

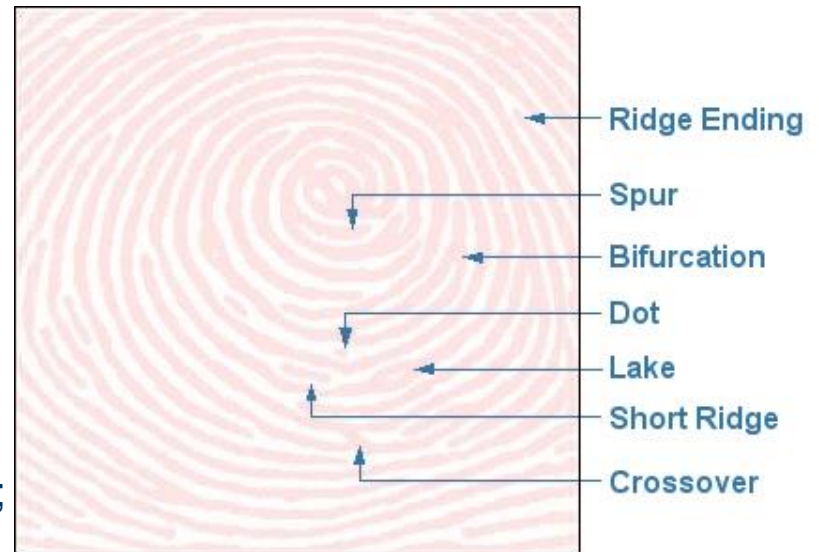


Fingerprint Minutiae Patterns

Name	Visual Appearance
1. Ending ridge (including broken ridge)	1.
2. Fork (or bifurcation)	2.
3. Island ridge (or short ridge)	3.
4. Dot (of very short ridge)	4.
5. Bridge	5.
6. Spur (or hook)	6.
7. Eye (enclosure or island)	7.
8. Double bifurcation	8.
9. Delta	9.
10. Trifurcation	10.

Friction Ridges

- 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 and 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.



