
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*).

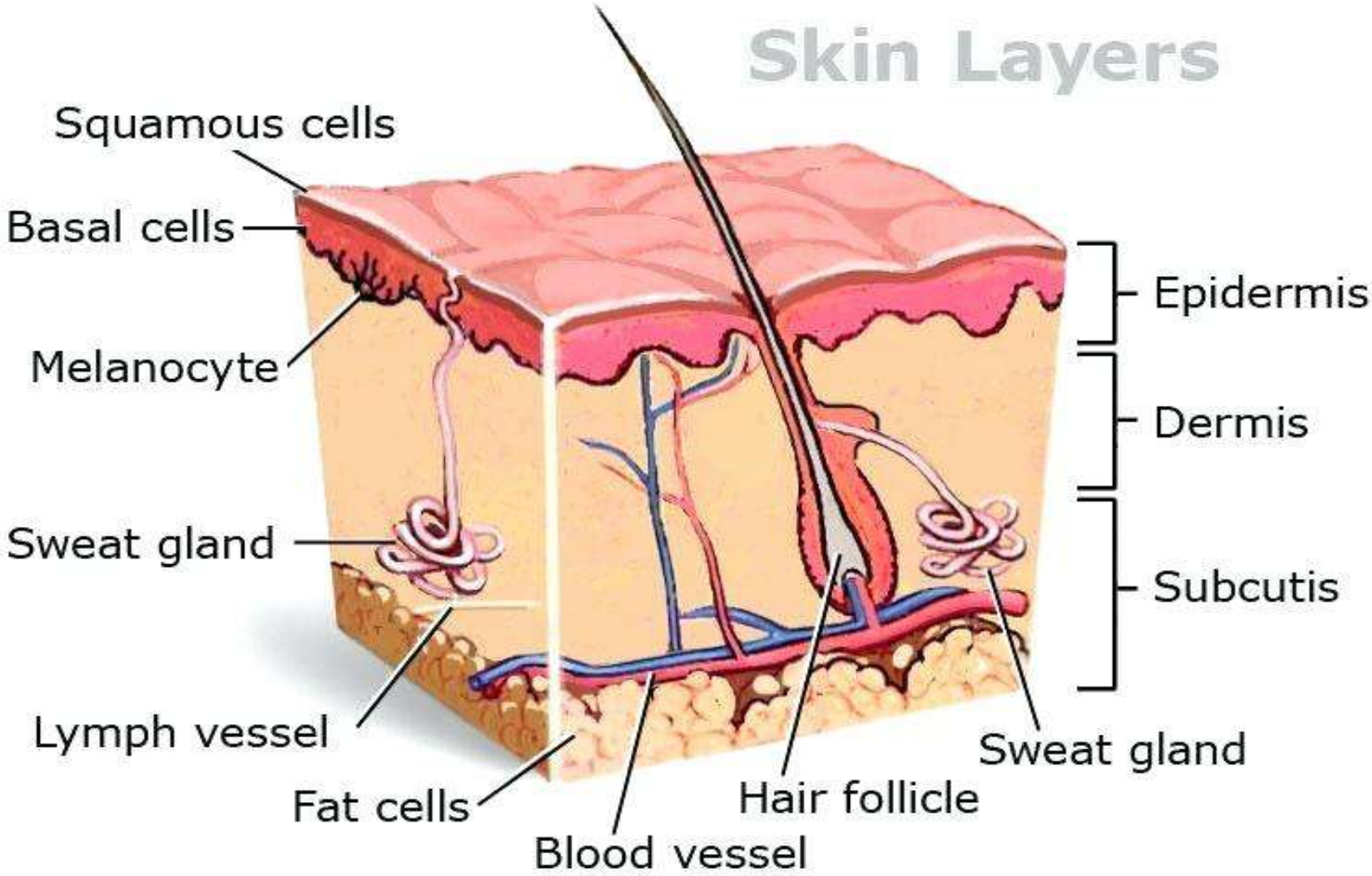
What are Fingerprints?

