NSTA 2013

Ward's Forensics: Crosscutting Concepts of Crime Scene Investigation

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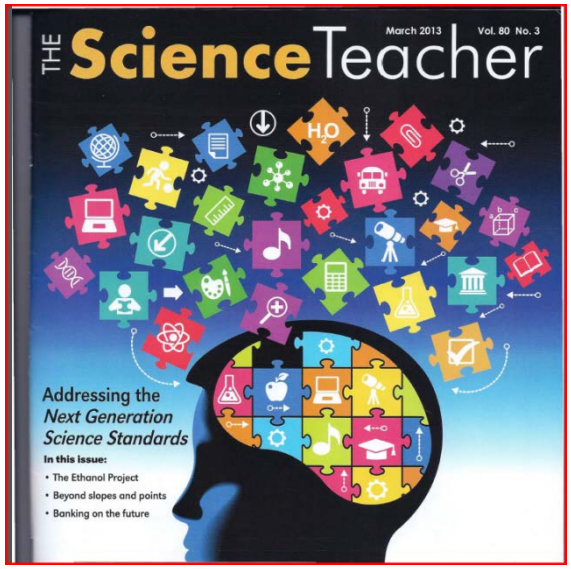
ward's science

How Can We Address Standards?

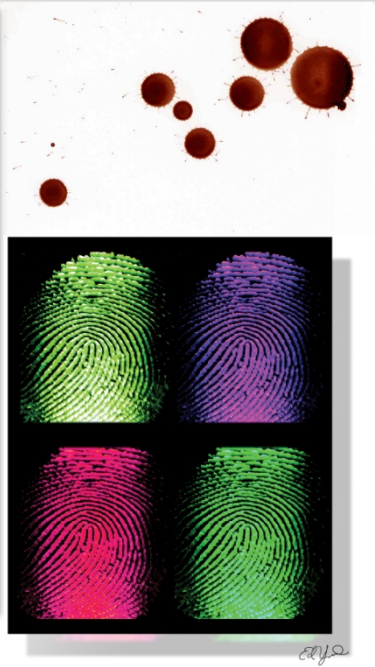


Science and Engineering Practices

- Ask Questions and/or Define Problems
- Develop and Use Models
- Plan and Carry Out Investigations
- Analyze and Interpret Data
- Use Mathematics and Computational Thinking
- Construct Explanations and/or Design Solutions
- Engage in Argument From Evidence
- Obtain, Evaluate, and Communicate Information

Crosscutting Concepts

- Patterns
- Cause and Effect
- Scale, Proportion and Quantity
- Systems and System Models
- Energy and Matter: Flows, Cycles, and Conservation
- Structure and Function
- Stability and Change