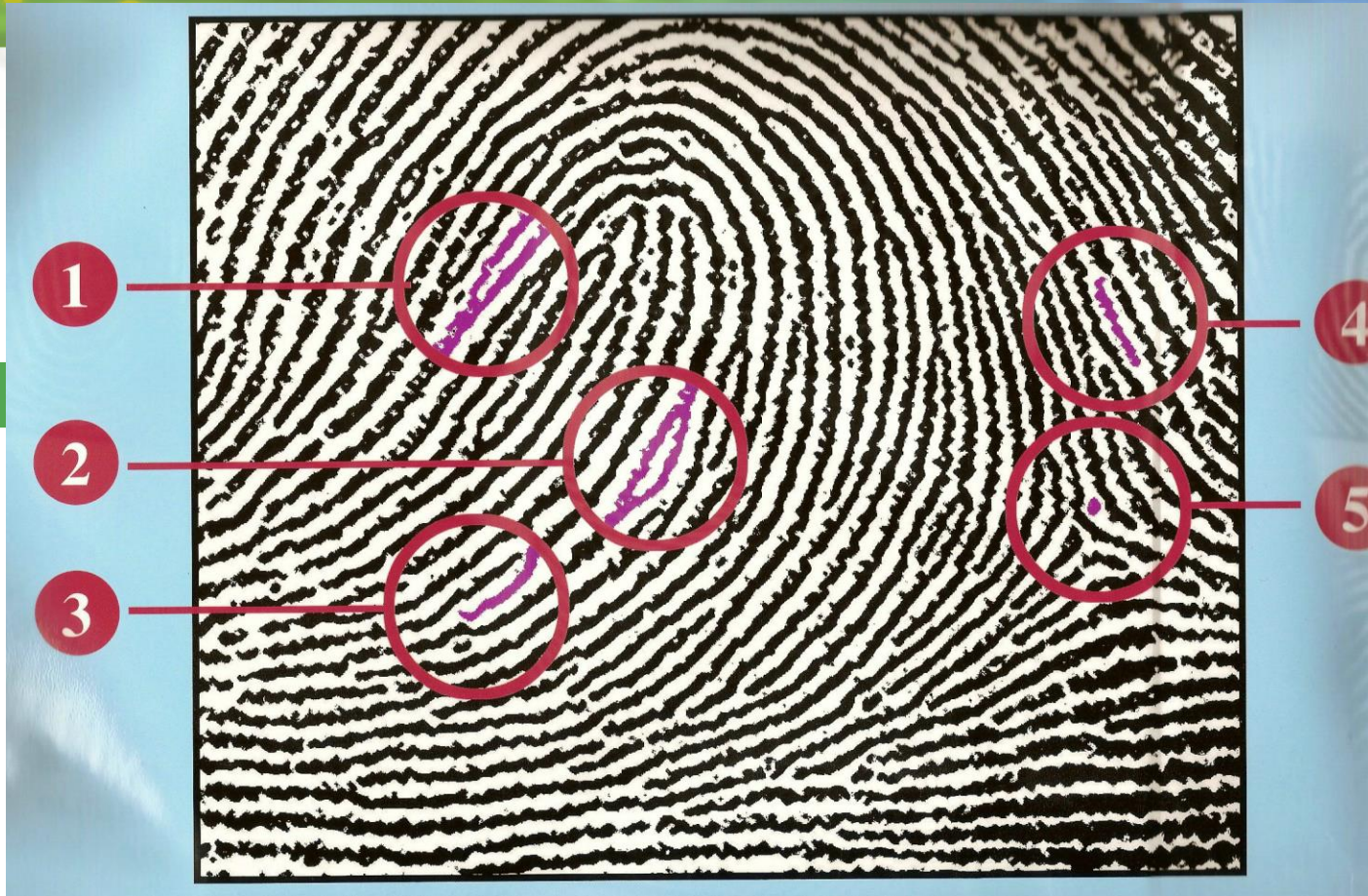
MINUTIAE

BIFURCATION



ENCLOSURE





1. Bifurcation: the point at which one friction ridge divides into two friction ridges.

2. Enclosure: a single friction ridge that bifurcates and rejoins after a short course and continues as a single friction ridge.



