## Development of Latent Prints

### Rationale
Forensic Fingerprint Examiners are often expected to develop latent fingerprints on items of evidence before comparisons of fingerprints can be made.

### Objectives
The student will be able to:
1. Identify the factors affecting fingerprints.
2. Select appropriate techniques for the development of latent prints on various surfaces.

### Engage
Gently rub your nose with your fingers then plant your fingerprints on a white plastic surface such as the cover of a white binder. Show the students that the fingerprints are not visible. Apply a small amount of black fingerprint powder to a fingerprinting brush and gently swirl the brush over the area to bring up the fingerprints. Explain the difference between latent and plastic fingerprints.

### Key Points

#### I. Types of Fingerprint Impressions
- **Patent fingerprints** – visible prints left on a smooth surface when blood, ink, or some other liquid comes into contact with the hands and is then transferred to the surface.
- **Plastic fingerprints** – actual indentations left in some soft materials such as clay, putty, wax, or dust.
- **Latent fingerprints** – hidden prints caused by the transfer of oils and other bodily secretions onto a surface. They can be made visible by different methods (dusting with powders, chemical reactions, etc.).

#### II. Fingerprint Powders are applied lightly to a nonabsorbent surface with a soft brush. They readily adhere to sweat residues and/or deposits of body oils left on the surface.
- **Gray and black powders** are the most common, and are chosen to create the best contrast with the surface.
- **Magnetic powder** is applied with a special brush on leather and rough plastic surfaces.
- **Fluorescent powders** are used to photograph latent prints on multi-colored surfaces. They fluoresce under ultraviolet light.

#### III. Fingerprint Chemicals
- **Ninhydrin** reacts with amino acids in sweat to form purple-blue prints. A 0.6% solution (in ethanol) is sprayed onto porous surfaces such as paper.

<table>
<thead>
<tr>
<th>Course</th>
<th>Forensic Science</th>
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<tbody>
<tr>
<td><strong>Unit IX</strong></td>
<td>Fingerprints</td>
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<tr>
<td><strong>Essential Question</strong></td>
<td>How do they develop fingerprints that may not be visible?</td>
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<tr>
<td><strong>Prior Student Learning</strong></td>
<td>- History of Fingerprints - Classification of Fingerprints - Minutiae</td>
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<tr>
<td><strong>Estimated Time</strong></td>
<td>1 ½ hours lecture 1+ hour lab</td>
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</table>
B. Physical Developer is a silver nitrate-based liquid reagent used on porous surfaces. It is often used as the last resort because it destroys protein.

C. Cyanoacrylate (superglue) fuming was developed in 1982 by Japanese Police. It is used on a variety of materials, not only to visualize latent prints, but also to semi-permanently affix them to the surface.

D. DFO (1,8-diazafluotrn-9-one) is a newer replacement chemical for ninhydrin. It is 2.5 times more sensitive than ninhydrin.

E. Rhodamine 6G is a fluorescent dye that may be used after cyanoacrylate fuming to visualize latent prints under laser light.

F. Iodine fuming is one of the oldest latent print development methods. Solid iodine crystals sublime, and the vapor will react with fatty oils and some sweat residue. Iodine prints are not permanent and will begin to fade once the fuming process is stopped.

G. Gentian violet (or crystal violet) is used for developing latent prints on the adhesive side of tape. An aqueous solution of crystal violet is sprayed directly onto the adhesive.

H. Amido Black is a protein dye stain that can develop faint bloody fingerprints on porous and nonporous surfaces.

I. LCV (Leuco Crystal Violet) is a protein stain spray that can develop faint or invisible bloody fingerprints on non-porous surfaces.

IV. Preservation of developed latent prints
   A. Photograph
   B. Covering the prints to preserve it in its entirety (if on a small object)
   C. Lifting the prints with adhesive tape and placing the tape with prints on a card with labels

V. Composition of fingerprints
   A. Sweat
      1. 99.0-99.5% water
      2. 0.5-1.0% solids
         a) 50% organic solids (mostly amino acids)
         b) 50% inorganic solids (NaCl and KCl)
   B. Contaminants
      1. Bodily fluids (blood, saliva, nasal secretions, semen, etc.)
      2. Oils and fats (sebum)

VI. Factors affecting fingerprints
   A. Age – thinner epidermis, flattening of dermal papillae, creases, etc.
   B. Fine ridge structure – less skin contact leads to a spotty appearance.
   C. Stimuli – sweating can be due to warmth, exertion, fever, drugs, anxiety, tension, pain, or spicy foods.
   D. Occupational and medical condition – teaching, and other positions
in which a person handles or shuffles papers, can cause fine ridge structure.