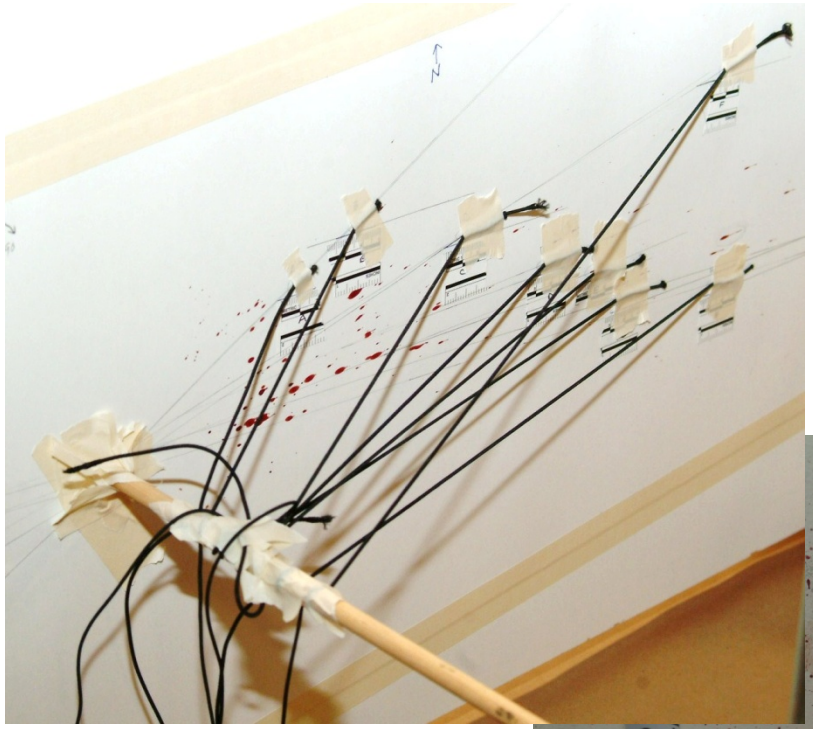


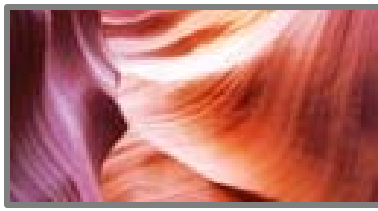
MS. Structure, Function and Information Processing

HS: Forces and Interactions

HS: Inheritance and Variation of Traits

Activity One: Bloodstain Pattern Analysis





Bloodstain Pattern Analysis

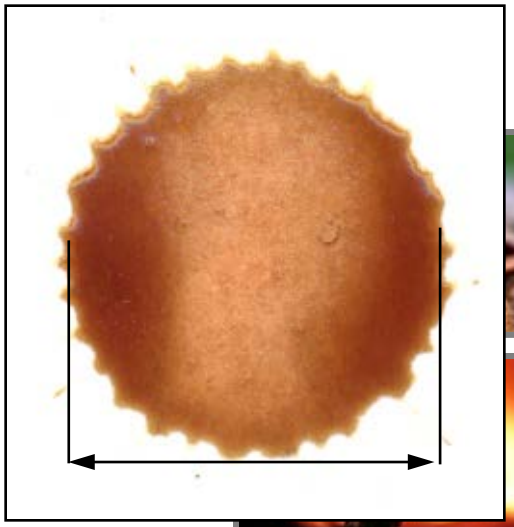
- Bloodstain patterns (blood spatter) indicate the dynamics of a crime scene
- BSPA (bloodstain pattern analysis) is an application of physics
- Physics: forces, projectile motion
- Mathematics: graphing, trigonometry
- Students LOVE blood spatter activities
- We will sample two activities today
  - Vertical blood drops
  - Angled blood drops




Drop Patterns from a Vertical Impact

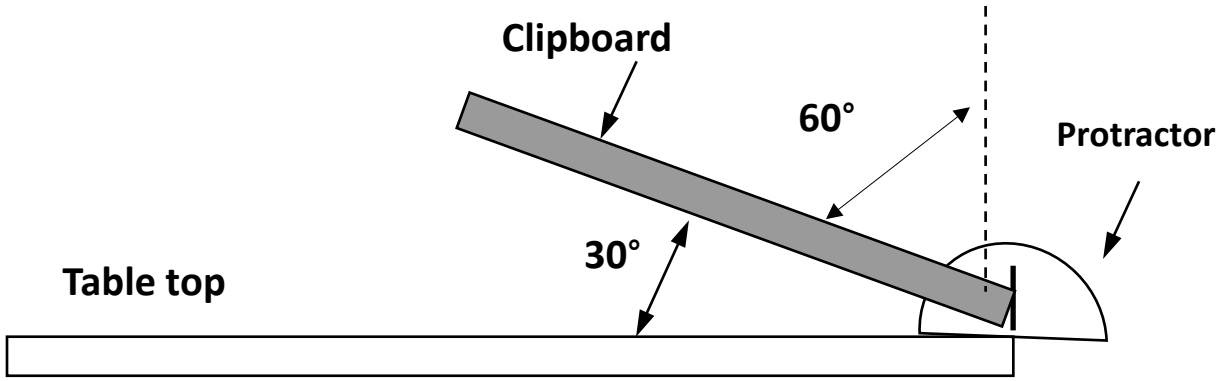
- Drop simulated blood from different heights on to a note card: 15, 30, 45, 60, 75, and 100 cm.
- Two-person job: one measures and one drops.
- Hold dropper bottle vertical.
- Keep target card flat.
- Drop 2-3 drops from each height.
- Don’t drop ‘drops’ on top of one another.
- Label, label, label.

Analysis of Vertical Drops



- Measure the diameter in millimeters.
- Measure multiple drops for each drop height, then average.
- Do not include the spines.
- Fill in the chart on your worksheet.
- Graph Drop Height vs. Diameter: Which are Independent/Dependent Variables?
- Discuss the results?
- How can this graph be useful?

