



Fingerprints

Learning Objectives

- ☐ I can describe history and reliability of fingerprinting
- ☐ I can identify fingerprint characteristics and matches
- ☐ I can collect fingerprint evidence
- ☐ I can identify other print types

Historical Development

1. 300 B.C. - The oldest documents showing fingerprints date from **China**
2. 1792-1750 B.C. - Fingerprints pressed into clay tablets marked contracts were found from ancient Babylon.
3. 1684 - **Dr. Nehemiah**'s described patterns he saw on human hands under a microscope
4. 1788 - **Johann Mayer** was the first scientist to recognize that each person's fingerprints are unique
5. 1823 - Nine fingerprint patterns were described by **Jan Evangelist Purkyn**.

Historical Development

6. 1856 – **Sir William Herschel** began the collection of fingerprints and noted they were not altered by age.
7. 1883 – **Alphonse Bertillon** was able to identify a repeat offender using the first fingerprint database.
8. 1888 – **Sir Francis Galton** and **Sir Edmund Richard Henry** developed the fingerprint classification system that is still in use in the United States.

Historical Development

9. In 1891, **Iván (Juan) Vucetich** improved fingerprint collection. He began to note measurements on identification cards, as well as adding all ten fingerprint impressions. He also invented a better way of collecting the impressions.
10. Beginning in 1896, **Sir Henry** (mentioned in the last entry on the previous slide), with the help of two colleagues, created a system that divided fingerprints into groups. Along with notations about individual characteristics, all ten fingerprints were imprinted on a card (called a *ten card*).

What are Fingerprints?

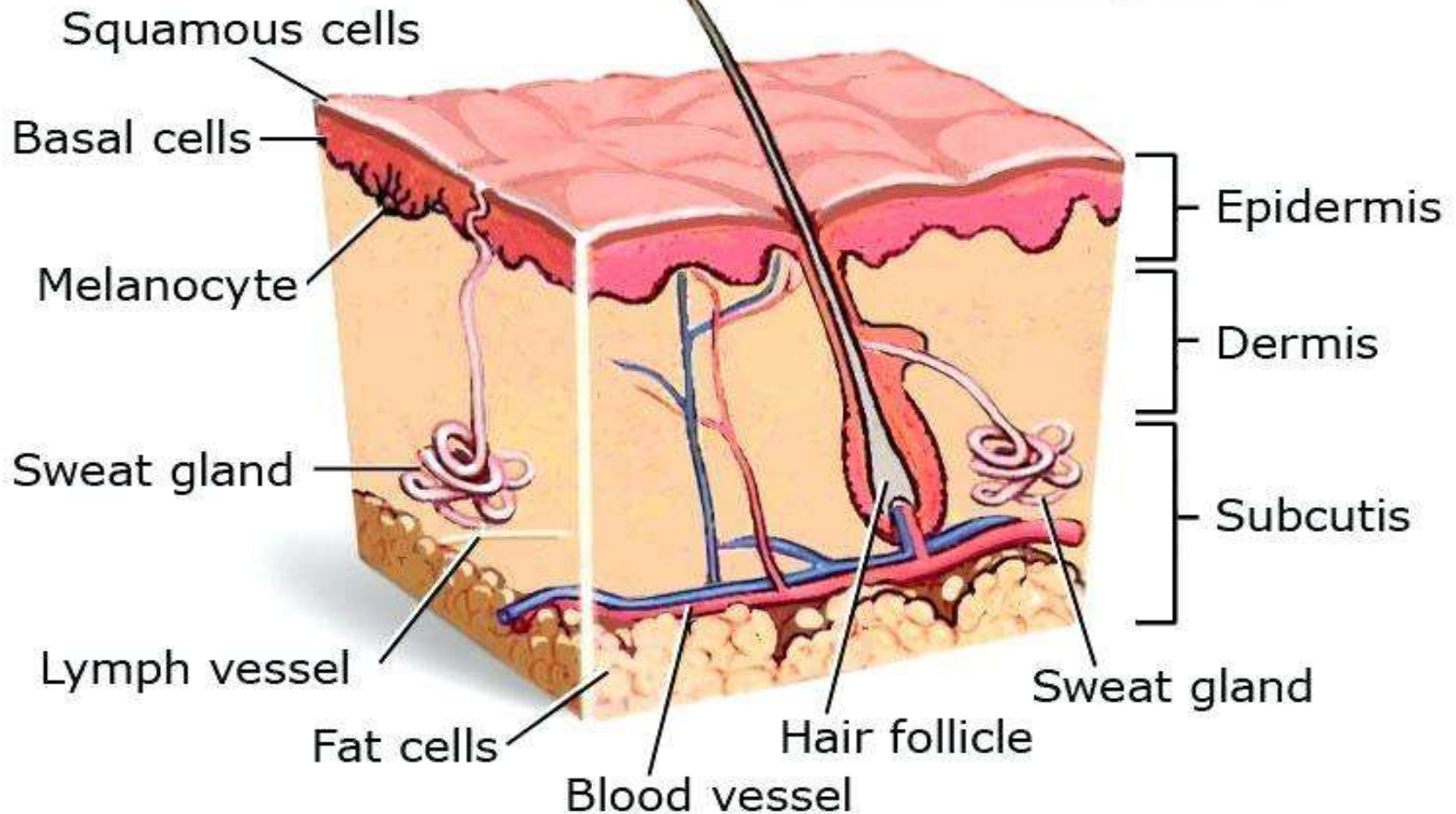
All fingers, toes, feet, and palms are covered in ridges which help us grip objects

Ridges are arranged in connected units called *dermal*, or *friction*, *ridges*

Fingers accumulate natural secretions and dirt which get left behind on objects we touch as fingerprints

Structure of Skin

Skin Layers



Structure of Skin

Epidermis

- Outer layer of dead, squamous (flattened) cells provides a protective waterproof layer
- Inner layer of epithelial cells are still living

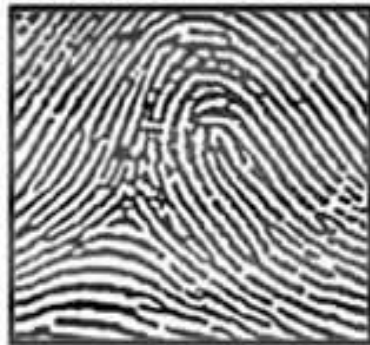
Dermis

- Separated by the Epidermis by the basal layer
- Includes blood vessels, oil and sweat glands, hair follicles, fat tissue, and nerves