E. Transposal factors
   1. Receiving surface texture
   2. Contaminants on the hands
   3. Contaminants on the receiving surface
   4. The manner of contact
   5. The amount of pressure

F. Environmental factors
   1. Temperature
   2. Humidity
   3. Handling

Activities

2. Play and discuss a video about fingerprint analysis. To find a video do an Internet search for the following: Forensics you decide a man scorned. Use the Discussion Rubric for assessment.


Assessments
Development of Latent Prints Lab Quiz and Key
Development of Latent Prints Lab Checklist
Discussion Rubric
Individual Work Rubric

Materials
Development of Latent Prints computer-based presentation
Development of Latent Prints Lab
   Development of Latent Prints Packet
   Black fingerprint powder
   Soft-bristle fingerprinting brush
   Transparent tape
   Superglue
   Glass microscope slides
   Empty soda cans
   Compact discs
   Empty glass bottles
Latex or Nitrile gloves
Small paper cup
Fuming chamber
0.6% Ninhydrin solution
Black felt tip markers

Resources

Do an Internet search for the following: Forensics you decide a man scorned

Accommodations for Learning Differences
For reinforcement, students will make a chart of fingerprint composition and suitable development methods. Use the Individual Work Rubric for assessment.

For enrichment, students will identify numerous points of identification present on each fingerprint on the developed latent prints, and compare them to the known standards. Use the Individual Work Rubric for assessment.

State Education Standards
Texas Essential Knowledge and Skills for Career and Technical Education §130.295. Forensic Science (One Credit).
(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:
   (A) demonstrate safe practices during laboratory and field investigations;
   (B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.
(2) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:
   (F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides,
stereoscopes, metric rulers, electronic balances, gel electrophoresis apparatuses, micropipettors, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, cameras, Petri dishes, lab incubators, meter sticks, and models, diagrams, or samples of biological specimens or structures;

(G) analyze, evaluate, make inferences, and predict trends from data;

(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(D) evaluate the impact of scientific research on society and the environment;

(E) evaluate models according to their limitations in representing biological objects or events;

(8) The student analyzes fingerprints in forensic science. The student is expected to:

(C) distinguish among visible, plastic, and latent fingerprints;

(D) perform laboratory procedures for lifting latent prints on porous and nonporous objects using chemicals such as iodine, ninhydrin, silver nitrate, and cyanoacrylate resin;

(E) perform laboratory procedures for lifting latent prints on nonporous objects using fingerprint powders such as black powder and florescent powders;

College and Career Readiness Standards
Science Standards
I. Nature of Science: Scientific Ways of Learning and Thinking
C. Collaborative and safe working practices
   1. Collaborate on joint projects.
   2. Understand and apply safe procedures in the laboratory and field, including chemical, electrical, and fire safety and safe handling of live or preserved organisms.
   3. Demonstrate skill in the safe use of a wide variety of apparatuses, equipment, techniques, and procedures.
Objective: To recover and preserve latent fingerprints on various materials using common methods.

Materials:
- Black fingerprint powder
- Soft-bristle fingerprinting brush
- Transparent tape
- Superglue
- Glass microscope slides
- Empty soda cans
- Compact discs
- Empty glass bottles
- Latex or Nitrile gloves
- Small paper cup
- Fuming chamber
- 0.6% Ninhydrin solution
- Black felt tip markers

Procedure:

**Fingerprint powder (FP)**
1. Rub your fingers through your hair, on your forehead or behind your ear to pick up oils.
2. Place a fingerprint on to one of the nonporous objects available in the lab (compact discs, glass bottles, soda cans, or glass microscope slides).
3. Apply a small amount of the black fingerprint powder with the brush. Be sure to tap or twist excess powder from the bristles back into the container.
4. Using a circular pattern, swirl the brush over the print. The bristles should just glaze the surface of the object. The print should begin to appear.
5. Lift the prints with transparent tape and apply the tape to the space provided in this lab packet.
6. Provide the following information near the affixed tape:
   a. Date and time
   b. Your name
   c. Location of recovery (ex. Soda can found near the body, CD found in the suspect's vehicle, etc.)
   d. Collection method (black FP powder)

**Superglue Fuming**
1. Place a fingerprint on a nonporous surface. Make sure that your fingers are not overloaded with oil.
2. Label the object with your name in a location away from your planted fingerprint(s).
3. Place a small paper cup, filled halfway with water, inside the fuming chamber.
4. Place a few drops of superglue to the inverted empty soda can over the heat source (light bulb).
5. Immediately cover the fuming chamber and observe the progress of the fuming. Remove the lid when the print appears completely developed.
6. Remove the item from the fuming chamber and examine your fingerprint. The ridge pattern should appear white.