Drop Patterns From an Angled Impact

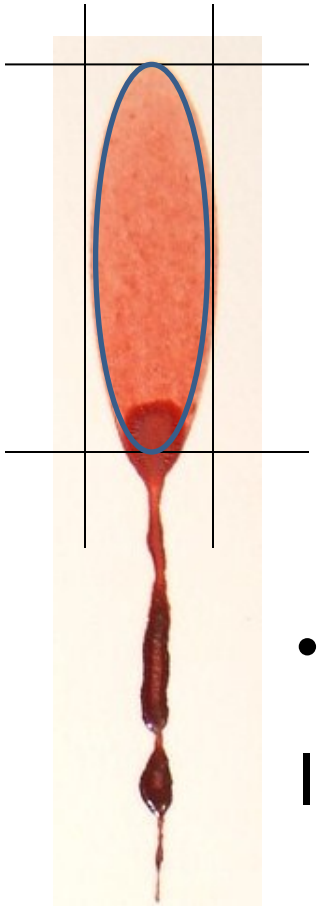


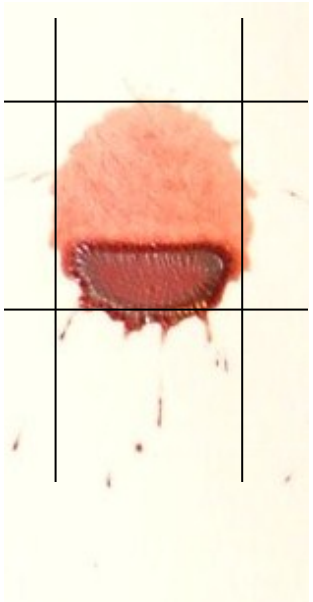
- Attach an index card to a clipboard.
- Adjust the index card to correct angle using protractor.
- Hold the dropper level.
- Angles to be tested: 20^0, 40^0, 60^0
- Bottle should be ~30 cm from the angled board surface.
- Drop 2-3 single drops onto the card.
- Hold to count of ten, drop board, and unclip note card.
- LABEL!

Model This! ☺

Measuring Angled Blood Drops

- Only measure the body of the drop—No spines or tails!