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



Structure of Skin

Epidermis

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

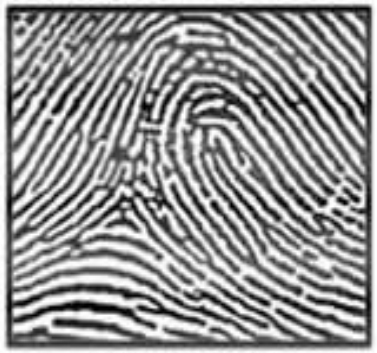
Dermis

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

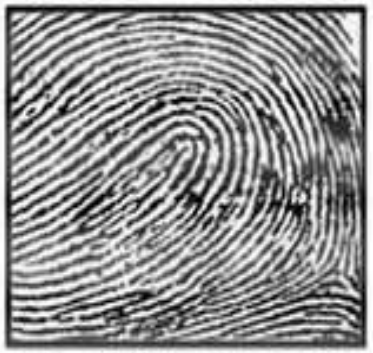
Three Types of Fingerprints

Loops

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



L - Radial Loop
R - Ulnar Loop

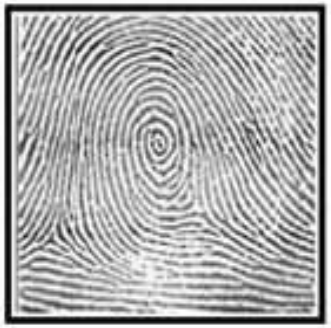


L - Ulnar Loop
R - Radial Loop

Three Types of Fingerprints

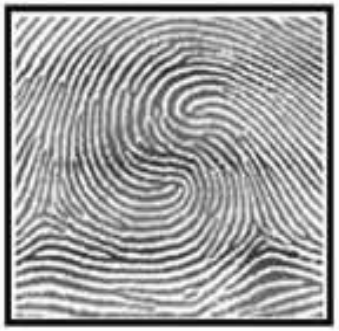
Whorls

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

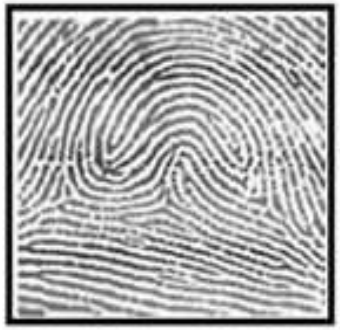


Plain Whorl

Central Pocket Whorl



Double Loop Whorl

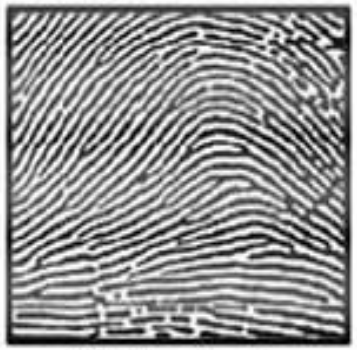


Accidental Whorl

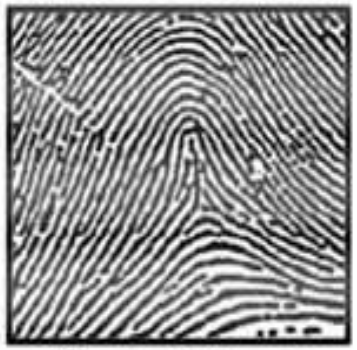
Three Types of Fingerprints

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

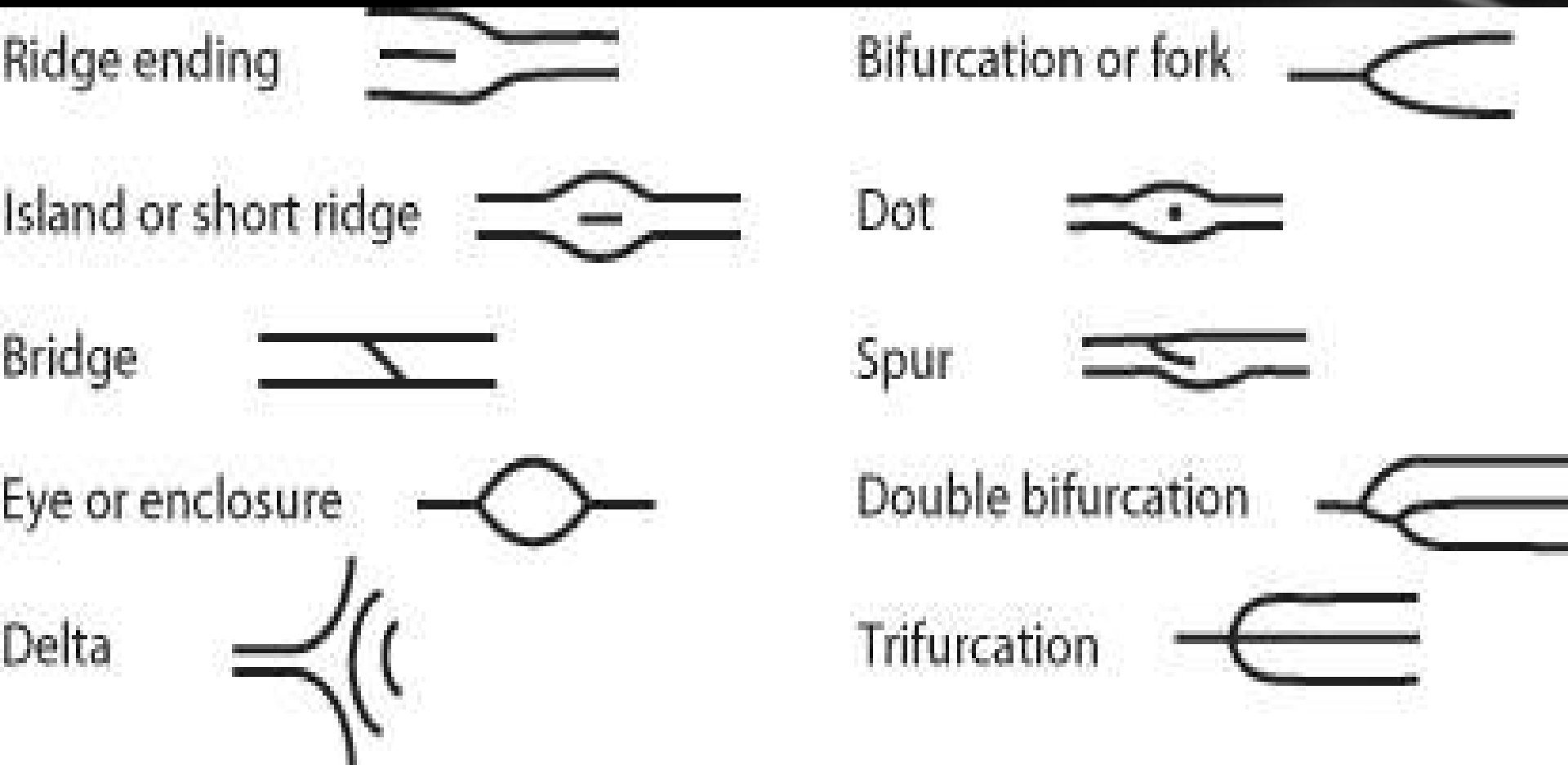
Radial Loop

Classify the Fingerprint

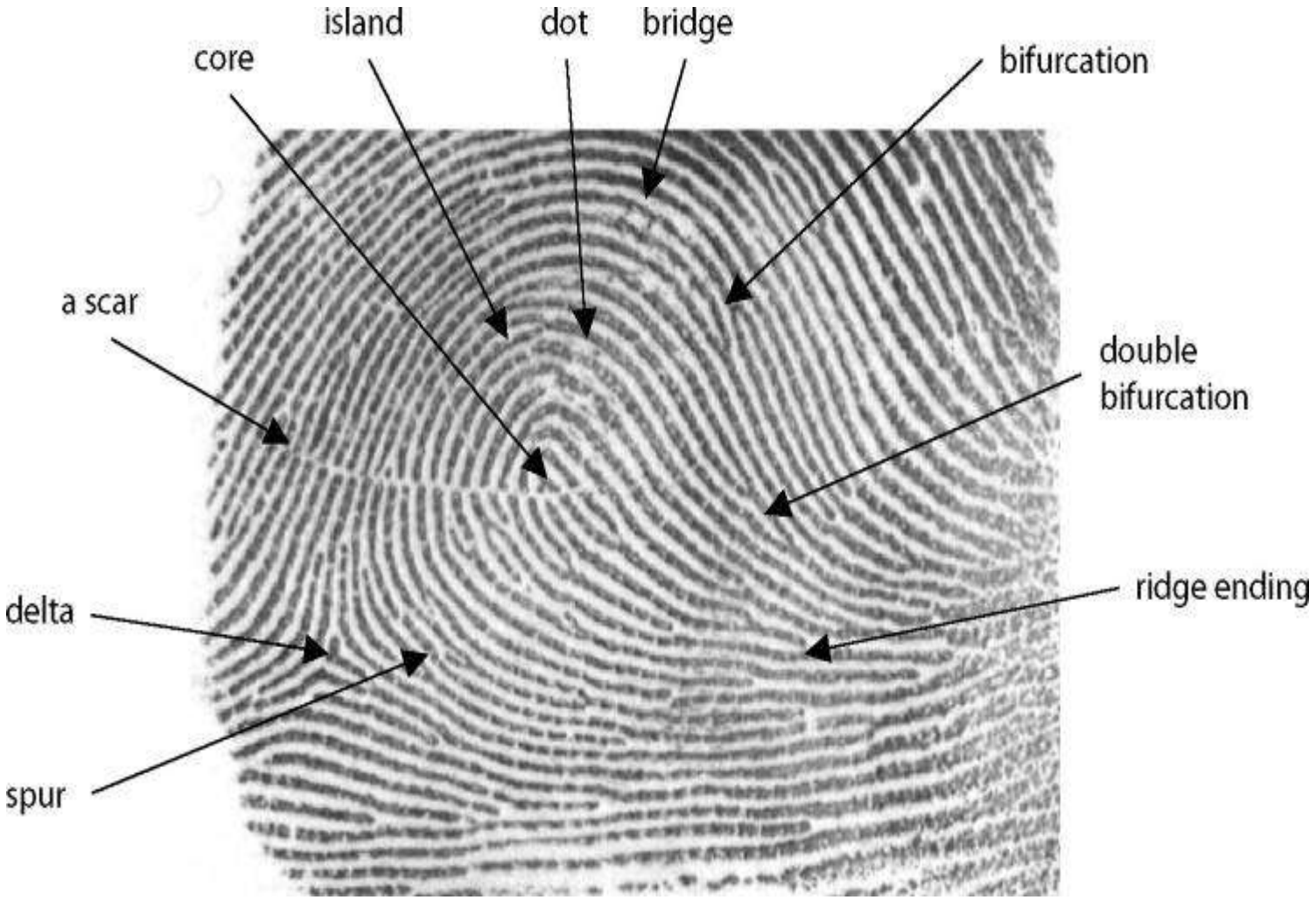
Double Loop Whorl

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

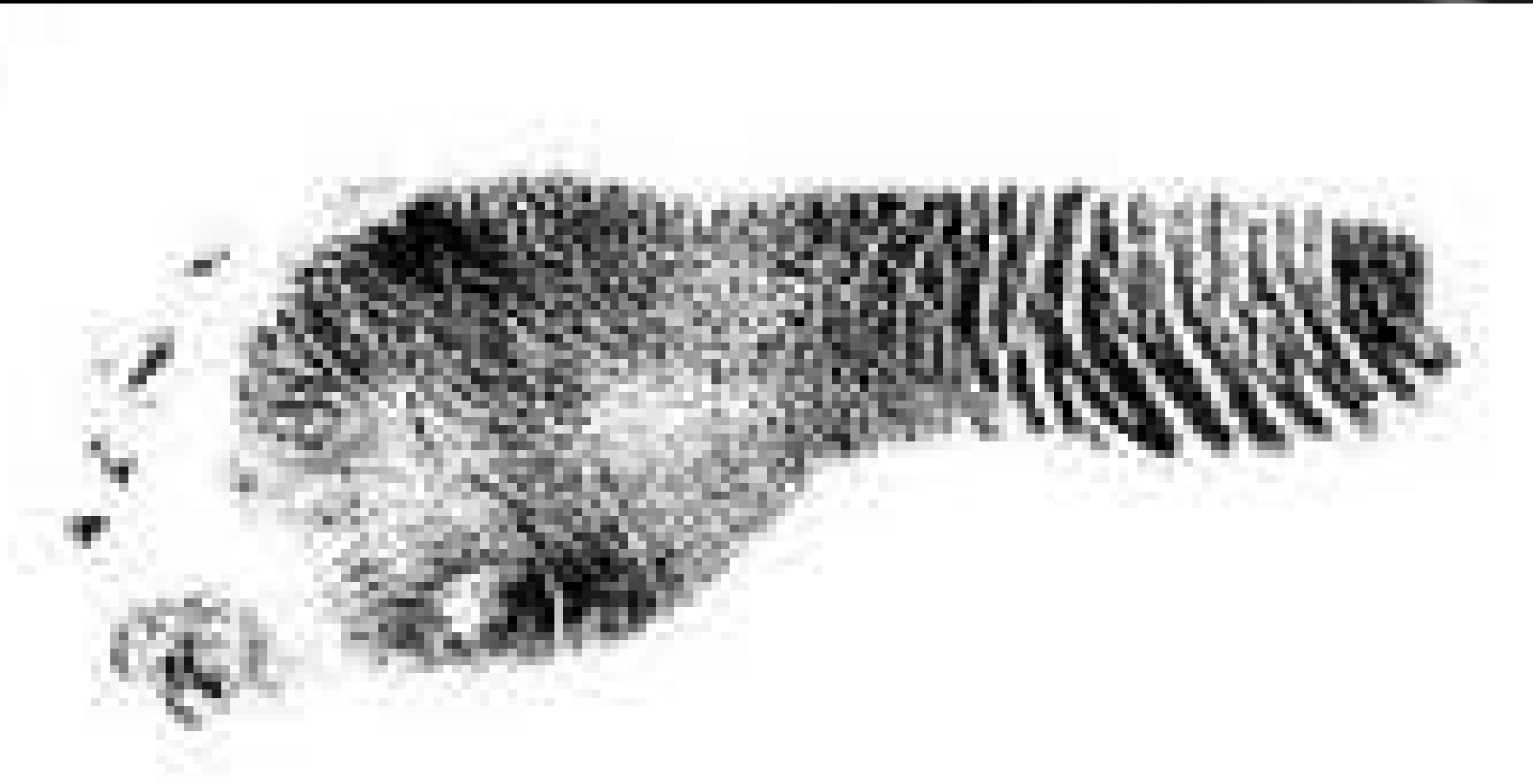
Appearance: Brownish print (fades quickly) Must be photographed or sprayed with starch solution