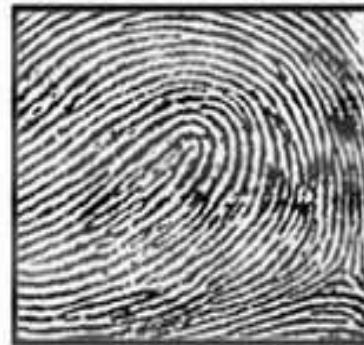
Three Types of Fingerprints

Loops

- Ridges enter on one side and exit on the same side
- About 65% of Population



L - Radial Loop
R - Ulnar Loop

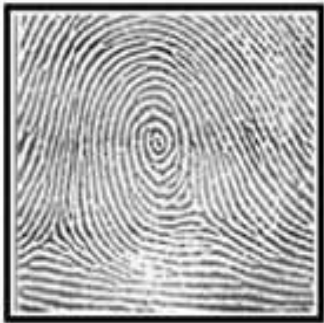


L - Ulnar Loop
R - Radial Loop

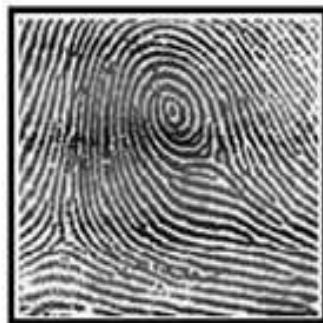
Three Types of Fingerprints

Whorls

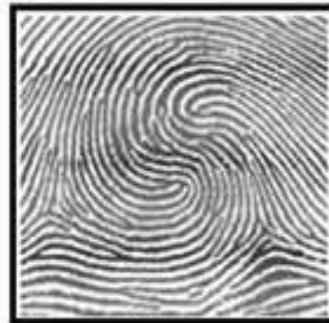
- Consists of circles, more than one loop, or a mixture of pattern types
- About 30% of Population



