Module 6C
Detection, Collection, and Preservation of Fingerprints

Forensic Science Teacher Professional Development
Unit 3
Detection, Collection, and Preservation of Fingerprint Evidence
The best place to develop latent prints is in the laboratory. However, sometimes it may be necessary to develop latent prints at crime scenes.

If prints are developed at the scene, caution should be taken to ensure that no prints are altered or destroyed.

In order to document the print evidence, crime scene photographs should be taken both before and after processing.

Examination of print evidence with a laser or special light source should be done before any processing or development of the prints is performed.

Also, it is good practice to make a test print to determine the best procedure or technique to use before lifting the actual print.
Unit 3 Detection, Collection, and Preservation of Fingerprint Evidence

• Processing techniques vary depending on the type of surface the print was left on, as well as the residue of the latent print, including perspiration, blood, oil or grease, and dust.

• The condition of the surface, characteristics including dryness, wetness, dirtiness, and tackiness or stickiness, also contributes to determining the correct processes.

• While developing prints, personnel should wear gloves and document all lifts for later identification.

• Because not all fingerprints are readily visible, all objects suspected of bearing fingerprints should be treated as though they have fingerprints on them.
Part 1 Identification and Prints at the Scene

- Crime scene personnel must locate fingerprint evidence at the crime scene.
- The examiner should start at the center of the crime scene and work his or her way out in a grid-like fashion to identify latent fingerprint evidence.
- Entrance and exit points should always be carefully examined for prints, as well as objects that were disturbed or surfaces that were likely touched during the crime.
- Personnel should use gloves and handle objects and surfaces carefully so that prints are not obliterated.
- Plastic and patent prints are sometimes easier to locate since they tend to be more visible than latent ones.
- Patent prints can usually be located on dirty or dusty surfaces.
Part 1 Identification and Prints at the Scene

- Plastic prints can be found on candles, drying paint, and soap. Latent prints are most easily found on smooth, polished surfaces and are usually located by using oblique lighting.
- Any weapons used in the crime, and their parts, should always be carefully examined for prints, including both unfired and spent bullet cartridges.
- The floors should always be carefully examined for fingerprints or bare footprints.
- Fingerprints can also be found on rougher surfaces such as wood, tightly woven materials, starched fabrics, and human skin.
- In addition, any loose paper or documents should be thoroughly checked for latent prints.
- If possible, objects that are suspected of having prints on their surfaces should be collected.
Part 1 Identification and Prints at the Scene

- Documentation of fingerprint evidence includes recording information about the print, drawing sketches, and obtaining photographs.
- All prints should have a record of the exact location and a description of the object the print was located on.
- Before developing any prints, photographs should be taken using different angles and lighting techniques because there is always the possibility of obliterating or altering part of the fingerprint detail during the processing.
Part 2 Conditions Which Affect Latent Prints

There are many conditions which may affect the ability to recover prints from a scene. The following conditions can impact whether or not a print is recovered:

1. *Type of surface:* The best surface is smooth, clean, and glossy or nonporous. Coarse cloth, grained leather, unfinished wood, and stippled surfaces generally are poor candidates.

2. *Manner in which the object was touched:* If the finger moves slightly while in contact with the object, ridge detail may be lost or distorted beyond recognition. Many times, the pattern area may be smudged but other areas may be clear.

3. *Weather:* Certain weather conditions may dry out or wash away the print, especially if the print is on an exterior surface.

4. *Humidity:* Humidity may cause the print to be absorbed into a surface or dissipate.
Part 2 Conditions Which Affect Latent Prints

- Conditions, continued:

5. *Perspiration*: Perspiration may obliterate the print if both ridges and valleys are covered. The more oil deposited with perspiration, the longer the latent will last. Oil is transferred to the fingers from the hairy area of the body. Frequently, there is no oil in the perspiration of the finger.

6. *Use of the object*: The way an object is handled may affect the way a fingerprint is deposited on it. Was the object simply handled and set down? Was the object used as a weapon? Was the object used as a pry tool? Marks may appear in the fingerprint.

7. *The suspect*: Most suspects are not concerned about the way in which they handle items. Suspects are usually in a hurry in a burglary or other crimes, and they are not always careful about what they do and how they do it.
Part 3 Crime Scene Management

- Crime scene investigators should perform the following tasks at the scene:

  1. *Observation*: Do a cursory walk through the scene, preferably with someone who is intimate or familiar with the scene. People live different lifestyles and under varied conditions. The investigator is not there to make judgments on living conditions but rather to act in the capacity of a professional and identify and develop the evidence.

  2. *Evaluation*: What is of evidentiary value? What will be the best method to deal with the evidence? What is the evidence saying? How was the evidence used? Good investigators will seek answers to questions about what was touched, used, or altered during the commission of the crime by the suspect, victim, or both. They will also observe what safety issues are associated with the crime scene.
Part 3 Crime Scene Management

- Tasks, continued:

3. **Documentation**: How will the scene best be documented? What is important and what is extraneous? Which documentation technique should be utilized such as photography, notes, or diagrams? Should all three be utilized? What is being depicted? Will the photographs be a true and accurate representation of the scene? Does the investigator or photographer need to shoot overall photos, medium photos, close up photos, or identification photos?

4. **Collection**: What should be collected? How will each item be collected? Does the investigator have appropriate containers? Are there sufficient numbers of containers? What safety issues are involved? Are there bloody prints? Are there transportation issues?