Other Prints

Palm: Contains ridges similar to fingers

Other Prints

Foot: Size of foot and toes, ridges

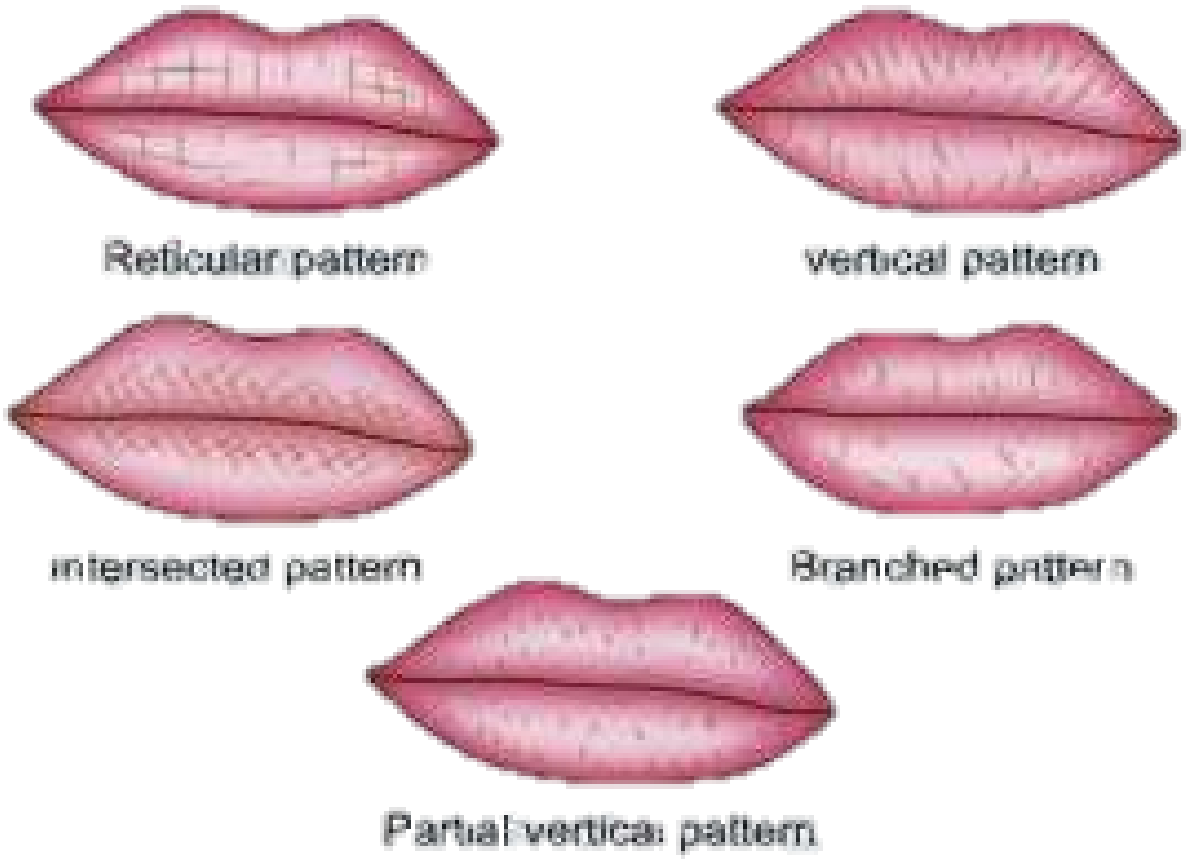


Other Prints

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

Other Prints

Lips: Several common patterns



Other Prints

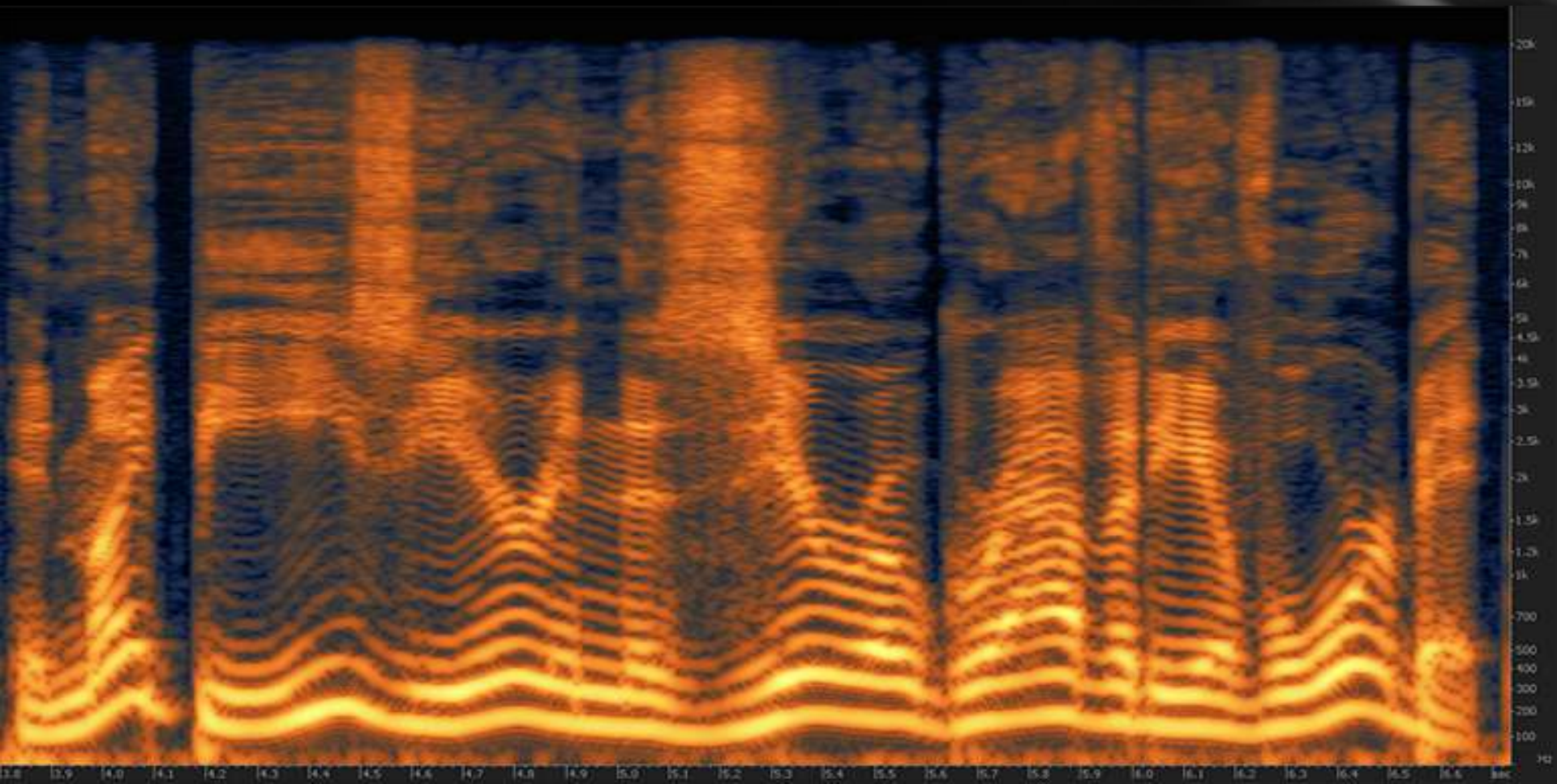
Teeth: Bite marks helped to convict Ted Bundy