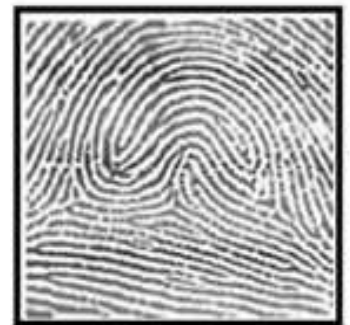
**Plain
Whorl**



**Central
Pocket
Whorl**



**Double
Loop
Whorl**

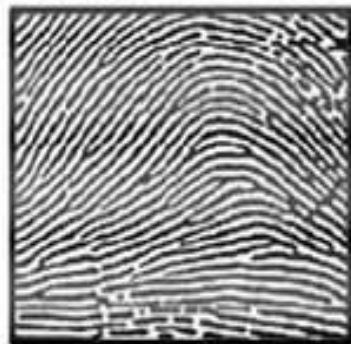


**Accidental
Whorl**

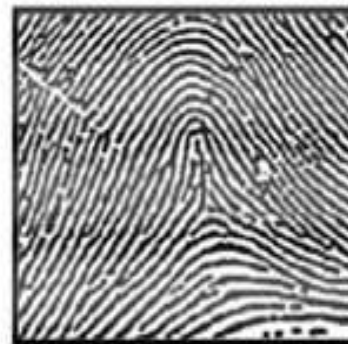
Three Types of Fingerprints

Arches

- Ridges enter on one side and exit on the other side
- About 5% of Population



Plain Arch



Tented Arch

Classify the Fingerprint



Plain Arch

Classify the Fingerprint



Central
Pocket Loop

Classify the Fingerprint



Ulnar Loop

Classify the Fingerprint



Tented Arch

Classify the Fingerprint



Accidental
Whorl

Classify the Fingerprint



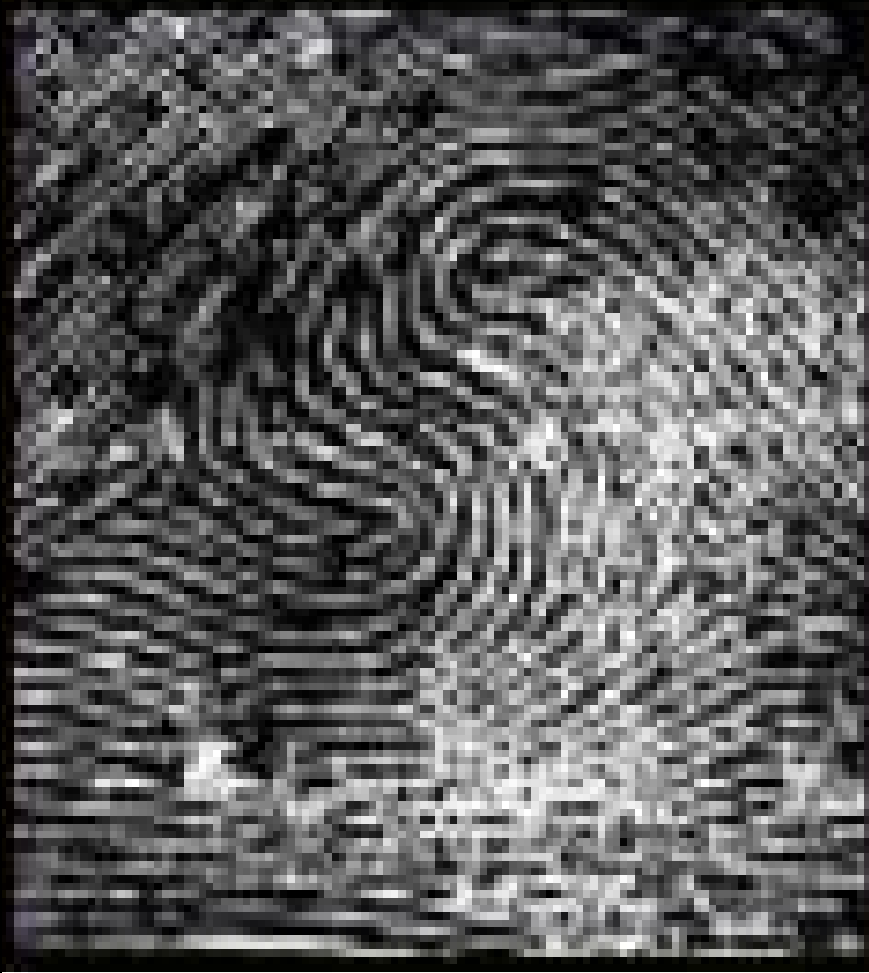
Plain Whorl

Classify the Fingerprint



Radial Loop

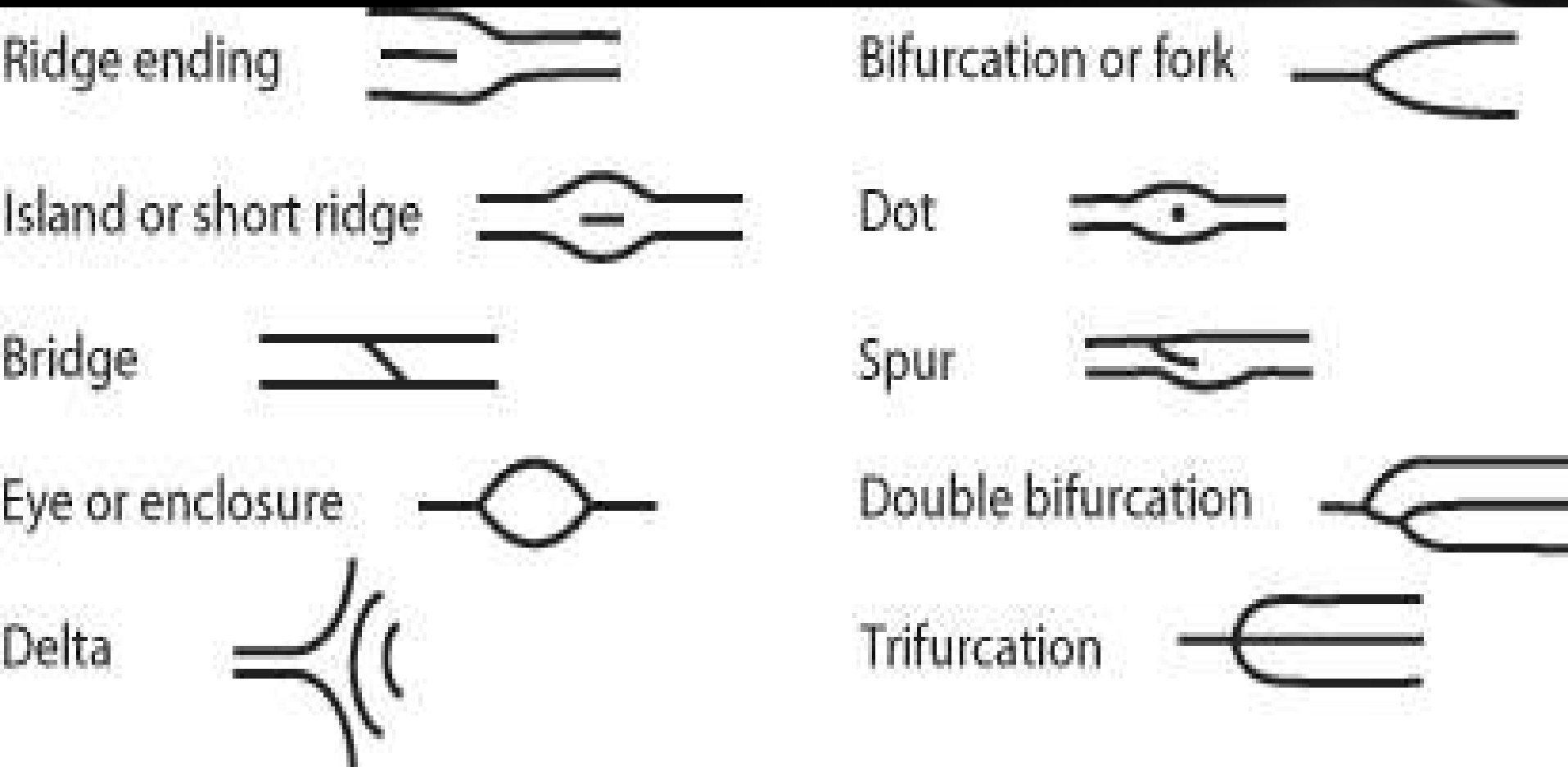
Classify the Fingerprint



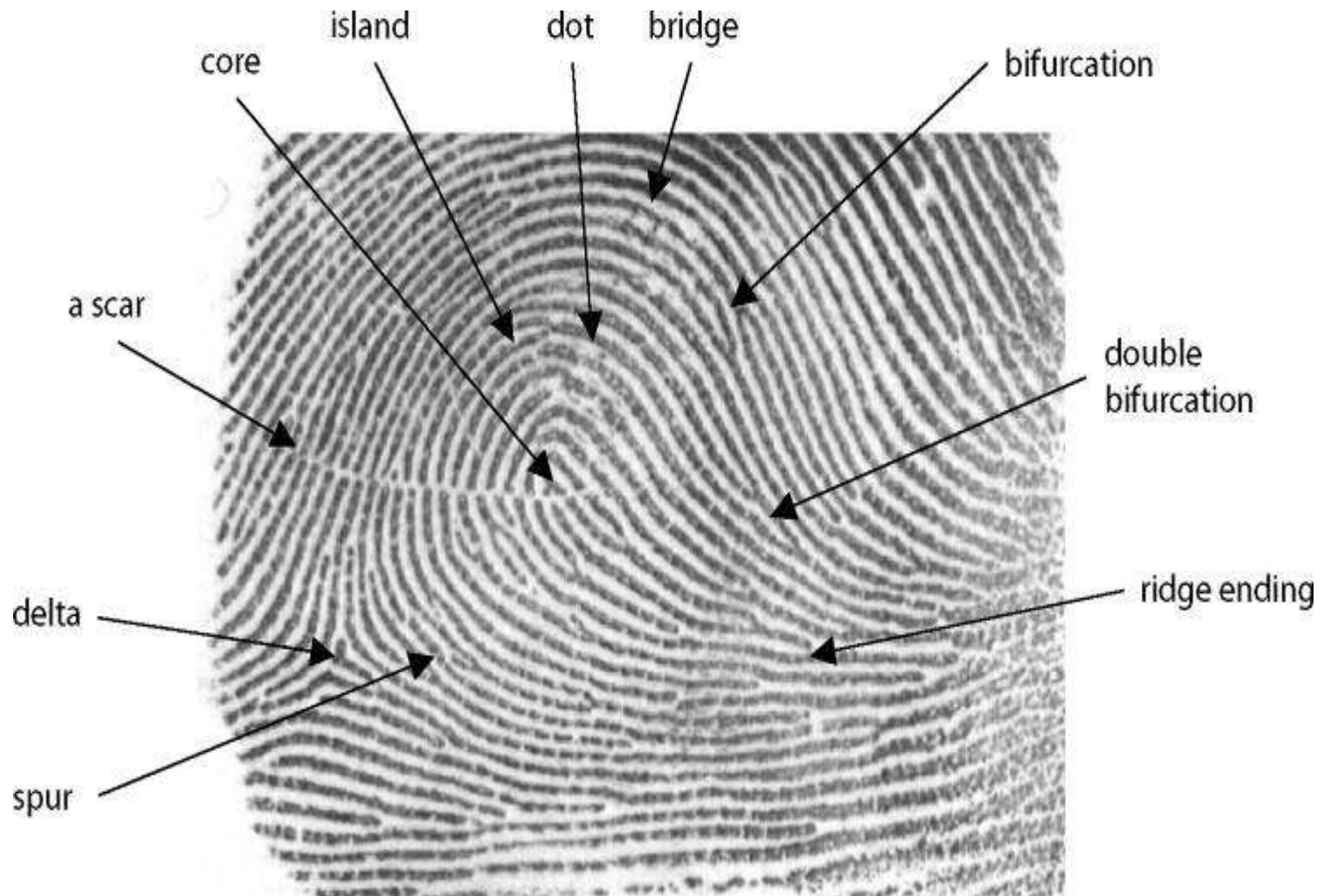
Double Loop
Whorl

Characteristics of Fingerprints

Minutiae are Small ridge patterns used for more accurate suspect identification.



Characteristics of Fingerprints



Looking for Fingerprints

1. **Patent fingerprints** are visible prints transferred onto smooth surfaces by blood or other liquids.
2. **Plastic fingerprints** are indentations left in soft materials such as clay or wax.