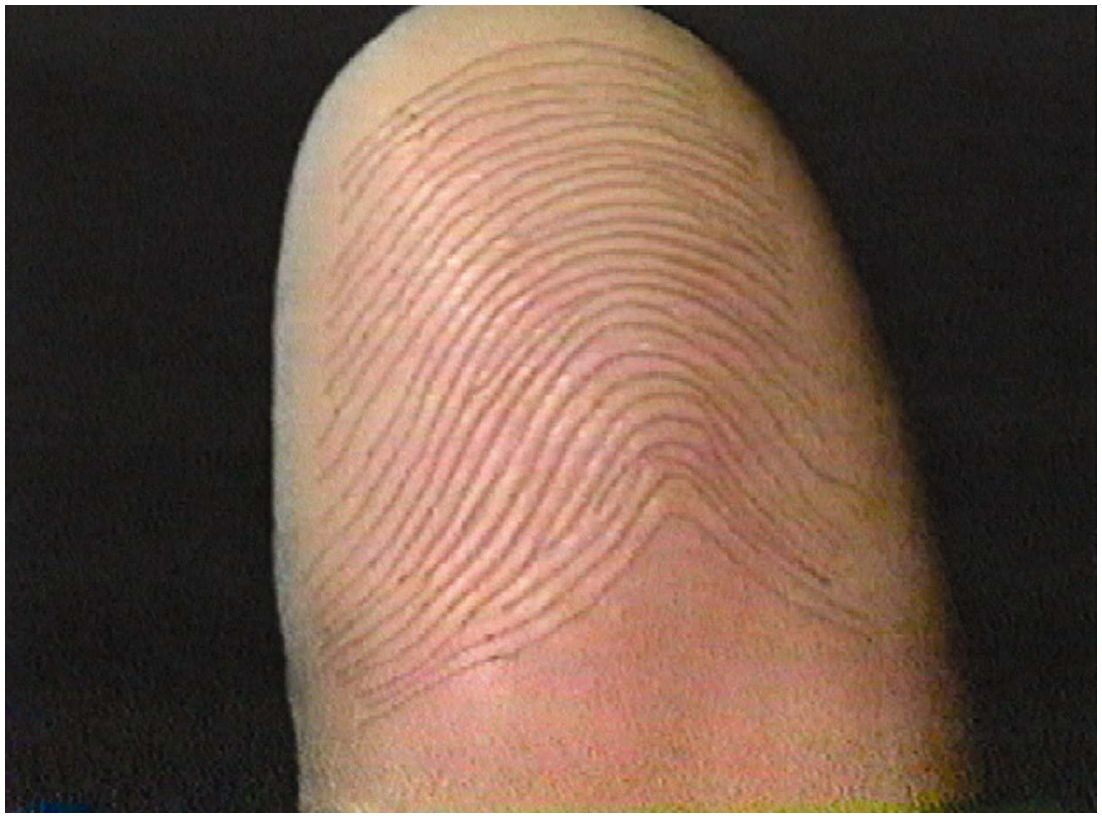




- Then calculate the impact angle

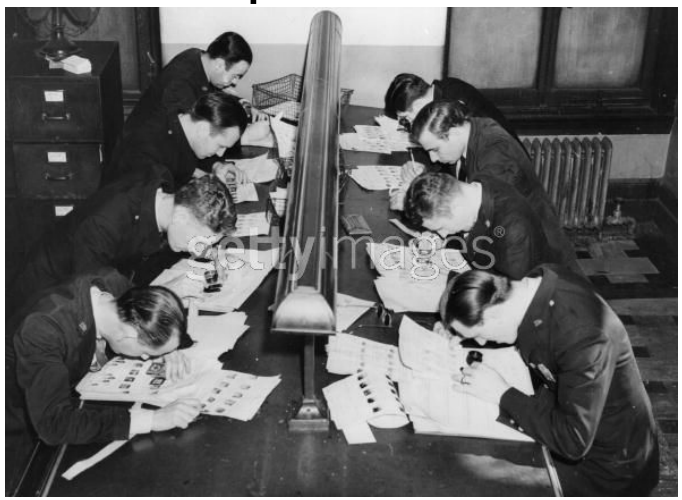
$$\text{Impact angle} = (\sin^{-1})\frac{\text{Width}}{\text{Length}}$$