MINUTIAE

**RIDGE DOT or
EDGEMENT ISLAND**

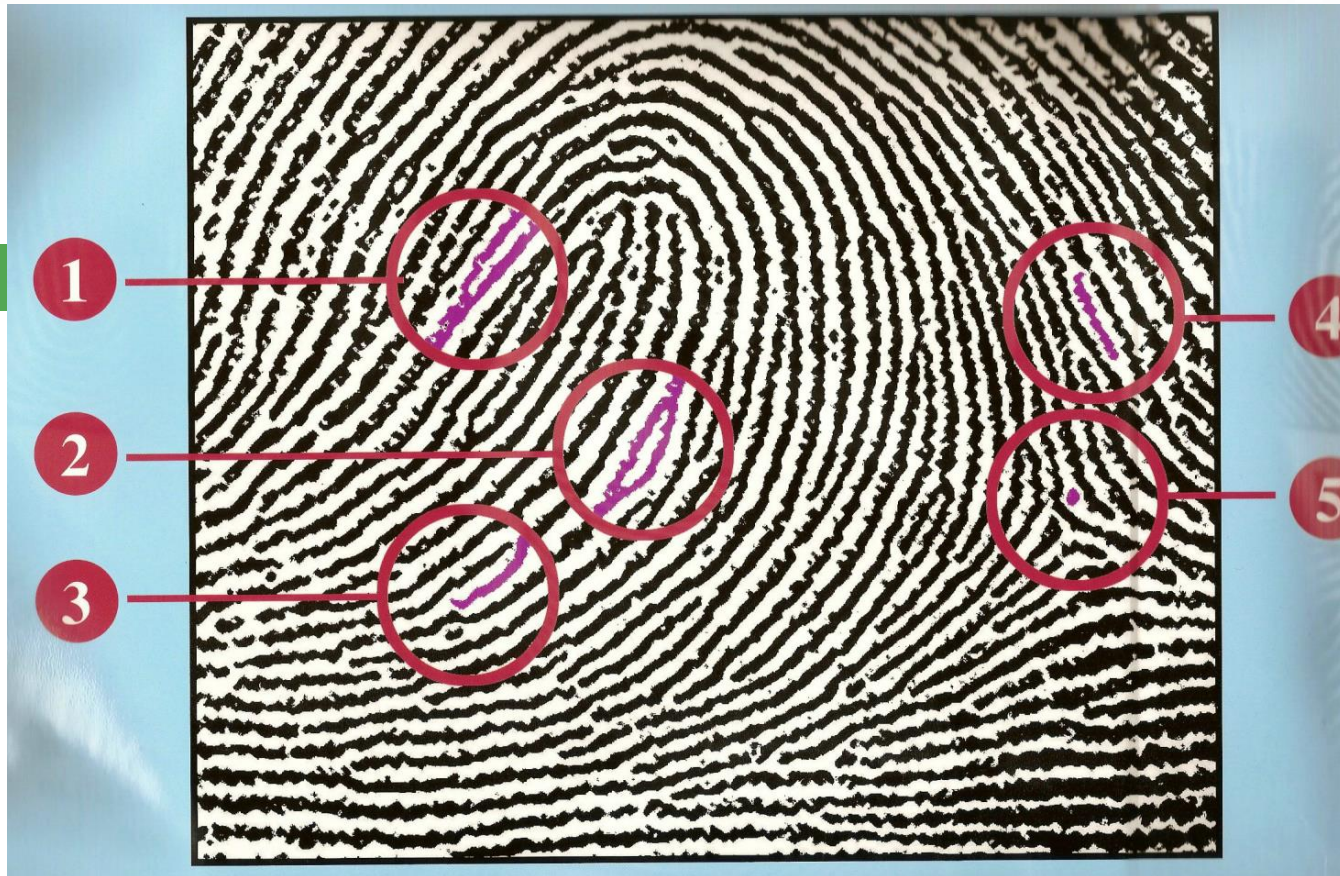


SHORT RIDGE



**RIDGE ENDING
Or Ending Ridge**





4. Short Ridge: A single friction ridge that only travels a short distance before terminating.

5. Ridge Dot: An isolated ridge unit whose length approximates its width in size.

3. Ending Ridge: A single friction ridge that terminates within the friction ridge structure.



Types of Fingerprints

There are 3 types of prints that investigators look for at crime scenes:

1. **Patent fingerprints**—visible prints transferred onto smooth surfaces by blood or other liquids
2. **Plastic fingerprints**—indentations left in soft materials such as clay or wax
3. **Latent fingerprints**—made visible by dusting with powders or the use of chemicals



IAFIS

- The FBI's Integrated Automated Fingerprint Identification System (IAFIS) is the largest biometric database of criminals in the world.
- Clear, legible fingerprints form the foundation of the Fingerprint Master File, which continues to grow by approximately 13,000 records each day.



IAFIS

Fingerprint Impression Types

Type 4

- Rolled impressions are the ten individually-taken fingerprint images rolled from nail to nail. The plain impressions are used to verify the sequence and accuracy of the rolled impressions.



IAFIS

Fingerprint Impression Types

Type 14

- Identification flat impressions are taken simultaneously without rolling. These are referred to as plain, slap, or flat impressions. The individual's right and left four fingers should be captured first, followed by the two thumbs (4-4-2 method). Instituting this finger capture method ensures the highest level of fingerprint sequence accuracy.



IAFIS – Rolling Prints

- recommended height for recording legible fingerprints is **approximately 39 inches from the floor.**
- This allows the forearm of an average adult to be parallel with the floor. This is the recommended position to record fingerprints



IAFIS – Rolling Prints

- If using the ink and paper method, roll the finger on the inking plate or pad so the entire fingerprint pattern area is evenly covered with ink.
- ink should cover from one edge of the nail to the other and from the crease of the first joint to the tip of the finger. *Using the correct amount of ink is vital*



IAFIS – Rolling Prints

- The side of the finger bulb is placed upon the card or platen.
- The finger is then rolled to the other side until it faces the opposite direction.
- Care should be exercised so the bulb of each finger, from tip to below the first joint, is rolled evenly.



IAFIS – Rolling Prints

- When using the ink and paper method and a rolled impression is not acceptable, you may use an adhesive retab to cover the fingerprint in its space. (Only two retabs can be applied to each fingerprint block.)



Fingerprint Forensic FAQs

o *How are latent fingerprints collected?*

Chemical	Uses	Application	Latent Print
Ninhydrin	Paper	Object dipped or sprayed in Ninhydrin. Wait 24 hours.	Purple-blue print
Cyanoacrylate vapor	Household items: plastic, metal, glass, and skin	Heat sample in a vapor tent.	White print
Silver Nitrate	Wood Styrofoam	Object dipped or sprayed in Silver Nitrate.	Black or reddish brown print under UV light
Iodine Fuming	Paper Cardboard Unpainted surfaces	In a vapor tent, heat solid iodine crystals.	Brownish print (fades quickly) Must be photographed or sprayed with a solution of starch.