3. **Latent fingerprints** are not visible but made so by dusting with powders or the use of chemicals.

Fingerprint FAQ's

Can fingerprints be erased?

No, if, for example, they are removed with chemicals, they will grow back.

Is fingerprint identification reliable?

Yes, but analysts can make mistakes.

Is fingerprint matching carried out by computers in a matter of seconds?

No, but the FBI's Integrated Automated Fingerprint Identification System (IAFIS or AFIS) can provide a match in 2 hours for the prints in its Master File.

Preserving Prints

Photograph fingerprint and surrounding object before doing anything else

If object is small, take it to the lab for analysis

If object is large, lift print using tape and place on card

Fingerprint Collection: Ninhydrin

Uses: Paper

*Directions: Dip or
spray, wait 24 hrs*

*Appearance: purple-
blue print*



Fingerprint Collection: Cyanoacrylate Vapor

*Uses: Plastic, Metal,
Glass, Skin*

*Directions: Heat
sample in a vapor
tent*

*Appearance: White
print*



Fingerprint Collection: Iodine Fuming

*Uses: Paper,
cardboard, unpainted
surfaces*

*Directions: Heat
iodine crystals in a
vapor tent*

*Appearance: Brownish
print (fades quickly)
Must be photographed
or sprayed with
starch solution*