Other Prints

Ear: Ear prints are just as unique as fingers

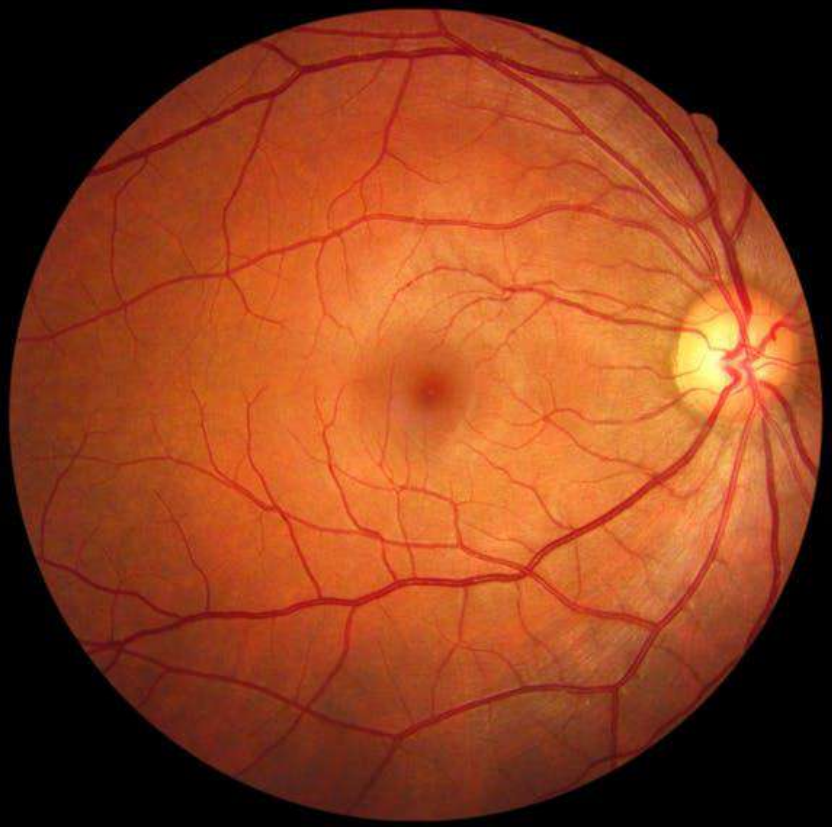
Other Prints

Voice: electronic pulses measured on a spectrograph

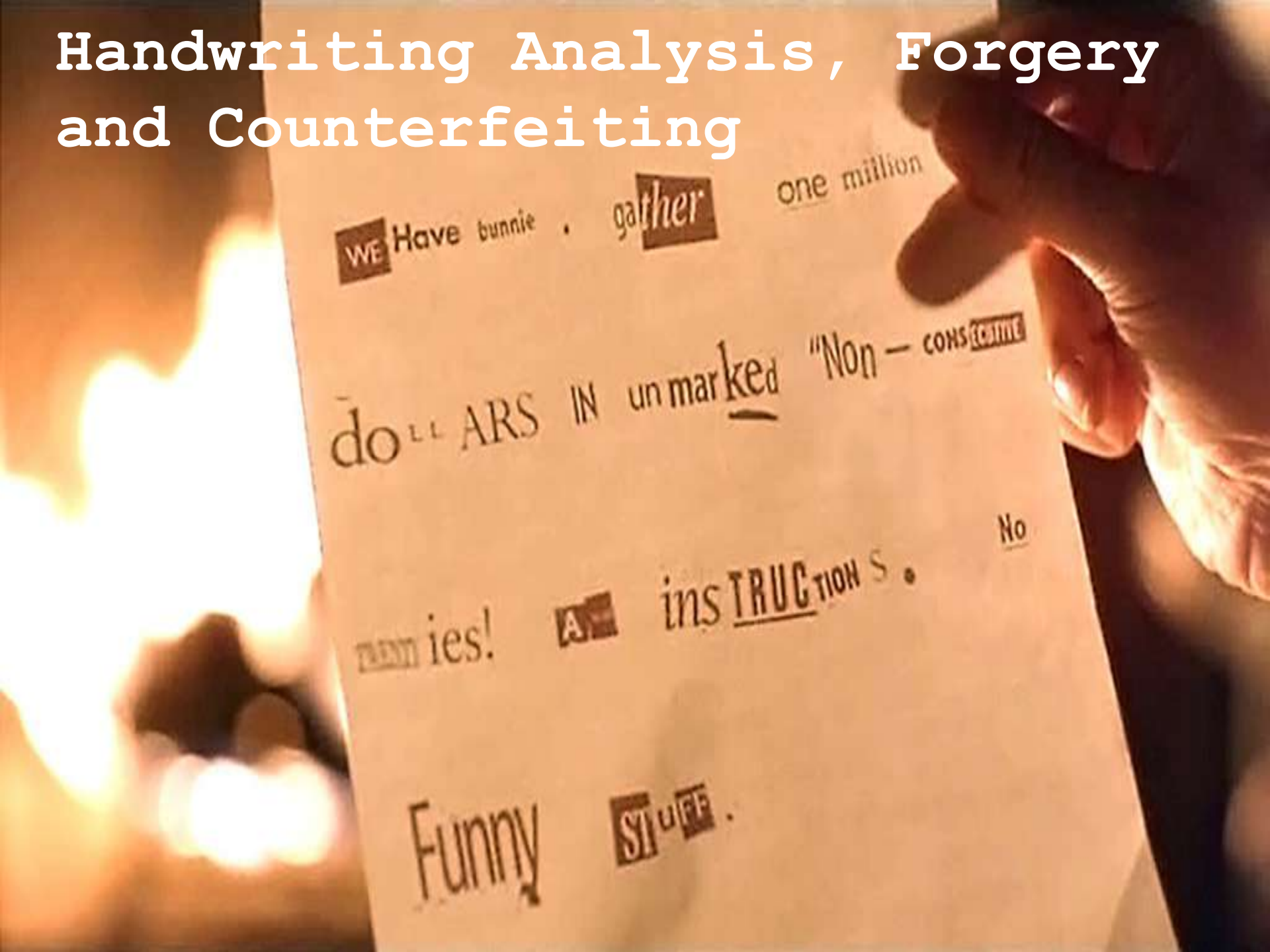


Other Prints

Retina: blood vessels in the eye are used in security



Handwriting Analysis, Forgery and Counterfeiting



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

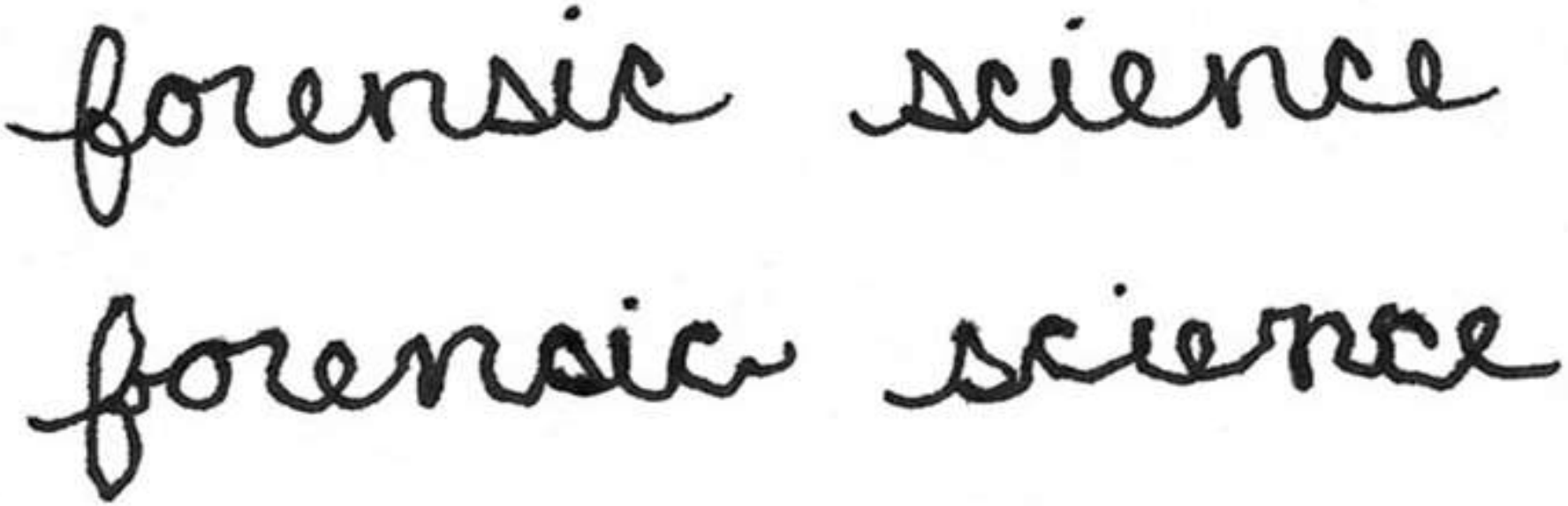
Compares handwriting samples objectively