Activity Two: Fingerprint Analysis

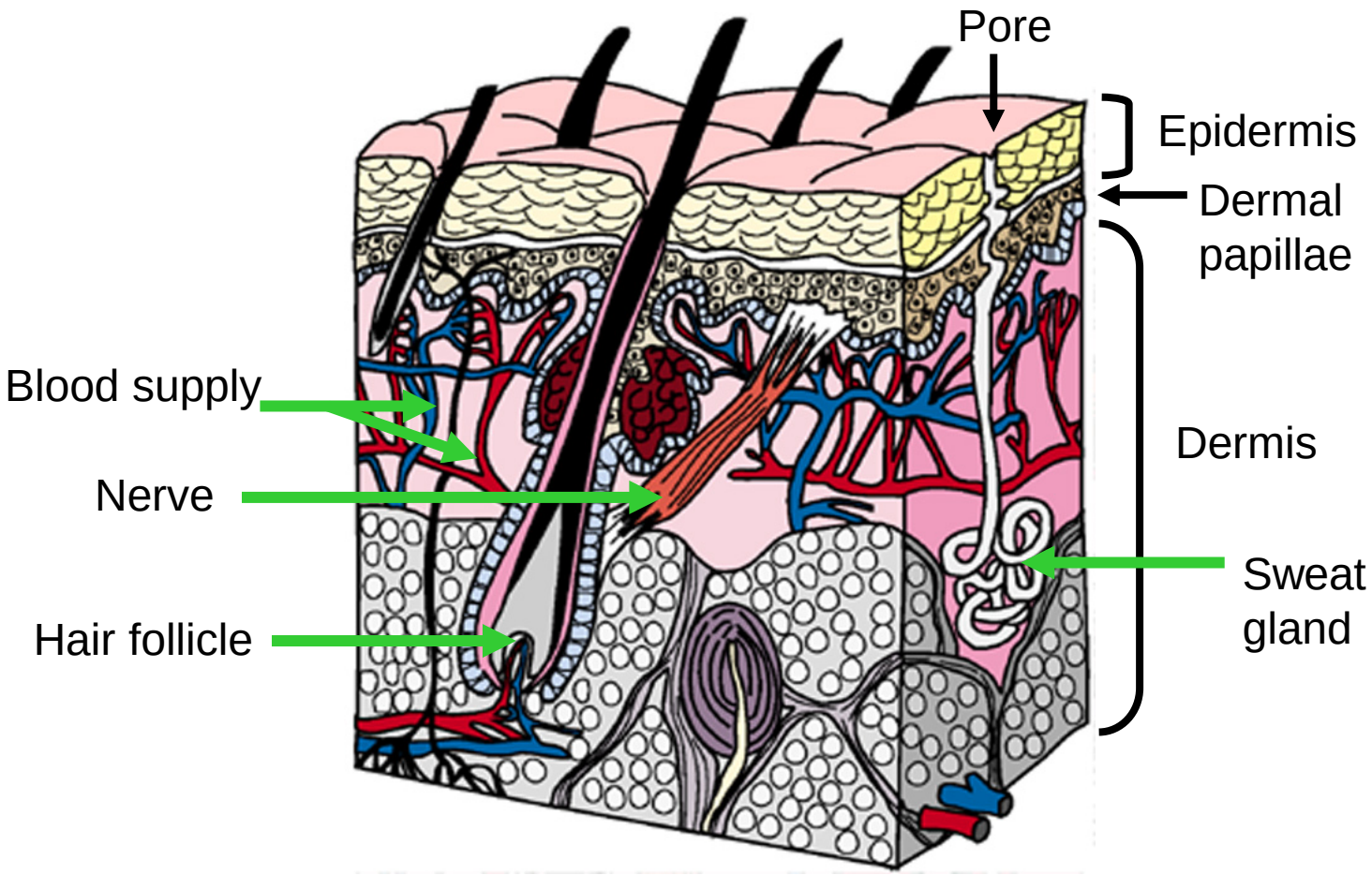


Fingerprints: Major Form of ID

- Major goal of investigation process is to identify people
- All individuals have unique set of fingerprints—even identical twins
- At this time, fingerprint ridge characteristics are considered to be individual evidence (as opposed to class evidence)
- *Dactyloscopy*: Science of comparison of friction ridge structures

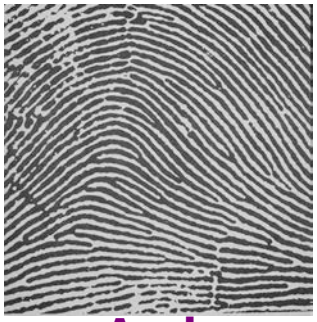


Structure of the Skin



3 Major Types of Fingerprint Patterns—Arches, Loops, Whorls

- Categorized by the presence or absence of a *delta* (triangular intersection of ridges)
- An Arch has NO deltas
- A Loop has ONE delta
- A Whorl has TWO deltas



