are the special characteristics that make the fingerprint a specific identifying characteristic of each individual. There are at least 150 individual ridge characteristics on the average fingerprint. If between 10 and 16 specific points of reference for any two corresponding fingerprints identically compare, a match is assumed. In a judicial proceeding, a point-by-point comparison must be graphically demonstrated for at least 12 different, but corresponding, points in order to prove the identity of a specific person.

### IDENTIFICATION OF PRINT CHARACTERISTICS

There are three specific classes for all Fingerprints based upon their general visual Pattern. These are: loops, whorls, and arches. Approximately 60% of the total population has loops, 35% have whorls, and 5% have arches. The three major groups are also subcategorized based upon smaller differences existing between the patterns within the specific group. These subcategories are as follows:

#### I. ARCH

- a) Plain arch
- b) Tented arch

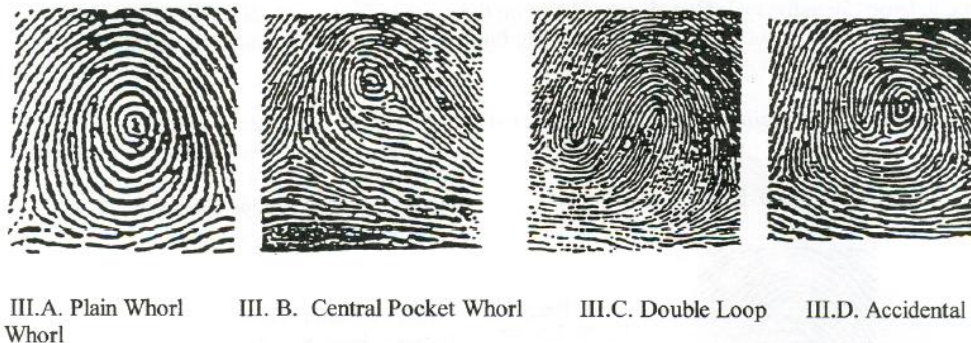
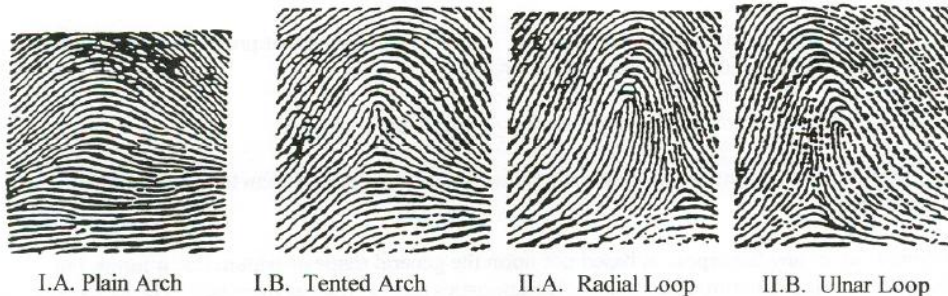
#### II. LOOP

- a) Radial loop
- b) Ulnar loop

#### III. WHORL

- a) Plain whorl
- b) Central pocket whorl
- c) Double loop
- d) Accidental whorl

Examples of each of these subcategories are illustrated as follows:



Of the two types of arches, the PLAIN ARCH is the simplest of all fingerprint patterns. It is formed by ridges entering from one side of the print and existing on the opposite side. These ridges tend to rise at the center of the pattern, forming a wavelike structure. The TENTED ARCH is similar, but instead of rising smoothly at the center, there is either a sharp up thrust or spike, or the ridges meet at an angle that is less than 90 degrees. Arches do not have type lines, deltas, or cores.

TYPE LINES are two diverging ridges usually coming into and splitting around an obstruction, such as a loop. A DELTA is the ridge point nearest the type line divergence. The CORE is the approximate center of the pattern.

A loop must have one or more ridges entering from one side of the print, re-curving, and exiting from the same side. If a loop opens toward the little finger, it is called an ULNAR LOOP; if it opens toward the thumb, it is a RADIAL LOOP. The patterned area of any loop is surrounded by two TYPE LINES. All loops must have one delta.

All whorl patterns must have type lines and a minimum of two deltas. A PLAIN WHORL and CENTRAL POCKET LOOP have at least one ridge that makes a complete circuit. This ridge may be in the form of a spiral, an oval, or any variant of a circular form. The main difference between these two patterns can be shown if an imaginary line is drawn between the two deltas contained within the two patterns. If the line touches any one of the spiral ridges the pattern is determined to be a plain whorl; if no ridge is touched, the pattern is a central pocket loop.

The DOUBLE LOOP is made up of any two loops combined into one fingerprint. Any print classified as ACCIDENTAL either contains two or more patterns (not including the plain arch) or the pattern is not covered by other categories i.e., a combination loop and a plain whorl or a loop and tented arch.