Iodine Fingerprint





Ninhydrin Fingerprint





Lifting Latent Prints (cont)

- ➡ **Ninhydrin--reacts with amino acids to produce a purple reaction.**
- ➡ **Silver nitrate--react with chlorides to form silver chloride, a material which turns gray when exposed to light.**
- ➡ **Cyanoacrylate--"super glue" fumes react with water and other fingerprint constituents to form a hard, whitish deposit.**
- ➡ **In modern labs and criminal investigations, lasers and alternative light sources are used to view latent fingerprints. It was first used by the FBI in 1978. Since lasers can damage the retina of the eye, special precautions must be taken and a filter used.**



Cyanoacrylate Fingerprints





New Technology - CTF

- columnar thin film (CTF),
- ultrathin material
- can be used to make impressions and reproduce microscopic details of surfaces at the scale of about 100 nm.
- CTF technology can reproduce the topographic details of a latent fingerprint.
- Identifying features (such as ridges and creases) become more prominent and visible.



CTF – the process

- Develops fingerprints by applying a CTF coating in a special vacuum chamber called a thermal evaporator
- The fingerprint is sprayed with an ultrathin layer of glass that hardens after about 30 minutes, revealing and preserving the topography of the print. The film is 200 times thinner than a sheet of paper, and each square inch contains billions of glass bristles.



Other Prints

- Ears--shape, length and width
- Face--pictures being used in Florida to find criminals
- Voice--electronic pulses measured on a spectrograph
- Feet--size of foot and toes; lines of the feet
- Shoes--can be compared and identified by type of shoe, brand, size and year of purchase



CTF

- The CTF technique to develop a fingerprint uses the physical properties of the fingerprint.
- Works better at preserving the print than dusting, superglue, etc.



CTF





Other Prints



Palm--lines can be identified and may be used against suspects.



Other Prints

Foot Prints are taken at birth as a means of identification for infants.





Shoe Impressions

- Shoeprint size indicates the foot size
- The depth of a foot or shoe impression indicates a person's weight
- The type of shoe can tell something of the person's job or personality
- Databases contain the names of specific manufactures and tread designs



Shoe Wear Patterns

Factors that personalize a person's footwear:

- Body weight
- The way a person walks
 - Weight distribution
 - Direction of toes (straight, pointing out or in)
- The surface on which the person walks
- Unique holes, cuts, and debris embedded in the tread

Collection of Shoe Impression Evidence



Why would the following steps be important?

1. Take photos as soon as possible
2. Take multiple photos of the impression from at least two different orientations
3. Place an identifying label and a ruler in position with the impression for the photo
4. Use oblique lighting when possible



Other Prints

Lips--display one of five common patterns

- ➡ **Short vertical lines**
- ➡ **Long vertical lines**
- ➡ **Rectangular lines that may crisscross**
- ➡ **Diamond**
- ➡ **Branching**



diamond grooves



Branching Grooves



long vertical grooves



rectangular grooves



short vertical grooves



Other Prints



Teeth--bite marks are unique and can be used to identify suspects. These imprints were placed in gum and could be matched to crime scene evidence.