Arch

Loop

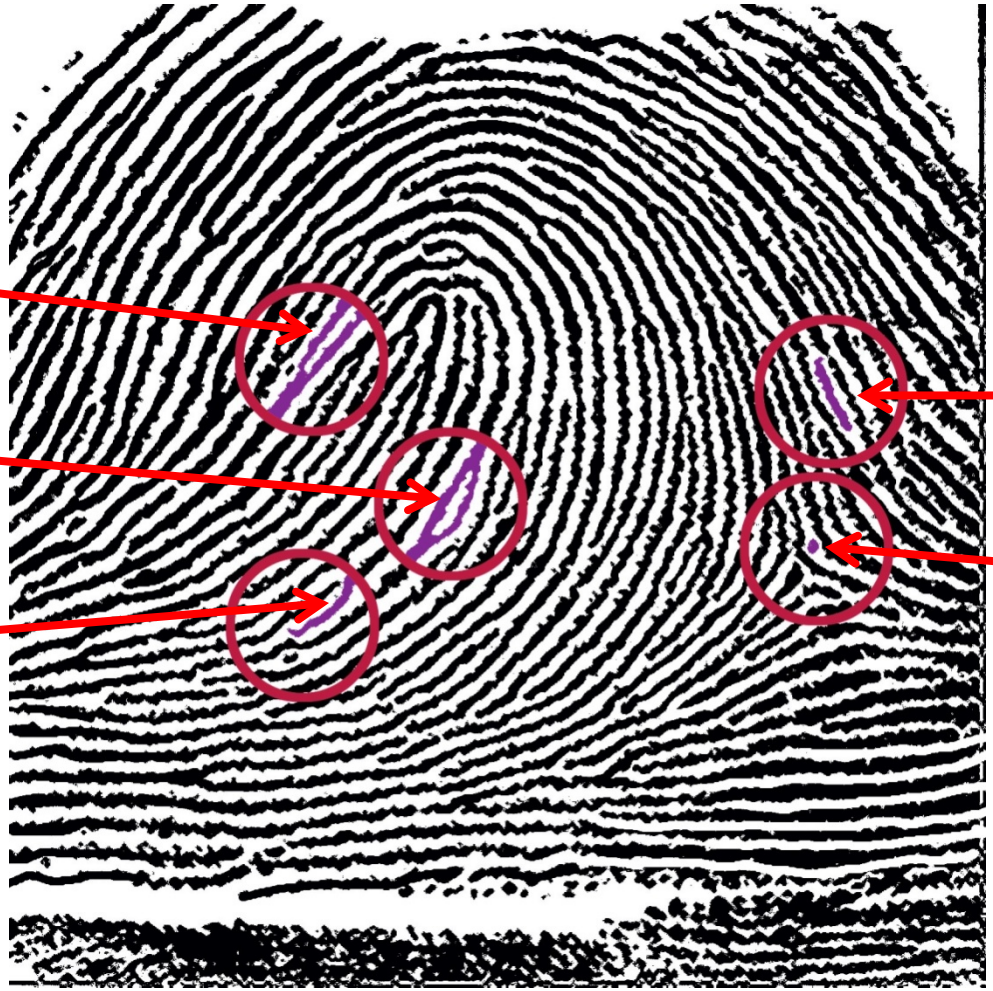
Whorl

Ridge Characteristics or Minutiae

a. Bifurcation

b. Enclosure

c. Ending ridge

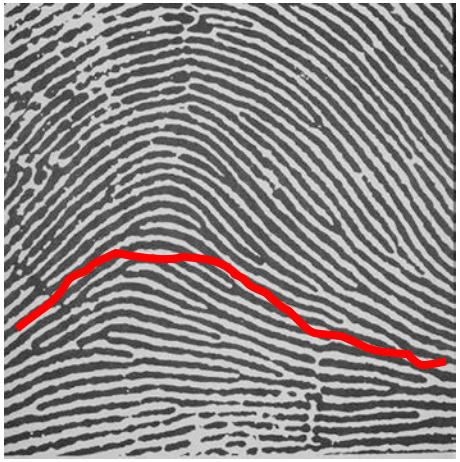


d. Short ridge

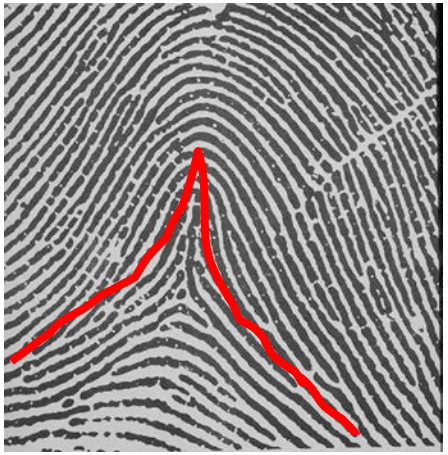
e. Dot

Arches

- Arch patterns differ in severity of slope of arch
- Two types of patterns: Plain and Tented
- 5% of fingerprints