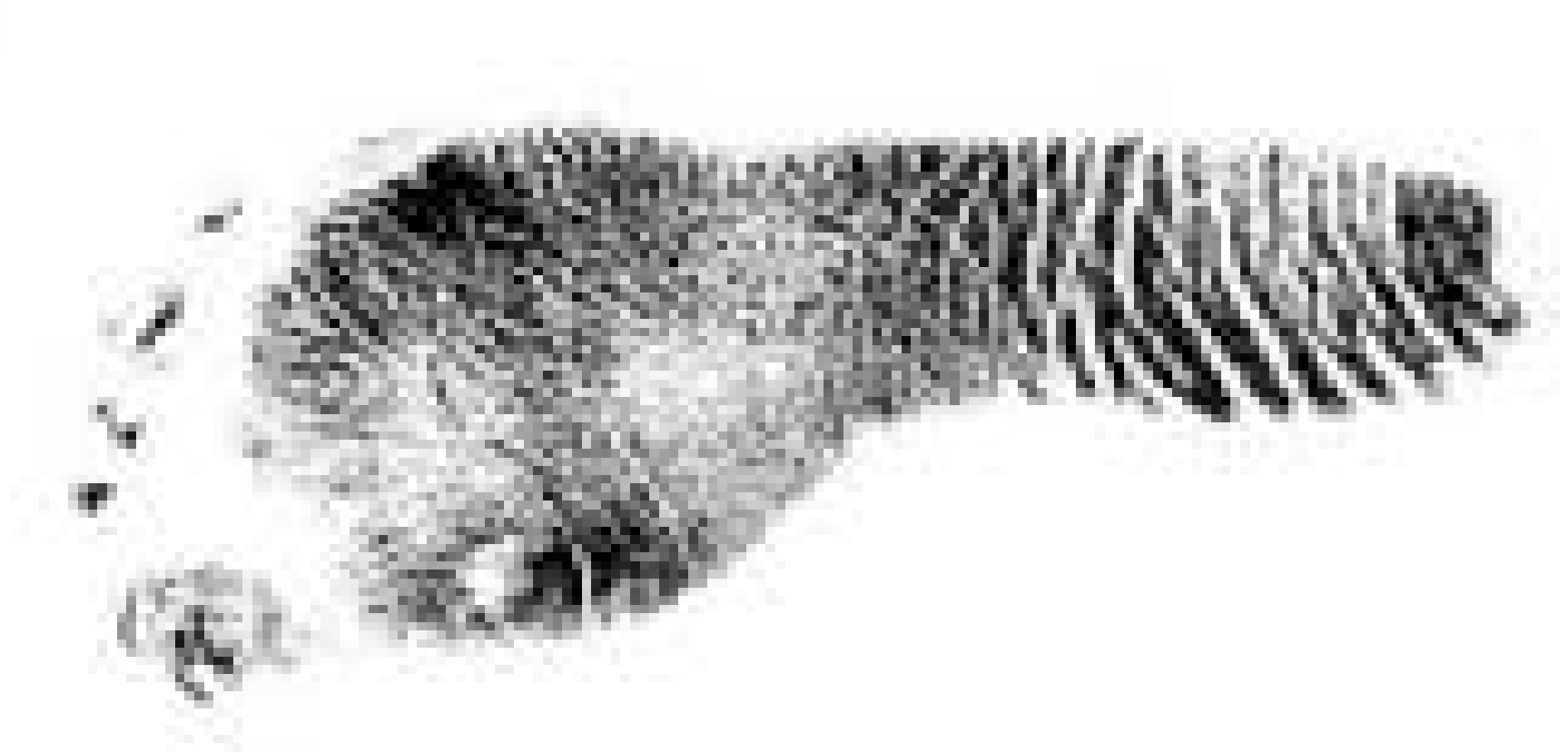
Other Prints

Palm: Contains ridges similar to fingers



Other Prints

Foot: Size of foot and toes, ridges



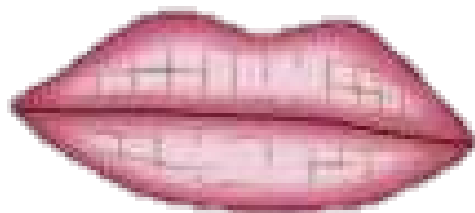
Other Prints

*Shoes: Type brand, size, year of purchase,
wear pattern*

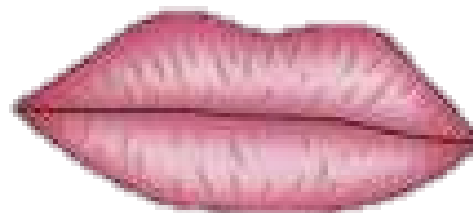


Other Prints

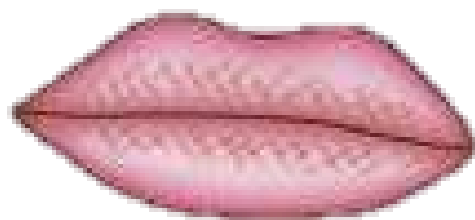
Lips: Several common patterns



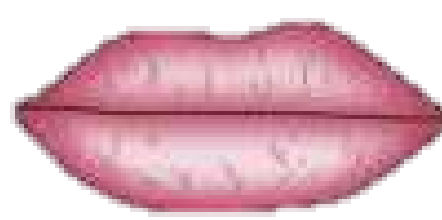
Reticular pattern



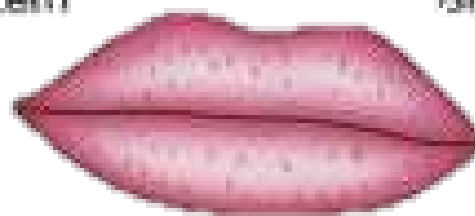
vertical pattern



intersected pattern



Branched pattern



Partial vertical pattern

Other Prints

Teeth: Bite marks helped to convict Ted Bundy



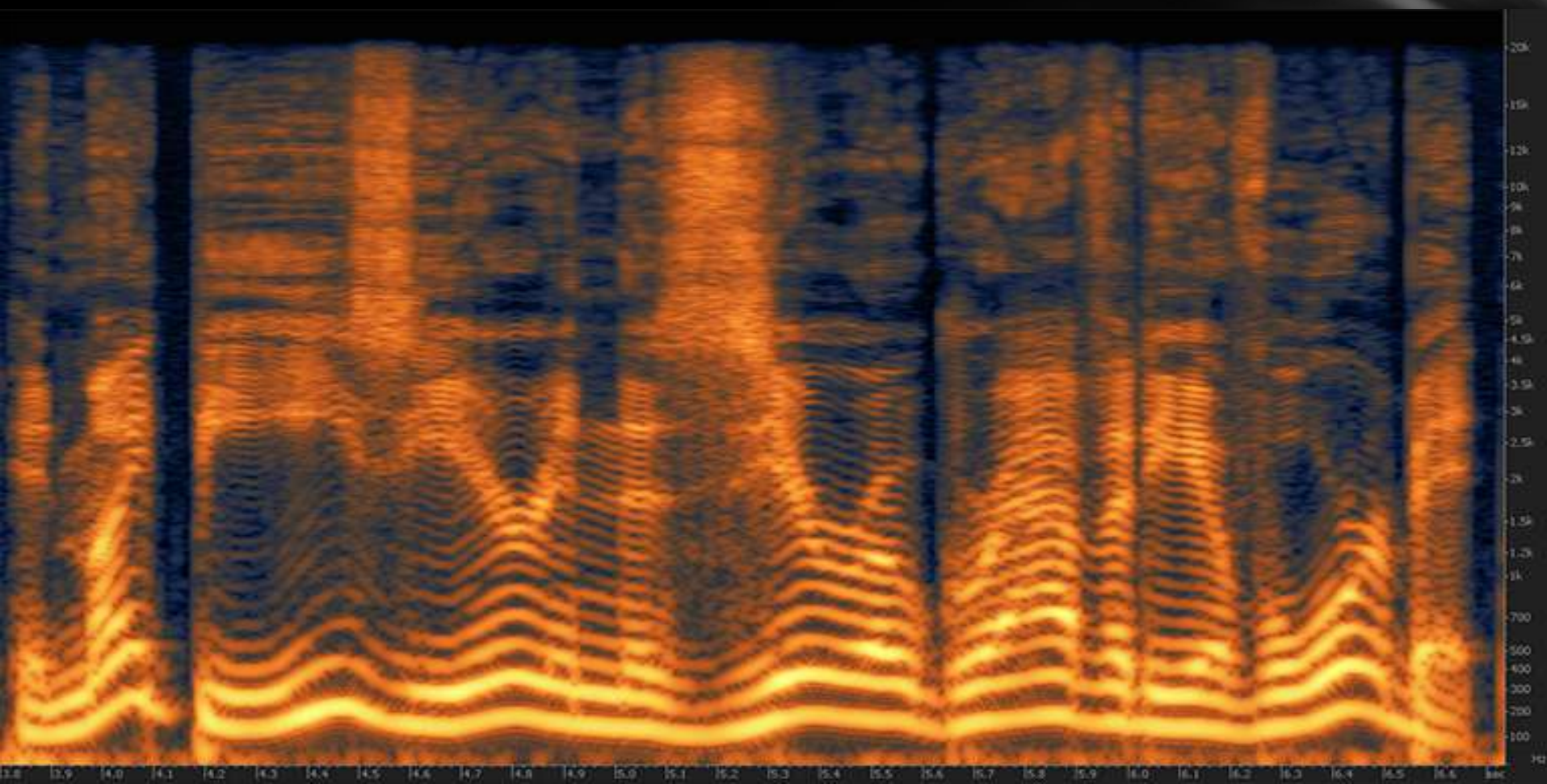
Other Prints

Ear: Ear prints are just as unique as fingers



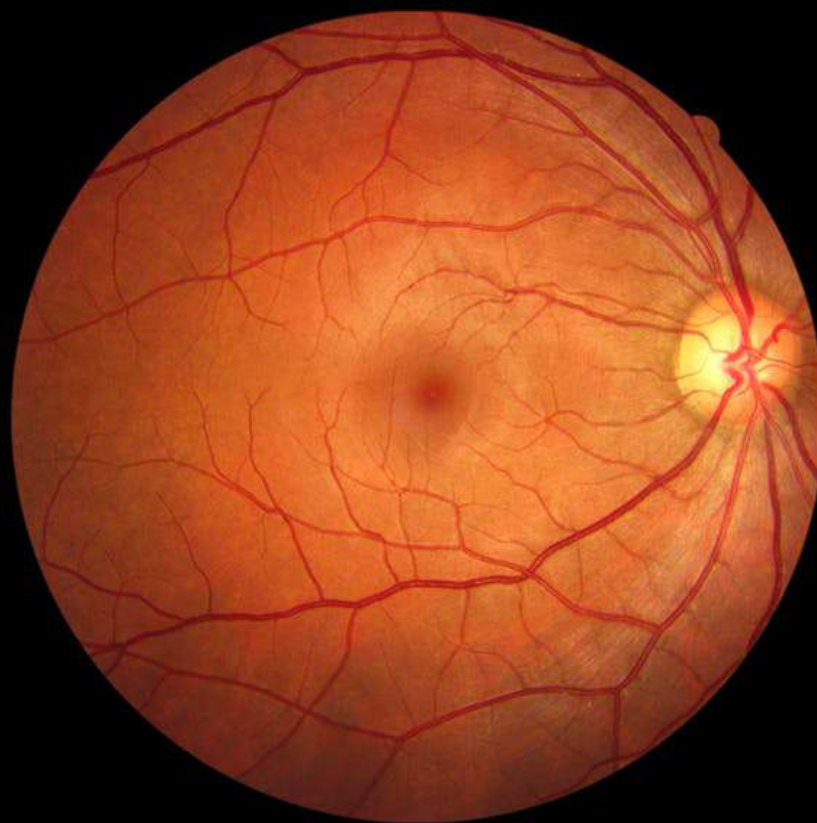
Other Prints

Voice: electronic pulses measured on a spectrograph



Other Prints

Retina: blood vessels in the eye are used in security



Handwriting Analysis, Forgery and Counterfeiting

WE Have bunnies . gather one million

doLLARS IN unmarked "Non - cons

emies! A insTRUCtIONS . No