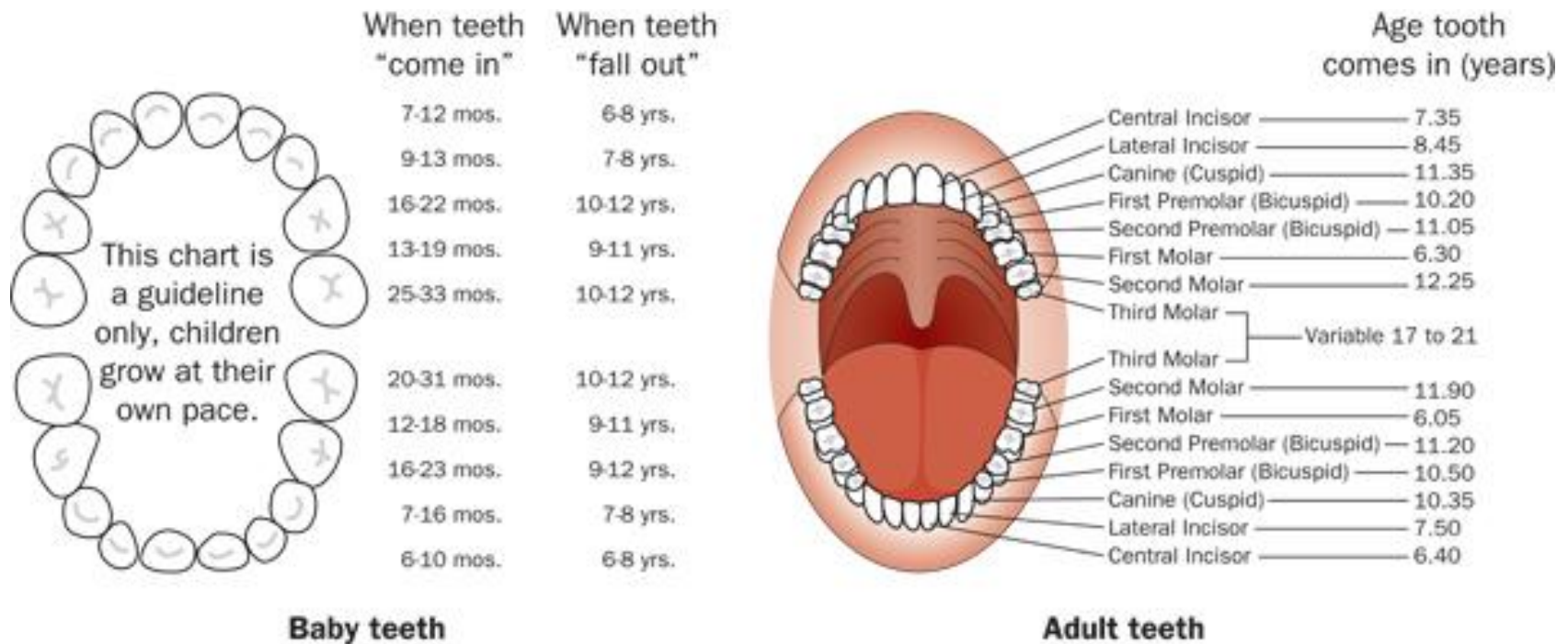


Dental Impressions

- Occasionally a perpetrator will leave behind a bite mark—considered individual evidence
- Note differences in the size of teeth and jaws, position, fillings, crowns, caps, breakage, and crowding



Development of Teeth





Dental Patterns in Forensics

- The investigation consists of recognizing, documenting, collecting, and analyzing evidence

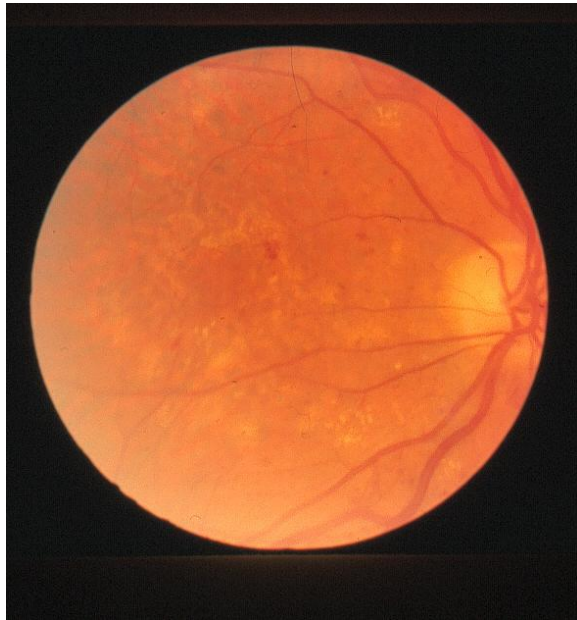
What are the two basic ways dental patterns can be used in forensic investigations?

- There are 76 points of comparison when comparing a suspect's dental patterns with bite marks left at a crime scene

What is the common method used to reveal whether there is a match?



Other Prints



The blood vessel patterns may be unique to individuals. They are used for today various security purposes.