Compared with samples stored in databases

Characteristics of Handwriting

1. Line Quality

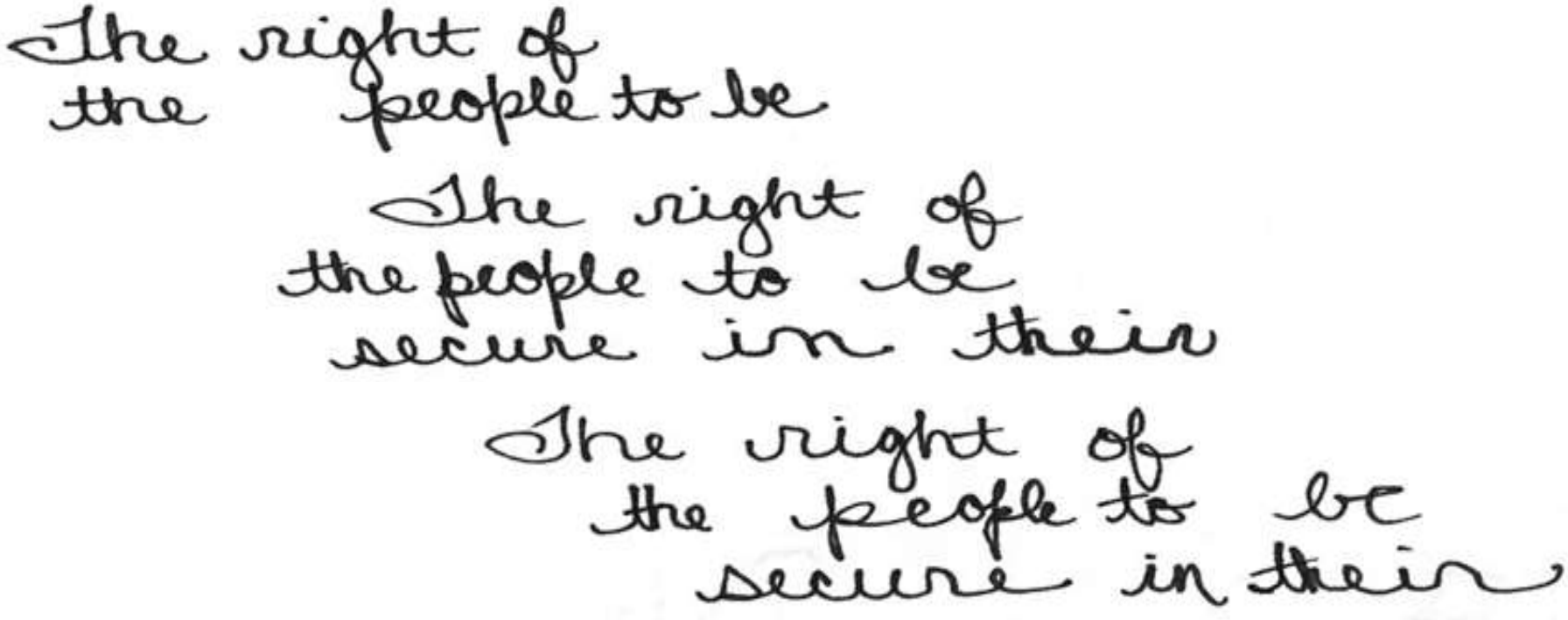
    Do the letters flow or are they erratic and shaky?



Characteristics of Handwriting

2. Spacing

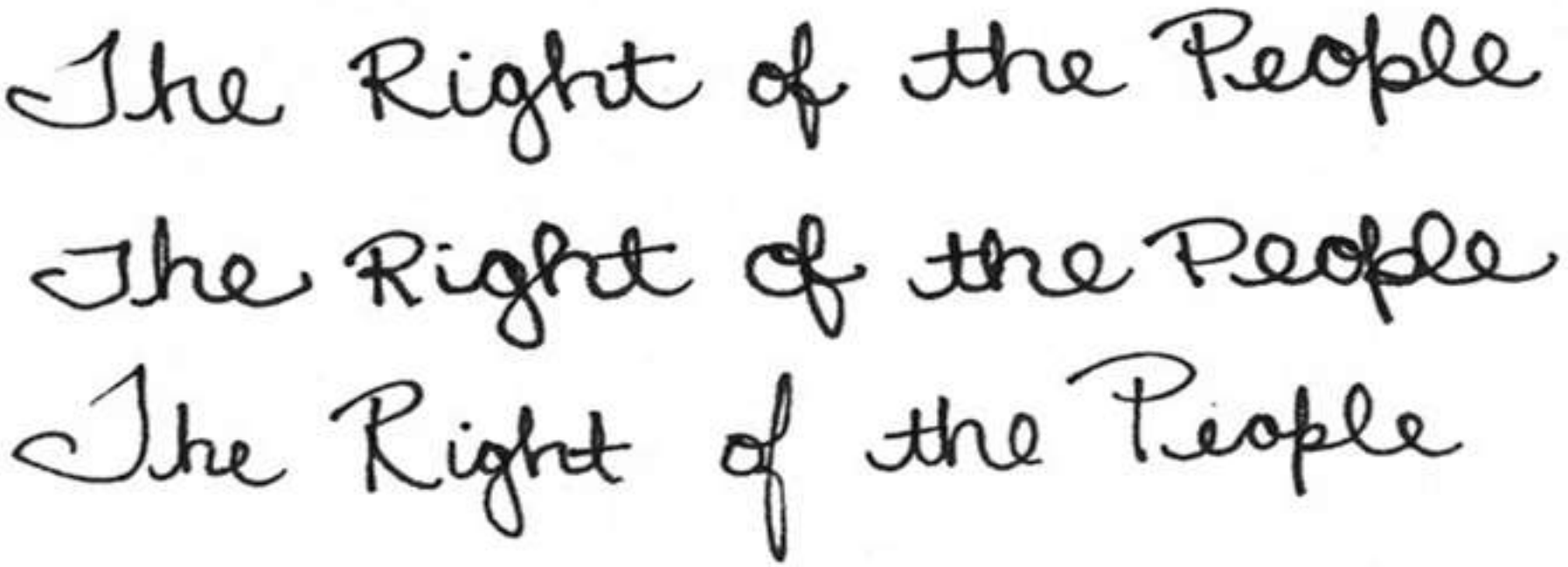
   Are the letters equally spaced or crowded?



Characteristics of Handwriting

3. Size Consistency

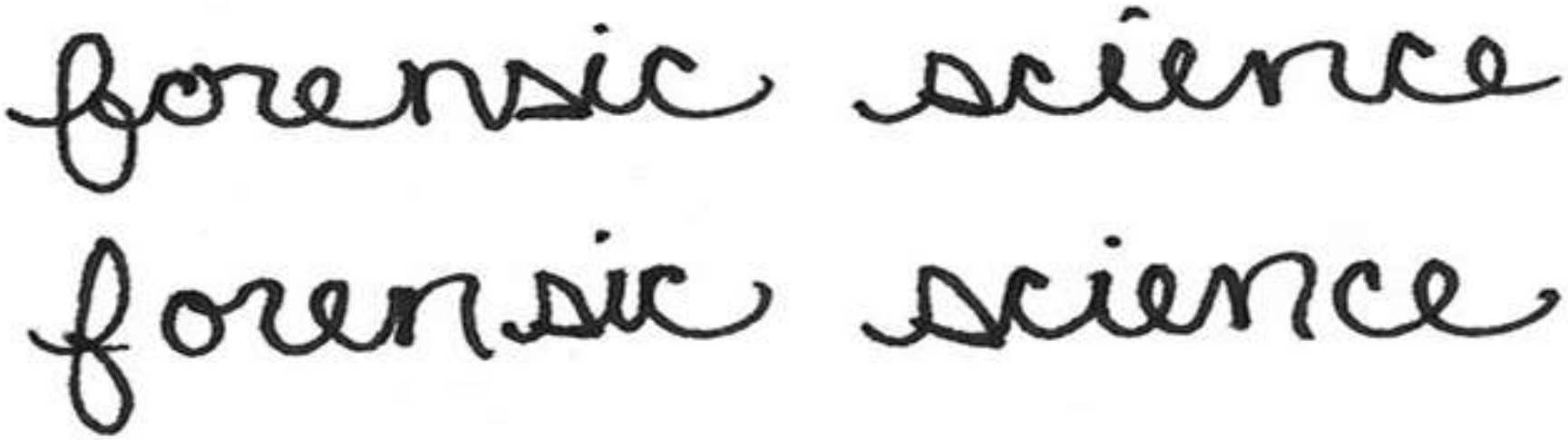
   Is the ratio of height to width is consistent or inconsistent?



Characteristics of Handwriting

4. Continuous

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



Characteristics of Handwriting

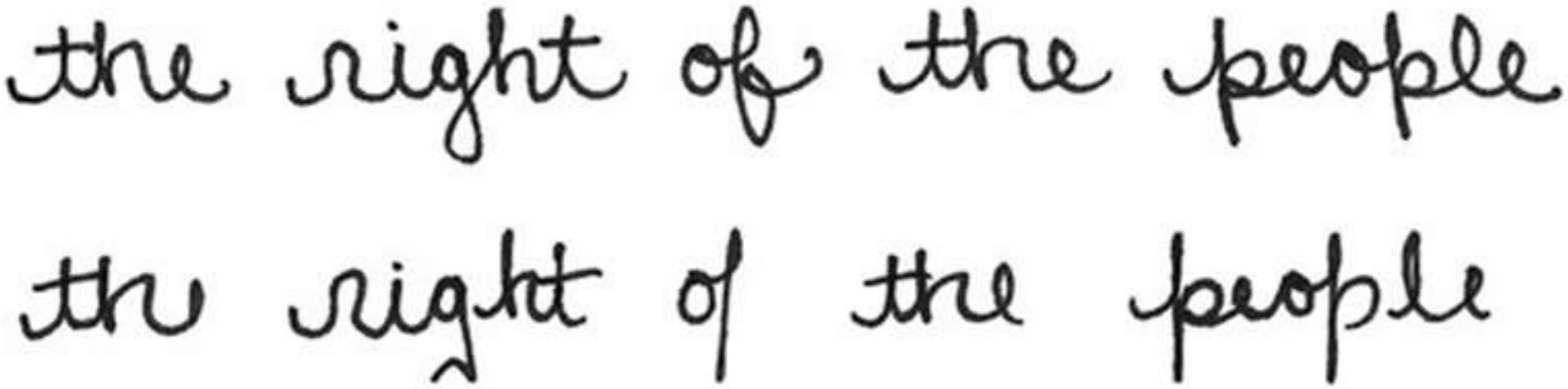
5. Connecting Letters

    Are capital and lower case letters connected or not?