Funny STUFF .

Learning Objectives

- ☐ I can analyze handwriting to determine a match
- ☐ I can describe crimes relating to forgery and fraudulence
- ☐ I can detect counterfeit bills
- ☐ I can examine samples of ink to match a sample to a source

Document Experts

Matches handwriting samples between a questioned document and known source, determine forgeries and fraudulence, and detect counterfeiting.

Graphologist

Studies the personality of a writer based on handwriting samples

Not widely accepted part of forensic science

Biometric Signature Pad

“Learns” to recognize how a person signs

Evaluates speed, pressure, and rhythm of the signature

Recognizes forgeries by the detection of even slight differences

Computerized Analysis

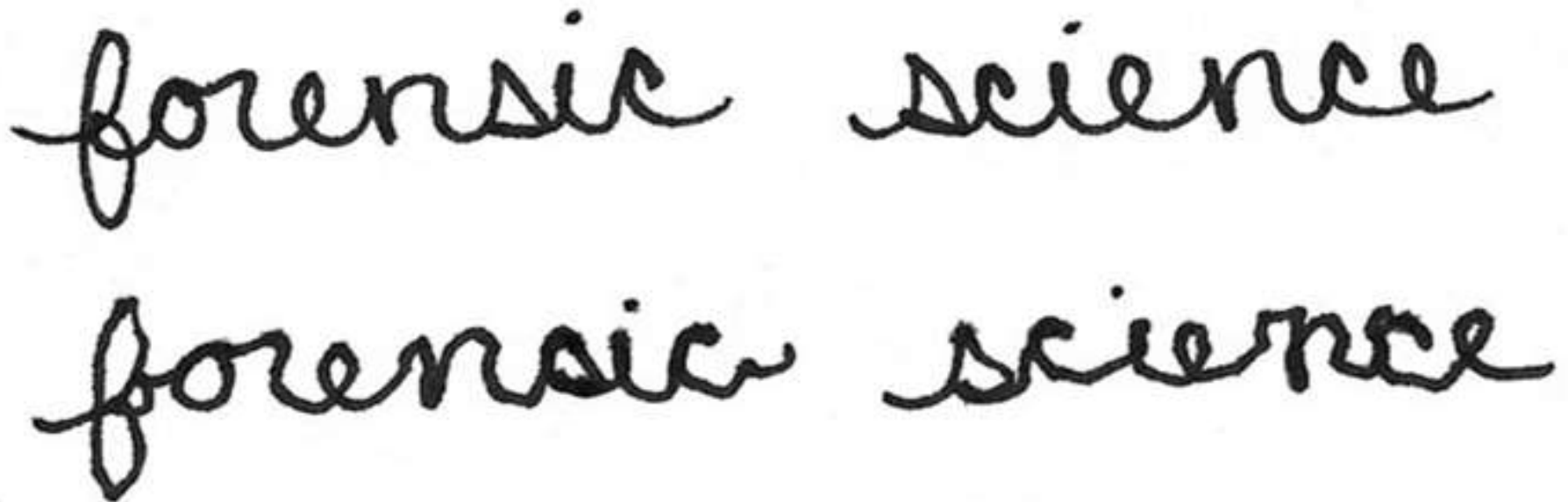
Compares handwriting samples objectively

Compared with samples stored in databases

Characteristics of Handwriting

1. Line Quality

Do the letters flow or are they erratic and shaky?



forensic science

forensic science

Characteristics of Handwriting

2. Spacing

Are the letters equally spaced or crowded?