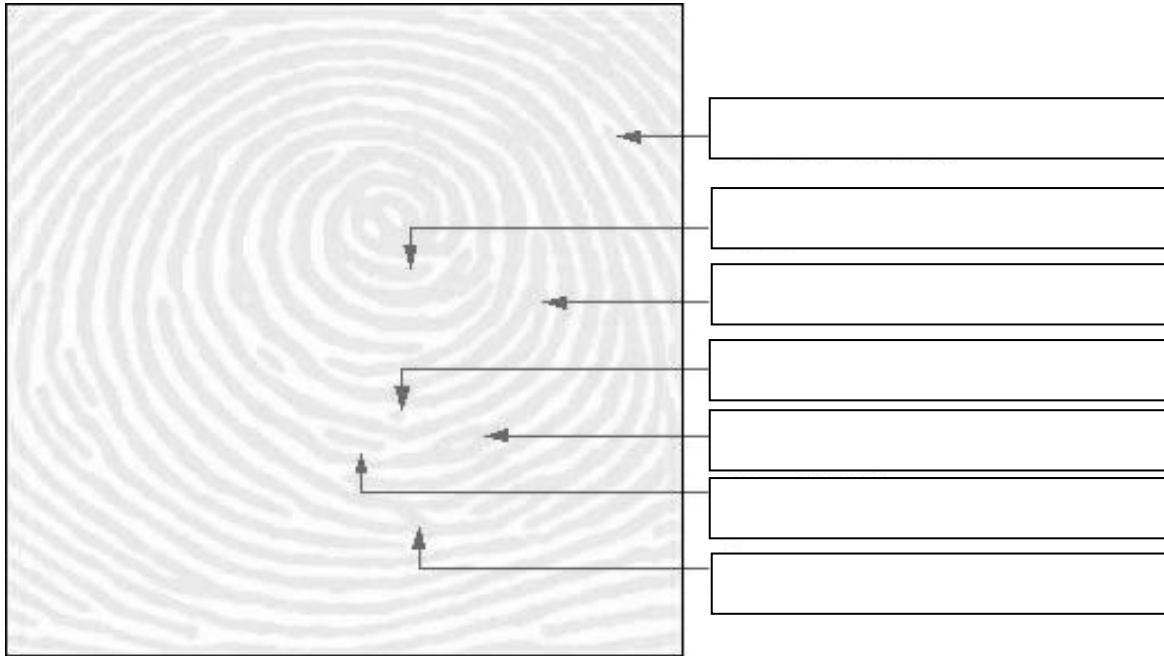
The term LATENT PRINT (hidden print) is a misnomer but often used inclusively. There are actually three kinds of CRIME-SCENE prints. These are:

1. VISIBLE PRINTS which are prints made by fingers touching a surface after the ridges have been in contact with a colored material such as blood, paint, grease, or ink.
2. PLASTIC PRINTS which are ridge impressions left on a soft material such as putty, wax, soap, or dust.
3. True LATENT PRINTS are invisible print impressions caused by the perspiration on the ridges of one's skin coming in contact with a surface and making an invisible impression on it. Perspiration contains water, salt, amino acids, or oils and easily allows impressions to be made.

### Lab: Fingerprint Analysis

**Directions:** Read the information about fingerprinting from the handout given to you and answer the questions below BEFORE making your fingerprints.

1. What is “friction ridge skin”?
2. Label the diagram below with the characteristics of a fingerprint.



3. Describe each of the following minutiae categories:
  - a. Ridge ending: \_\_\_\_\_
  - b. Spur: \_\_\_\_\_
  - c. Bifurcation: \_\_\_\_\_
  - d. Dot: \_\_\_\_\_
  - e. Lake: \_\_\_\_\_
  - f. Short ridge: \_\_\_\_\_
  - g. Crossover: \_\_\_\_\_
4. What is it about fingerprints that enable us to identify different individuals? Hint: describe the two fundamental principles of fingerprint identification.
5. What are the three major categories of fingerprints? What are the approximate percentages of the population fall under each of the categories?

**Directions:** Use the ink pad provided to make a fingerprint of each thumb and finger in the appropriate box. Analyze each print and provide the minutiae information of those prints. Cleanup: after creating a print for each finger, use alcohol to rub off the excess ink.

<b>Right Hand</b>				
Thumb	1 <sup>st</sup> Phalanx	2 <sup>nd</sup> Phalanx	3 <sup>rd</sup> Phalanx	4 <sup>th</sup> Phalanx
Classification:				
<b>Left Hand</b>				
Thumb	1 <sup>st</sup> Phalanx	2 <sup>nd</sup> Phalanx	3 <sup>rd</sup> Phalanx	4 <sup>th</sup> Phalanx
Classification:				

Examine 2 of the clearest print made from each hand. Label and count the minutiae in those two fingerprints. Use a hand lens to help you determine this.

Left/Right  
#\_\_\_ Phalynx

1. \_\_\_\_\_ridge ending
2. \_\_\_\_\_bifurcation
3. \_\_\_\_\_lake or enclosure
4. \_\_\_\_\_island
5. \_\_\_\_\_dot
6. \_\_\_\_\_spur
7. \_\_\_\_\_crossover or bridge

Left/Right  
#\_\_\_ Phalynx

1. \_\_\_\_\_ridge ending
2. \_\_\_\_\_bifurcation
3. \_\_\_\_\_lake or enclosure
4. \_\_\_\_\_island
5. \_\_\_\_\_dot
6. \_\_\_\_\_spur
7. \_\_\_\_\_crossover or bridge