Characteristics of Handwriting

6. Lettering Complete

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



Characteristics of Handwriting

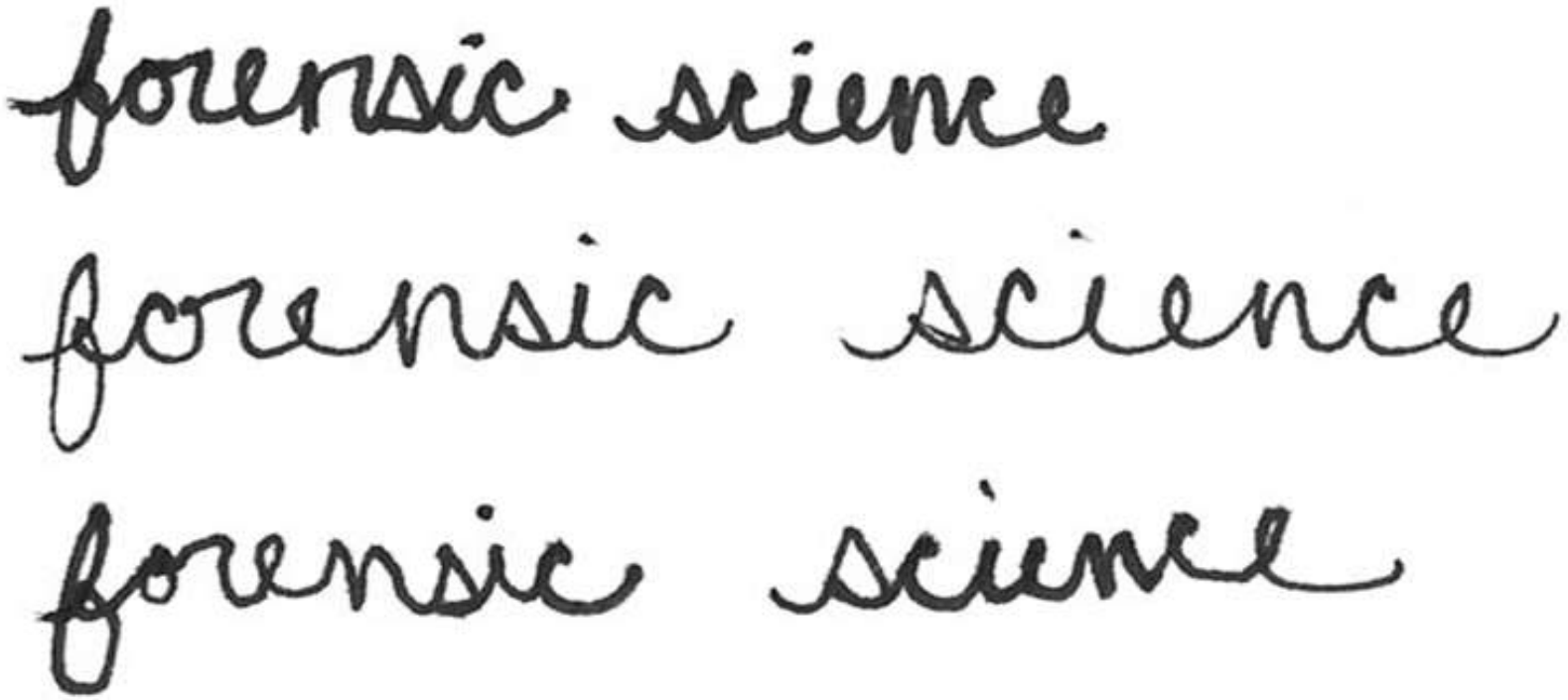
7. Cursive and Printed Letters

   Are letters in cursive, printed or both?

Characteristics of Handwriting

8. Pen Pressure

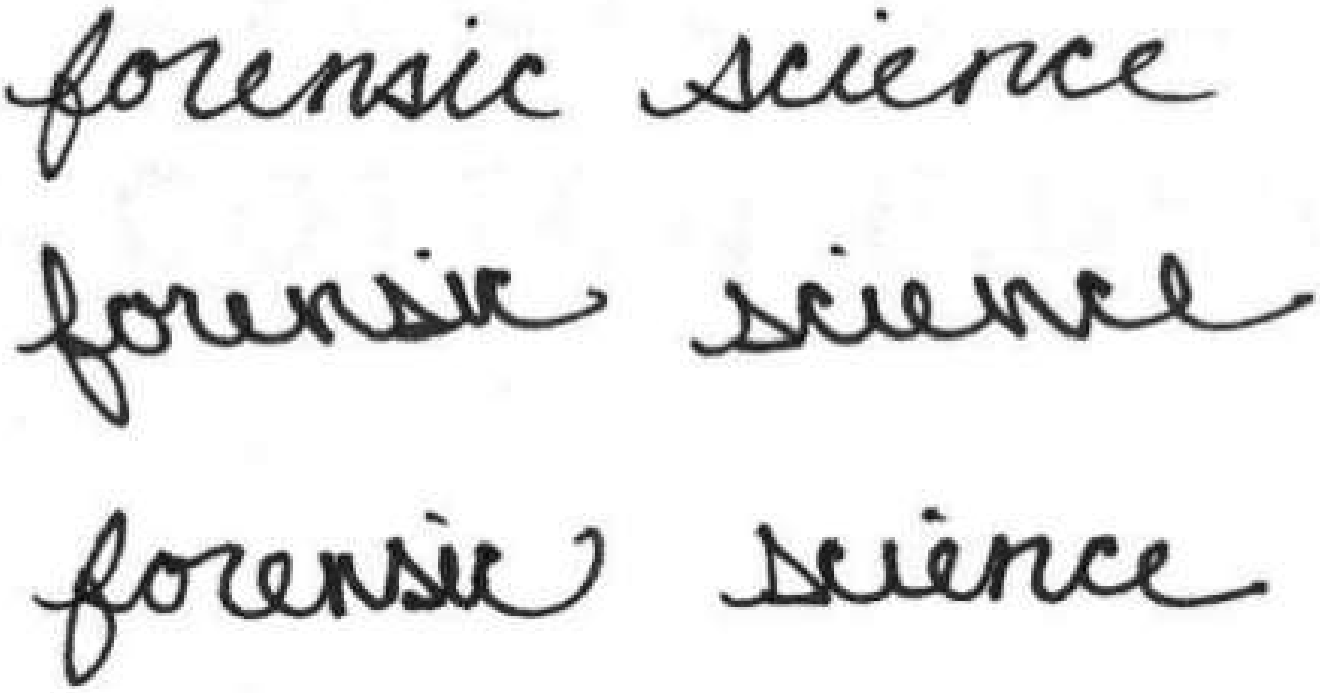
    Is equal pressure applied to upward and downward strokes?



Characteristics of Handwriting

9. Slant

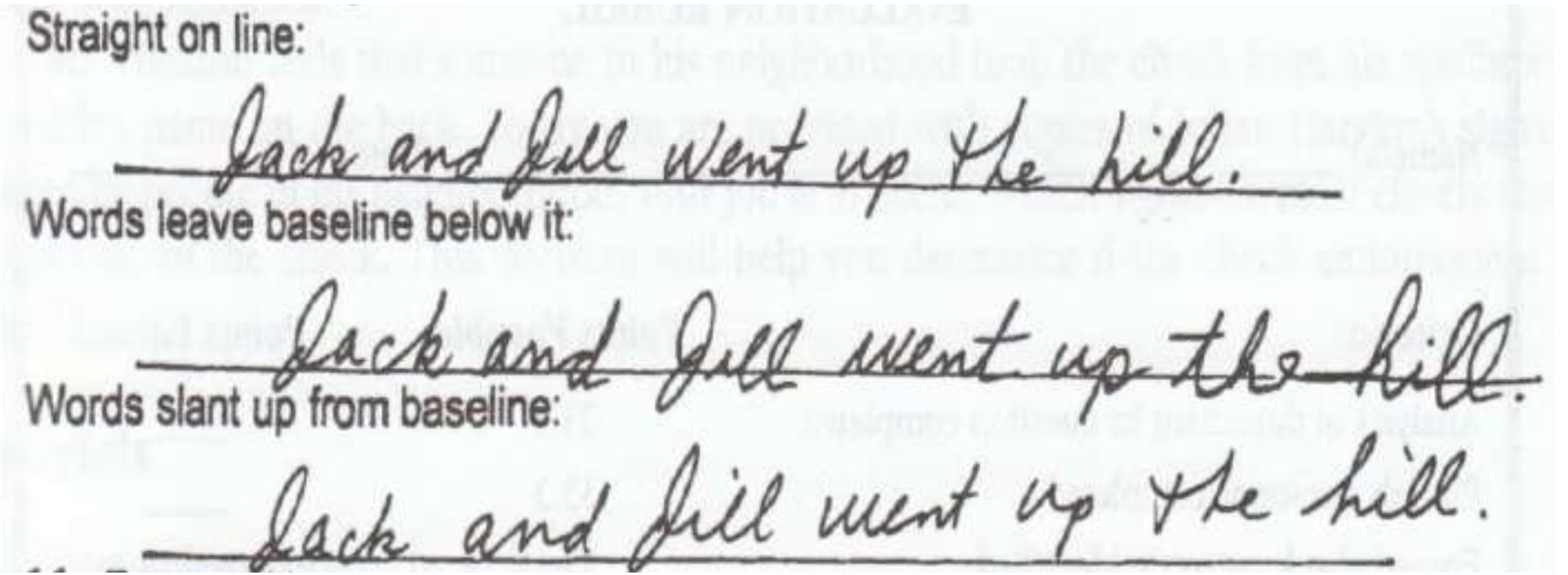
    If there is a slant does it slant left or right? Is it consistent?