The right of
the people to be

The right of
the people to be
secure in their

The right of
the people to be
secure in their

Characteristics of Handwriting

3. Size Consistency

Is the ratio of height to width is consistent or inconsistent?



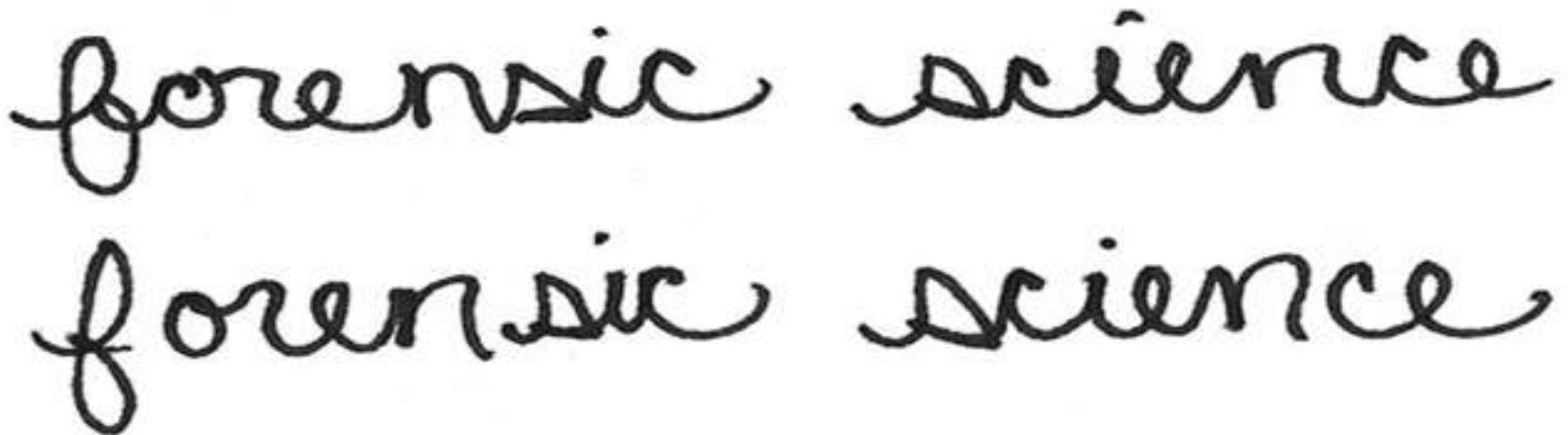
The image displays three lines of cursive handwriting, all reading "The Right of the People". The first line is written in a large, tall script. The second line is written in a medium-sized script. The third line is written in a smaller, more compact script. This visual comparison demonstrates a lack of size consistency in the handwriting.

The Right of the People
The Right of the People
The Right of the People

Characteristics of Handwriting

4. Continuous

Is the writing continuous or does the writer lift their pen?



The image shows two lines of handwritten text, both reading 'forensic science'. The top line is written in a continuous cursive style, where the letters are connected together without lifting the pen. The bottom line is written in a non-continuous cursive style, where the letters are also connected but there are visible gaps or lifts between the words 'forensic' and 'science'.

forensic science
forensic science

Characteristics of Handwriting

5. Connecting Letters

Are capital and lower case letters connected or not?

The Right of the

The Right of the

Characteristics of Handwriting

6. Lettering Complete

Does the letter begin and end on the page or are there any missing parts?

the right of the people

th right of the people

Characteristics of Handwriting

7. Cursive and Printed Letters

Are letters in cursive, printed or both?



Forensic Science

Forensic Science

Forensic Science

Characteristics of Handwriting

8. Pen Pressure

Is equal pressure applied to upward and downward strokes?

forensic science

forensic science

forensic science

Characteristics of Handwriting

9. Slant

If there is a slant does it slant left or right? Is it consistent?

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forensic science

forensic science

Characteristics of Handwriting

10. Line Habits

Is text on, below, or above the line?

Straight on line:

Jack and Jill went up the hill.

Words leave baseline below it:

Jack and Jill went up the hill.

Words slant up from baseline:

Jack and Jill went up the hill.

Characteristics of Handwriting

11. Fancy Curls or Loops

Are there fancy curls?

5. Connecting strokes, ending, and beginning strokes:

Do they begin as flourished or embellished?

→ My

Do they end flourished?

My^e

Do they begin as inflexible and straight?

M

Do they end abruptly?

Cat^e

Characteristics of Handwriting

12. Crossing "t"s and dotting "i"s

Are they correct or misplaced

Are i's dotted?

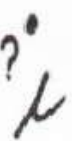
Lightly?



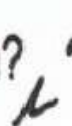
Firmly?



Left of stem?



Right of stem?



Circular pattern

Jabbed?



No dot?



Are t's crossed?

Lightly?



Heavy?



Left of stem?



Right of stem?



Concave?



Convex?

Uncrossed?



Short in proportion to stem?



Forgery

Forged documents include:

- checks
- employment records
- legal agreements
- licenses
- wills

Fraudulence – forgery for material gain

Preventing Check Forgery

Print checks on chemically sensitive paper

Large font size requires more ink and makes alterations more difficult

Use high resolution borders that are difficult to copy

Multiple color patterns

Embed fibers that glow under different light

Use chemical wash detection systems that change color when a check is altered

Literary and Art Forgery

The best literature and art forgers try to duplicate the original document or piece of art including the materials and techniques used in the original.