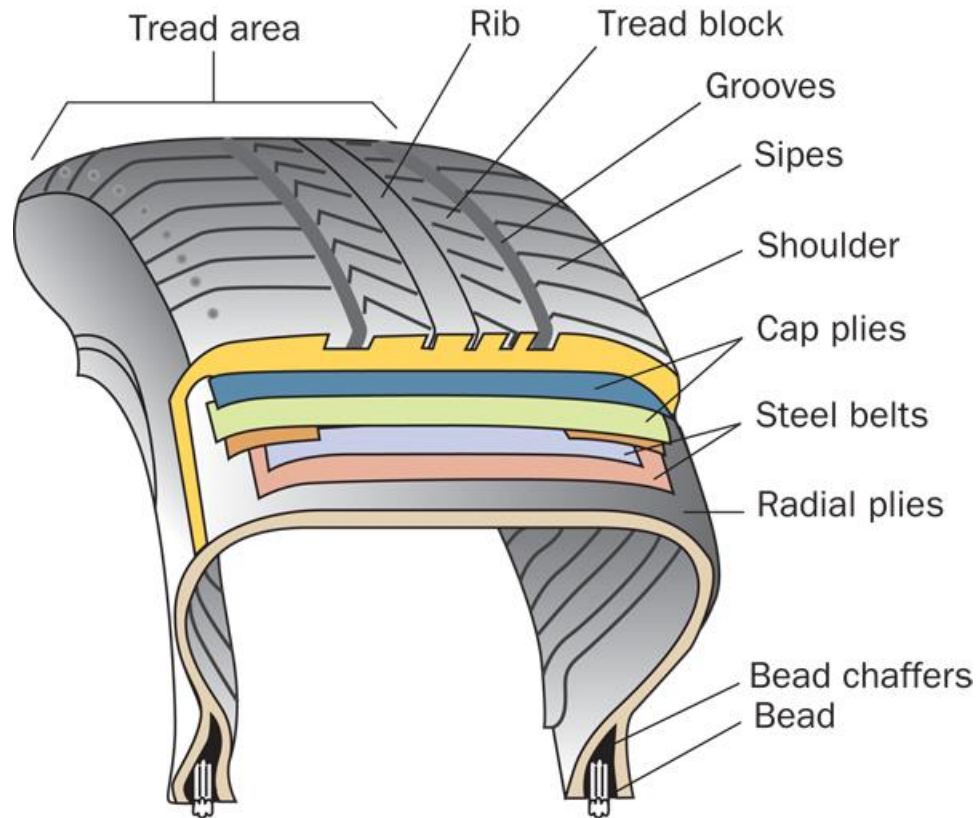


Tire Treads and Impressions

- Tread patterns can indicate the type of vehicle that left the mark
- Link a suspect or victim to a crime scene
- Reveal events that took place at the scene



Anatomy of a Tire





Recording Tread Impressions

- Count ridges and grooves across the tire width
- Note unique characteristics—wear or pebbles embedded in the grooves
- Create a print of the suspect's tire impressions through one revolution
- Compare impressions from the crime scene and suspect's tire
- Identifying tread patterns may not be enough to link a suspect with a crime scene



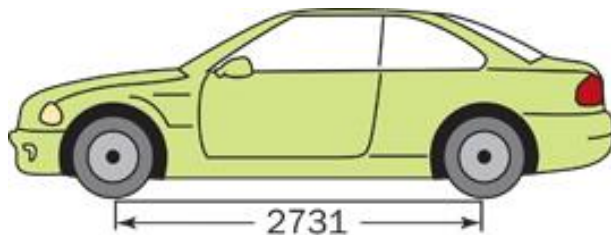
Identifying a Vehicle

Track widths—

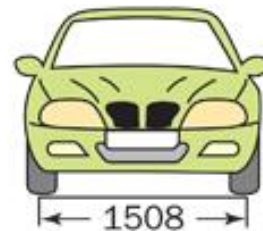
From center of tire to center of tire

Wheelbase length—

From center of front axle to center of rear axle



Side view



Front view



Rear view



Fingerprint Forensic FAQs

- Can fingerprints be erased?
Only temporarily; they will grow back if removed with chemicals
- Is fingerprint identification reliable?
Yes, but analysts can make mistakes
- Can computers perform matches in seconds?
No, but the FBI's Integrated Automated Fingerprint Identification System (IAFIS or AFIS) can provide a match in 2 hours



The Future of Fingerprinting

- New scanning technologies
 - Yield detail in minute patterns
 - Reduce analytical mistakes
 - Analyze trace elements of objects on the skin
- Technologies that recognize patterns in
 - Retina
 - Face
 - Veins in your palm



Case studies

Read both case studies on pages 143-144. For each, list the following information in your notes.

- o Case name
- o Suspect
- o Victim
- o Key evidence and classification
- o Outcome of case



..... Summary

- Fingerprints have long been used for identification, and in the mid-1800s were recognized as unique to each person.
- Three main groups include arches, whorls, and loops.
- Basic analysis includes looking for cores and deltas and making a ridge count.



..... Summary

- Investigators search for patent, plastic, and latent prints.
- Dusting with powders or using special chemicals can make latent fingerprints visible.
- New developments may eliminate errors by analysts.