Characteristics of Handwriting

10. Line Habits

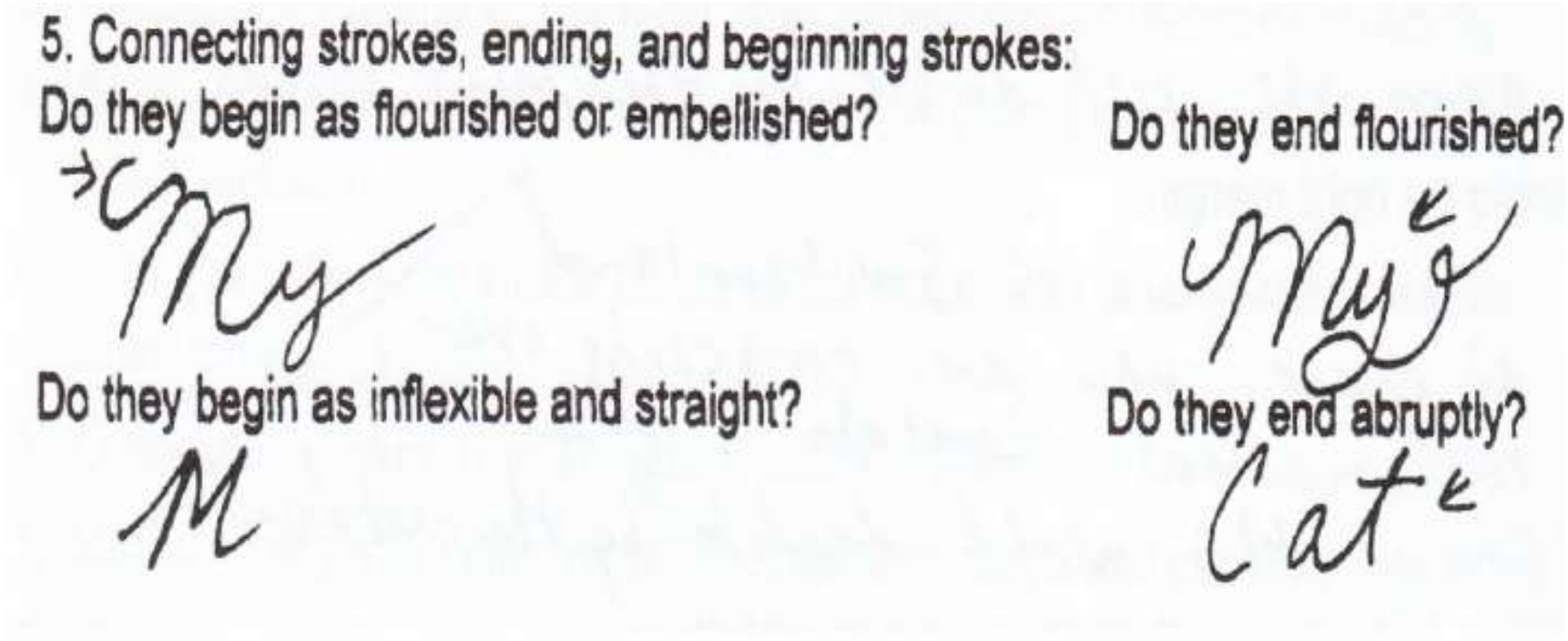
Is text on, below, or above the line?



Characteristics of Handwriting

11. Fancy Curls or Loops

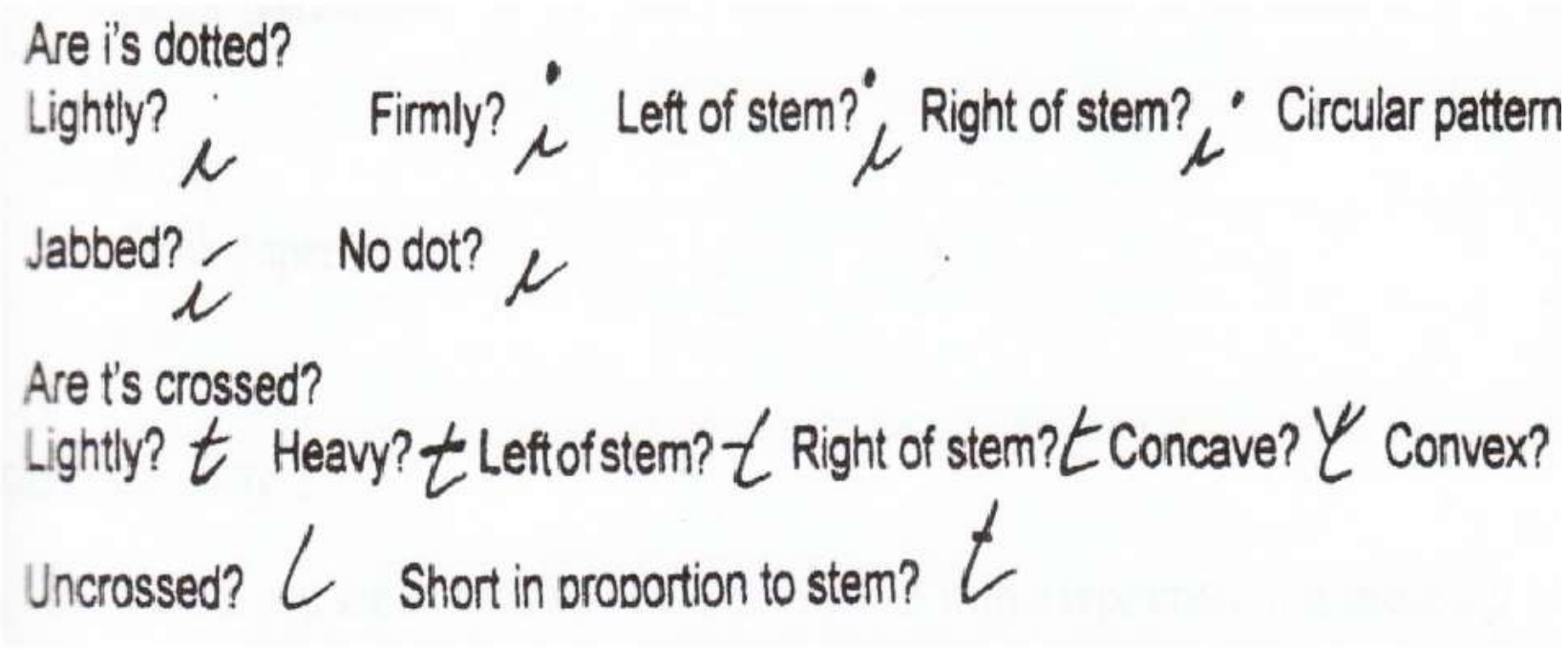
    Are there fancy curls?