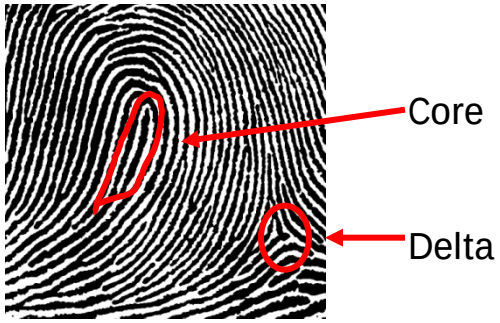


Plain Arch

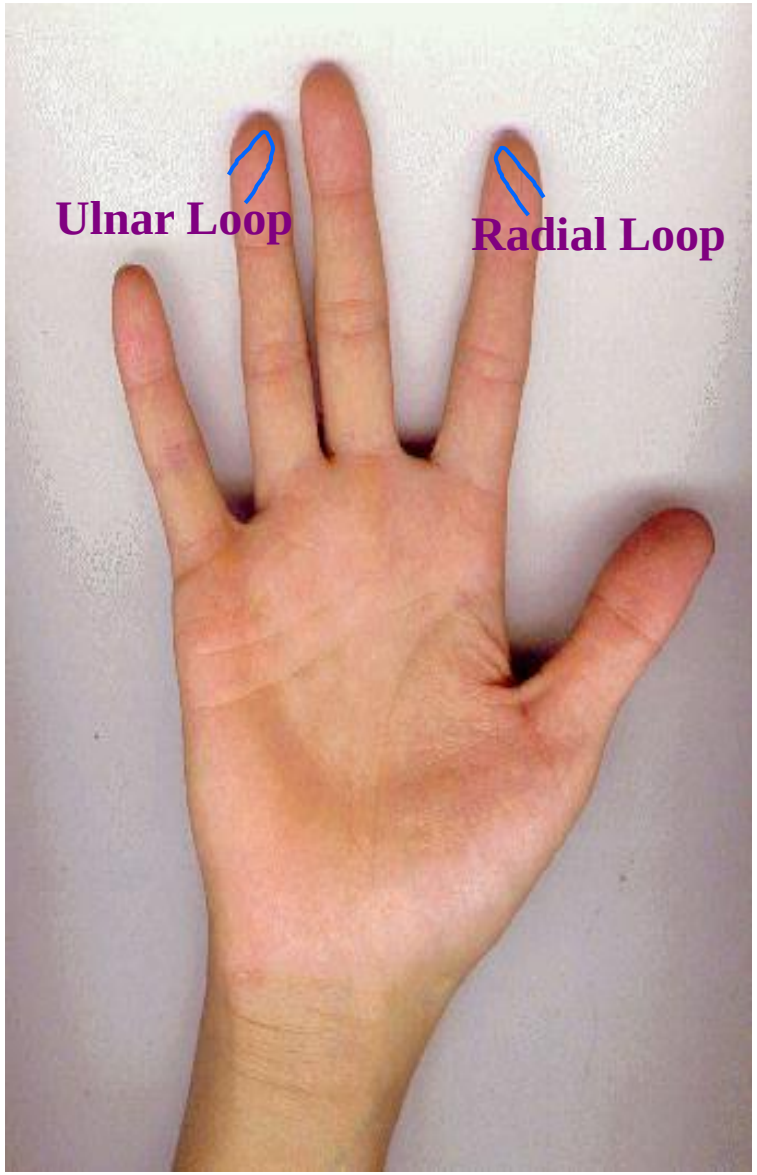


Tented Arch

Loops



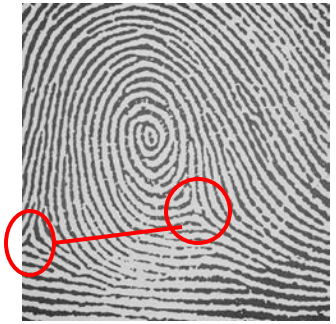
- Loop ridges enter from either side of the finger, re-curve and pass back along the side from which they entered
- Loops are identified by the direction loop opens to—known as radial (thumb side) or ulnar (little finger side)
- Nearly 65% of prints are loops



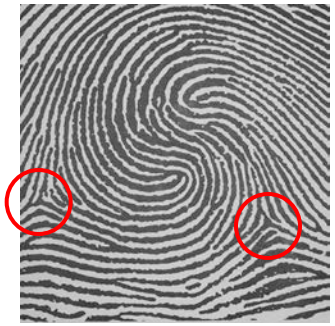
Whorls

- Whorls: all have 2 Deltas
- Four types of whorls
  - Plain
  - Double loop
  - Central pocket loop
  - Accidental
- Make up about 30% of fingerprints

Plain Whorl



Central Pocket Loop Whorl



Double Loop Whorl

Accidental Whorl

Proper Method of Inking Fingerprints

Roll Fingerprints Nail to Nail

Loop

INCORRECT

1) Delta needs to be present in a Loop pattern.

Whorl

INCORRECT

2) Deltas need to be present in a Whorl pattern.