**CAUTION:** ACRYLIC VAPORS ARE A NASAL MEMBRANE IRRITANT. AVOID INHALATION.
7) Dust the prints with contrasting color powder, and lift the prints with transparent tape. Apply the tape to the space provided in this lab packet.

8) Provide the following information near the affixed tape:
   a. Date and time
   b. Your name
   c. Location of recovery (ex. Soda can found near the body, CD found in the suspect vehicle, etc.)
   d. Collection method (CA fuming, black FP powder)

**Ninhydrin**

1) Obtain a piece of paper. Warm up your hands (the sweatier, the better) and touch the paper. If you have dry hands, ask a classmate to touch your paper.
2) Label a corner of the paper with your name using a black felt tip marker.
3) Put on a pair of disposable gloves.

**CAUTION: NINHYDRIN IS A SKIN IRRITANT. AVOID DIRECT SKIN CONTACT WITH THE NINHYDRIN SOLUTION.**

4) Using a spray bottle, evenly spray the paper with 0.6% Ninhydrin solution.
5) Allow the paper to dry. Blue-purple fingerprints should start to appear over time.
6) Attach and submit the paper with the developed prints with this lab packet.

**LP development with fingerprint powder**

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**Apply tape with fingerprints here**

**Date and time:**

**Recovered by:**

**Location of recovery:**

**Collection method:**
LP development with Superglue Fuming

Apply tape with fingerprints here

Date and time: ________________________________

Recovered by: _______________________________

Location of recovery: __________________________

Collection method: ____________________________
## Development of Latent Prints Lab Checklist

<table>
<thead>
<tr>
<th>Task steps</th>
<th>Pts.</th>
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<tbody>
<tr>
<td><strong>Safe Handling of Materials (10 pts.)</strong></td>
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<tr>
<td><strong>Fingerprint Powder</strong></td>
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<tr>
<td>Selection of powder color for best contrast (10 pts.)</td>
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<tr>
<td>Quality of the latent print(s) developed (10 pts.)</td>
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<tr>
<td>Documentation (date, time, location, etc.) (10 pts.)</td>
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<tr>
<td>Preservation of developed print(s) (5 pts.)</td>
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<tr>
<td><strong>Ninhydrin</strong></td>
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<tr>
<td>Quality of the latent print(s) developed (10 pts.)</td>
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<tr>
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<td><strong>Cyanoacrylate (superglue) fuming</strong></td>
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<tr>
<td>Preservation of developed print(s) (5 pts.)</td>
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<td><strong>Total points possible 100</strong></td>
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Development of Latent Prints Quiz

Part I: Multiple Choice

1) ___ 99.0 to 99.5% of sweat consists of ________.
   a. Organic solids
   b. NaCl
   c. Water
   d. Oils and fats

2) ___ The primary source of oils and fats found in fingerprints is ________.
   a. Sweat
   b. Sebum
   c. Semen
   d. Salt

3) ___ A fingerprint left on a dusty surface is an example of:
   a. Patent fingerprints
   b. Plastic fingerprints
   c. Latent fingerprints
   d. Accidental fingerprints

Part II: Short Answers

4) List six (6) factors that can affect fingerprints left at a crime scene.

5) What would be the best method to develop latent prints on:
   a. A bank check
   b. A plastic bottle

6) Explain in detail the reasons for the diminished possibility of recovering latent prints left by an elderly person.
Development of Latent Prints Quiz Key

1) C
2) B
3) B
4) Age, fine ridge structure, stimuli, occupational and medical condition, transposal factors, and environmental factors
5) a. Ninhydrin
   b. Cyanoacrylate fuming and Fingerprint powder
6) Elderly persons typically have finer friction ridges which may reduce the contact area with a surface. They also tend to have lower perspiration rate, reducing the amount of sweat residue left on contact.
## Discussion Rubric

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<tbody>
<tr>
<td>Participates in group discussion</td>
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<td>Encourages others to join the conversation</td>
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<td>Keeps the discussion progressing to achieve goals</td>
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<td>Shares thoughts actively while offering helpful recommendations to others</td>
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<td>Gives credit to others for their ideas</td>
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<td>Respects the opinions of others</td>
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<td>Involves others by asking questions or requesting input</td>
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<td>Expresses thoughts and ideas clearly and effectively</td>
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**Total Points (32 pts.)**

**Comments:**