Characteristics of Handwriting

12. Crossing "t"s and dotting "i's

    Are they correct or misplaced



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

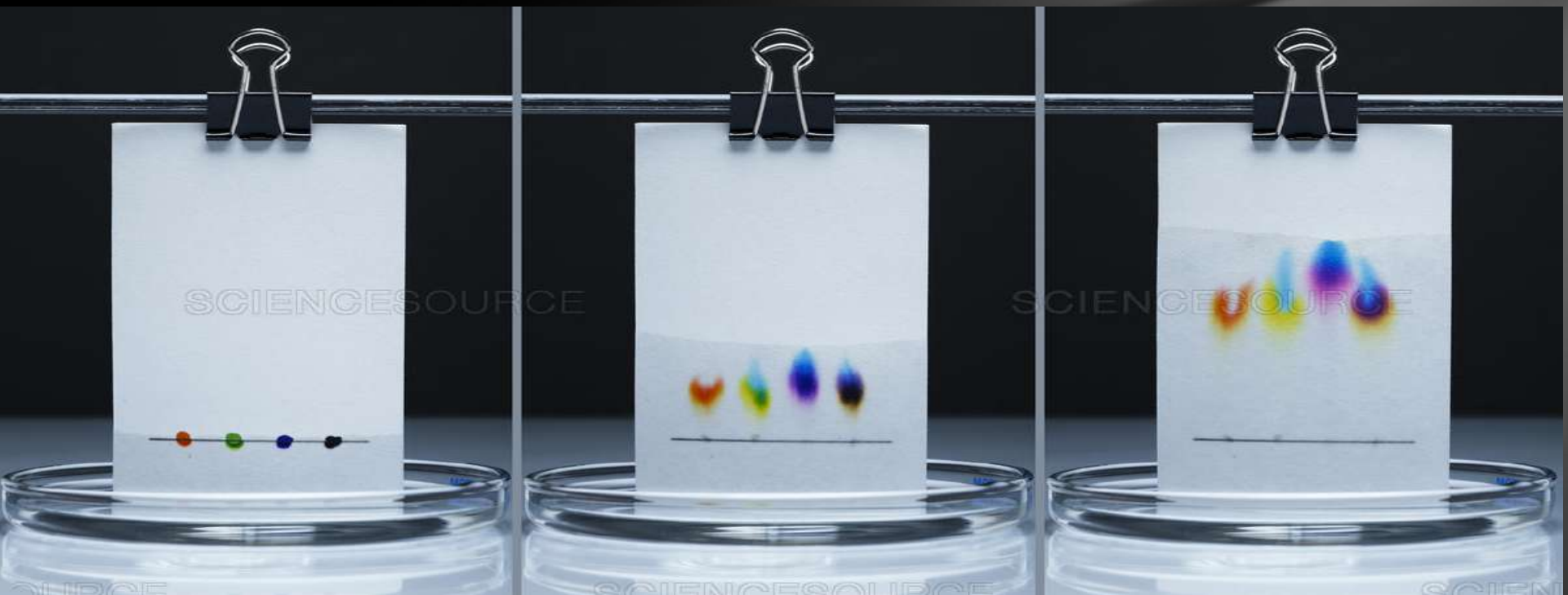
FEEL
Raised printing

TILT
Color-shifting numeral

CHECK
Watermark and security thread

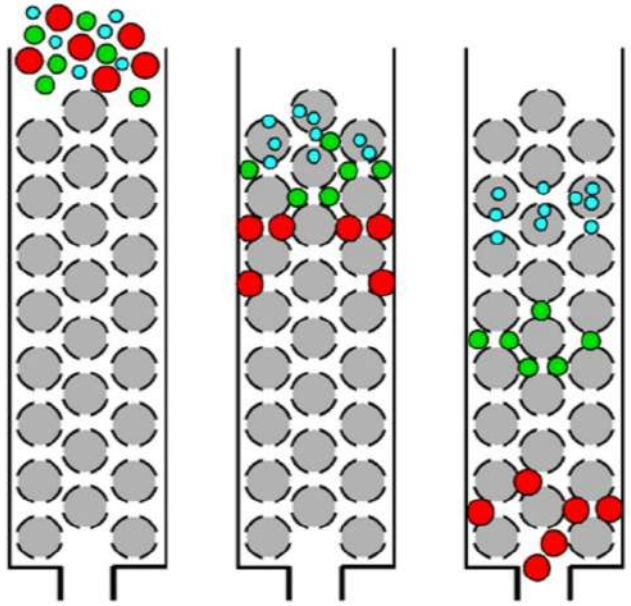
Analyzing Dyes

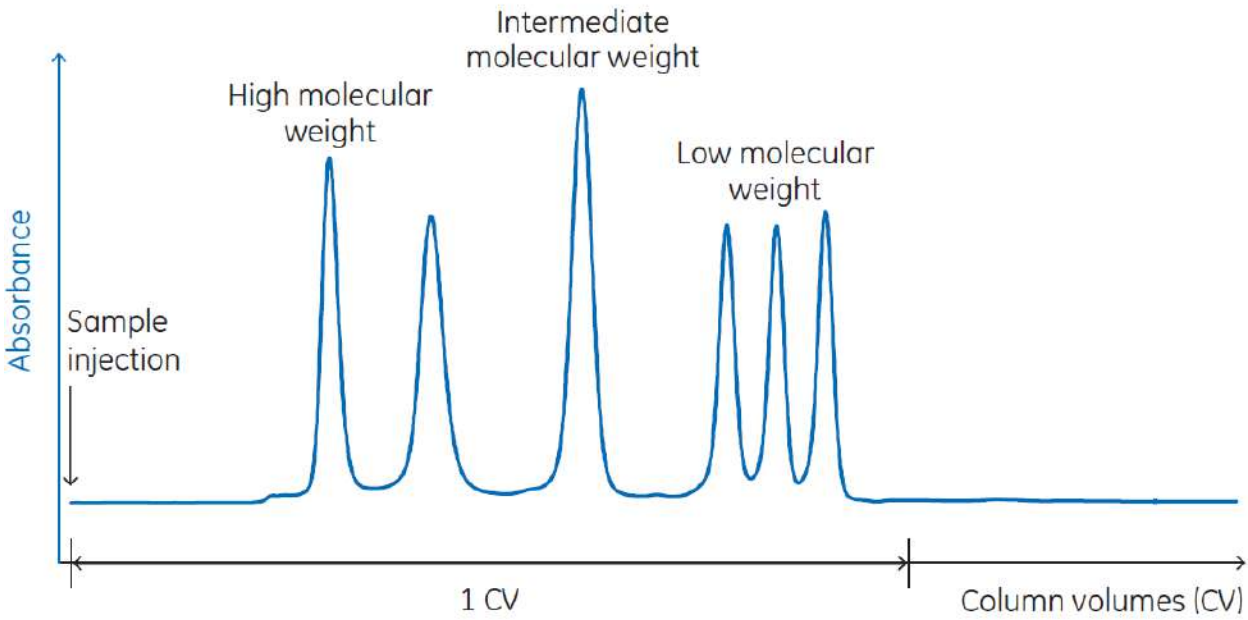
Paper Chromatography places a mixture on a solid phase, paper, which is then carried by a solvent as a mobile phase, usually water or alcohol. This separates components based on polarity.



Analyzing Dyes

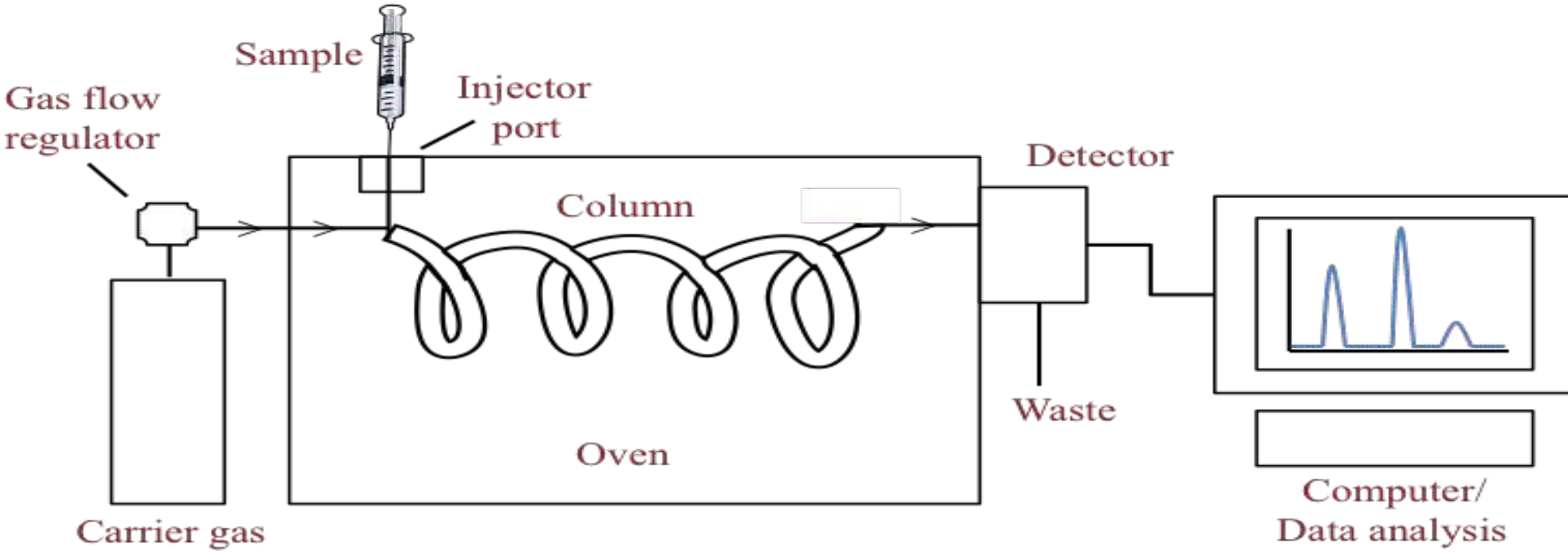
Size Exchange Chromatography allows a mixture to travel through beads with tiny holes in them. Smaller molecules travel quickly through the beads. Larger molecules get stuck and don't travel as quickly.





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.