Loop

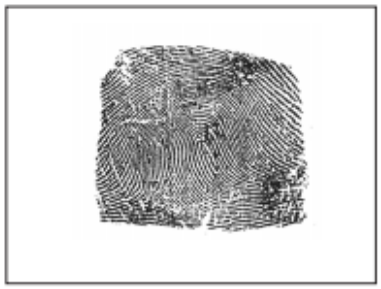
Whorl

CORRECT

1) Roll finger in a smooth continuous motion from nail to nail.
2) Roll thumbs towards subject. Roll fingers away from the subject.
3) Ensure entire first joint of the finger is in constant contact with the card.

Complete Pattern Area Not Present in Rolled Impressions

INCORRECT



CORRECT

http://www.fbi.gov/about-us/cjis/fingerprints_biometrics/recording-legible-fingerprints/capturing-legible-fingerprints

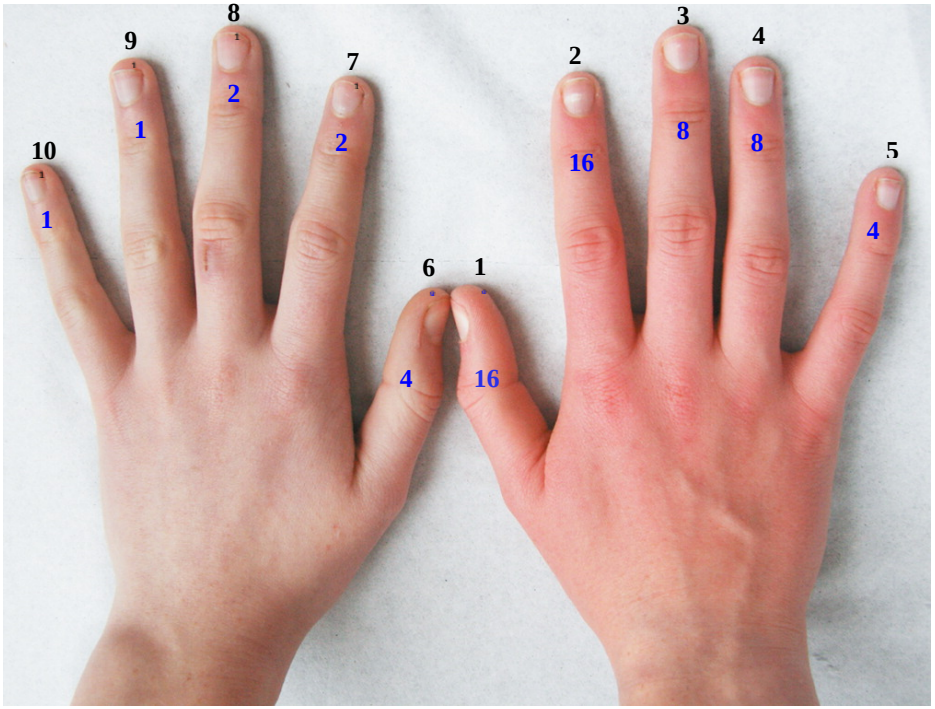
Activity: Roll your fingerprints!

- Practice first on scrap paper
- Paper is always at edge of table
- Wrists parallel and in line with table
- Nail bed to nail bed; fingertip to joint crease!
- Roll thumbs towards you; fingers away from you (It should feel awkward)
- Correct inking is a RECTANGLE!
- When finished IDENTIFY your fingerprint patterns: Arches, Loops or Whorls.
- Tally the group, calculate averages, compare to “literature values”

Other Fingerprint Mathematics

- Calculate the Henry Number

Henry System Value Chart



Black numbers = Finger number
Blue numbers = Finger value (if it is a whorl)

$$Henry\_Classification\_Formula = \frac{1+(even\_finger\_values\_for\_whorls)}{1+(odd\_finger\_values\_for\_whorls)}$$




Materials

- Fingerprint Kits from Wards
  - Magnetic Fingerprinting Kit
  - Perfect Print Ink Pads
  - Dusting Materials
- Introduction to Blood Spatter Kit
- Advanced Blood Spatter Kit
- Simulated Blood for Blood Spatter

- Book for Mathematics of FP: *Classifying Fingerprints,* by Nancy Cook (Amazon)
- *Forensic Science, The Basics,* by Jay A. Siegel and Kathy Mirakovits, 2nd Ed.
  - Lab Book coming out soon and 3rd Edition.




Thank You!