This may mean obtaining old paper, chemically treating it to make it appear older, mixing inks and dyes and copying tools or styles used at the time

Counterfeiting Currency



FEEL
Raised printing



TILT
Color-shifting
numeral



CHECK
Watermark and
security thread

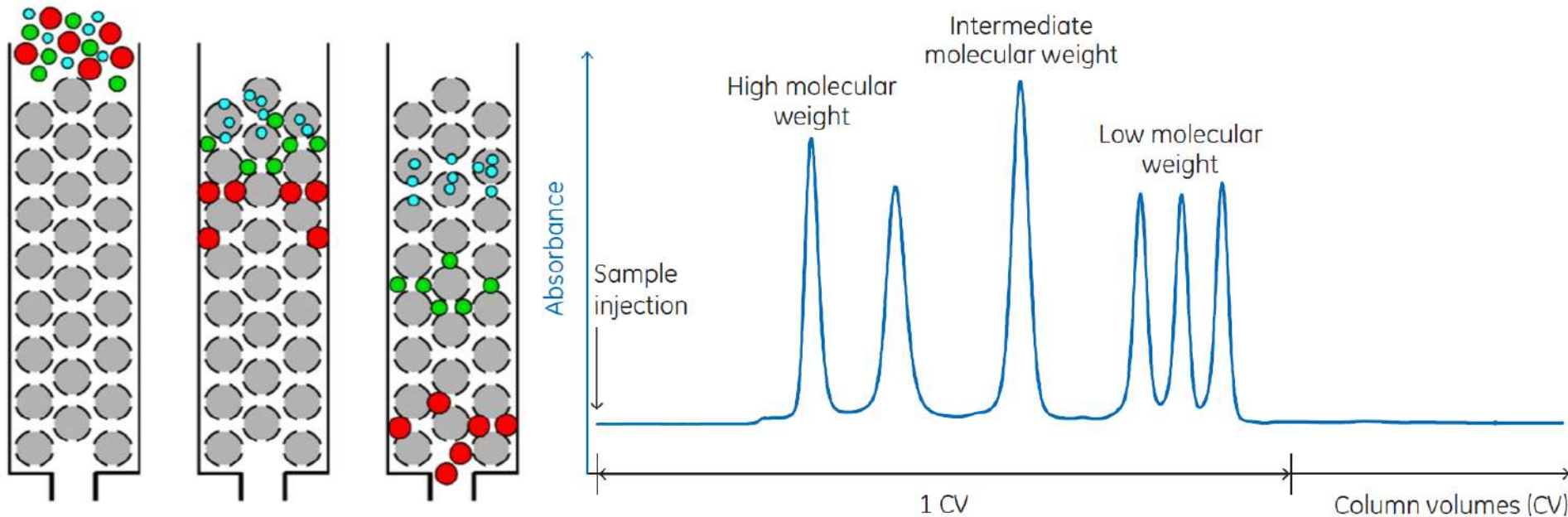
Analyzing Dyes

Paper Chromatography places a mixture on a solid phase, paper, which is then carried by a solvent as a mobile phase, usually water or alcohol. This separates components based on polarity.



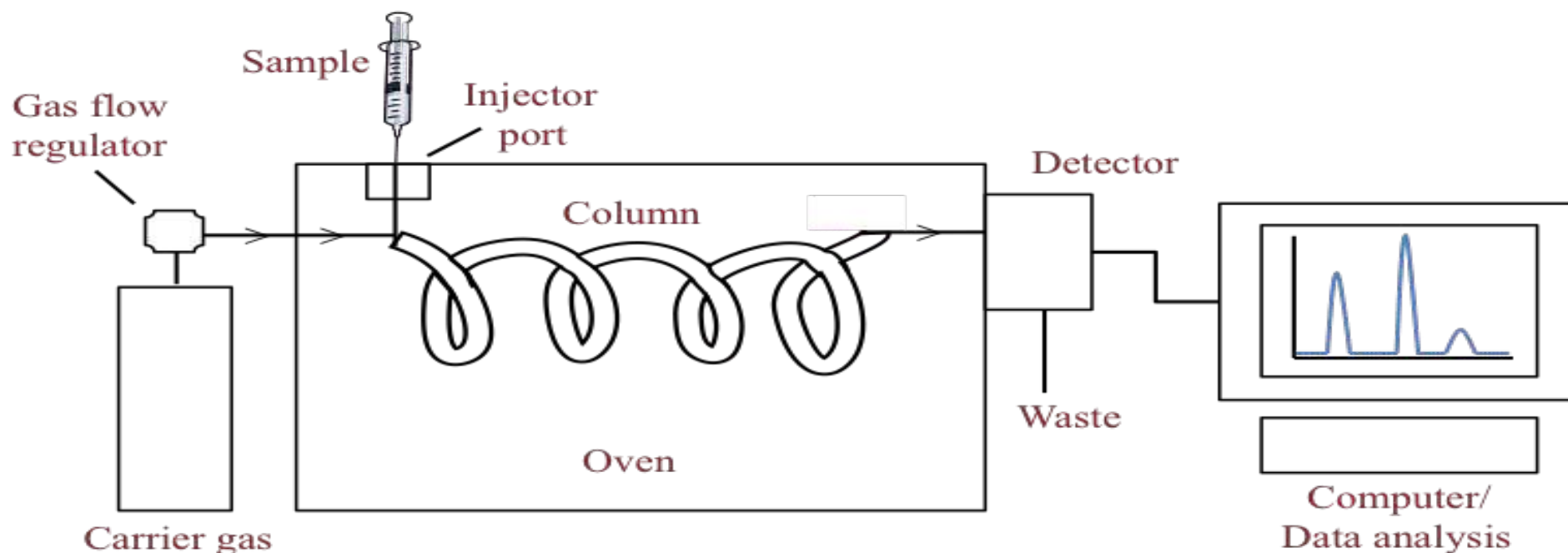
Analyzing Dyes

Size Exchange Chromatography allows a mixture to travel through beads with tiny holes in them. Smaller molecules travel quickly through the beads. Larger molecules get stuck and don't travel as quickly.



Analyzing Dyes

Gas Chromatography stationary liquid phase is injected into a heated chamber where it turns into a mobile gas phase when it reaches its boiling point separating compounds based on volatility.



Analyzing Dyes

Mass Spectrometer blasts molecules with electrons breaking them into positive ions called cations. Ions are then filtered based on mass and data is collected determining the identity of chemicals.