5. **Analysis**: Which technique will be used? Will the development be better performed at the scene?
Unit 4 Techniques for Print Enhancement
Unit 4 Techniques for Print Enhancement

- The most common techniques for print enhancement are powder dusting, cyanoacrylate fuming, commonly known as Super Glue® fuming, and ninhydrin.
- However, a variety of print enhancement methods are available to experienced personnel.
- The techniques fall into the following categories: powder, cyanoacrylate fuming, and chemical enhancement.
- Items with latent prints are usually collected at the scene and submitted to a forensic laboratory for processing.
- Latent prints can be developed by various methods because of the secretions of the glands discussed earlier in the module.
Unit 4 Techniques for Print Enhancement

- Latent print development techniques are typically chosen to target one or more of residue components such as those listed in Figure 32.

| Ions: sodium, potassium, calcium, iron, chloride, fluoride, bromide, iodide, bicarbonate, phosphate, sulfate, ammonium andsome magnesium, zinc, copper, cobalt, lead and manganese |
| Proteins |
| Amino acids (serine, glycine, ornithine, alanine, aspartic acid) |
| Glucose |
| Lactic acid |
| Urea |
| Pyruvic acid |
| Creatine |
| Creatinine |
| Glycogen |
| Uric acid |
| Fatty acids |
| Triglycerides |
| Sterols |

Figure 32
Residue components
Unit 4 Techniques for Print Enhancement

- Oils and residue from the sweat glands combine with material from contact with various surfaces to contribute to the fingerprint residue composition.
- Methods to develop latent prints were devised based on the knowledge of latent print residue composition.
- The techniques for print enhancement fall into three categories:
  1. Physical
  2. Chemical
  3. Combination or special illumination methods
Part 1 Physical Methods

- Physical methods involve the application of particles which adhere to print residues.
- The most common physical method is powder dusting using a black or gray powder, but other colors and types of powders are available.
- Dusted prints are then tape lifted and placed on a surface of contrasting color to the powder.

Figure 33
Powder dusting
Part 1 Physical Methods

- Fingerprint powdering is the application of finely ground, colored powder to a nonporous object to make latent prints visible.
- Powder clings to moisture, oil, and other residues.
- There are many types of commercially available colored and metallic powder.
- Typical powders are black, white, and bichromatic. Different colors of powder provide for a contrast with the background on which the print is developed.
- Luminescent or fluorescent powders are useful for processing prints found on surfaces that present a contrast problem if developed with regular powder.
- They achieve better results upon examination when viewed with an ultraviolet light or laser light source.
Part 1 Physical Methods

• There are important considerations when choosing a powder:
  ➢ The surface the print is on should be suitable for powder dusting and not attractive to the powder itself.
  ➢ The color selected should provide maximum contrast with the surface the print is on.
  ➢ The powder must adhere well to the deposits left by the friction ridges.
  ➢ The particle size should be fine enough to yield clear, well defined patterns.
Part 1 Physical Methods

- Luminescent or fluorescent powders are useful for processing prints found on surfaces that present a contrast problem if developed with regular powder. They give better results upon examination with ultraviolet light or laser light sources.

- The steps for developing prints using powder dusting are as follows:
  1. Select an appropriate powder and brush to use for lifting the print.
  2. Pour the required amount of powder into a small pile.
  3. Apply the powder to the brush by lightly touching the powder surface and tapping brush on a finger to remove any excess.
  4. Place the brush over the print and either spin brush between the fingers or lightly tap the brush to deposit the powder onto the latent print. If necessary, lightly brush the powder onto the print, brushing in the direction of any ridges that begin to appear.
  5. Build the powder onto the ridges and stop when the latent print reaches a point of sufficient clarity.
Part 1 Physical Methods

• Steps for developing prints, continued:

6. Clean excess powder from between ridges using brush or cotton.
7. Use cotton to process large areas by dipping cotton into powder and lightly wiping over the surface. When the outline of the latent print becomes visible, stop using the cotton and switch to the brush to complete the development.
8. Photograph the developed print.
9. Carefully apply a suitable fingerprint lifting tape. The tape should cover approximately one inch on either side of the latent. Start by pressing the tape down before the margin of the print. Slowly press it down, working back and forth across the face to ensure no air bubbles get trapped. After the tape is applied to the area, carefully peel the tape off the surface, lifting the print with it.
10. Transfer the tape to a transparent or contrasting colored card, once again making sure that there are no air bubbles trapped under the tape.
Part 1 Physical Methods

- Magnetic powders are useful on surfaces such as plastics and leather and are especially beneficial when examination of vertical surfaces, such as walls, is required. Magnetic powder develops fresh prints well but does not work as well for older prints.
Part 1 Physical Methods

- Steps for developing prints using magnetic powder:
  1. Place magnetic brush wand with magnet engaged into container of magnetic powder. This will produce a bristle-like effect at the end of the wand when withdrawn.
  2. Apply in a circular motion to the surface being examined. Make sure that only the magnetic powder touches the surface, not the wand.
  3. After the print has been developed, hold the wand over the container and withdraw the control rod. This will disengage the magnet and release the powder.
  4. Re-engage the magnet and pass the clean wand over the developed latent print and the surrounding area to remove excess powder. Do not touch the surface.
Part 2 Cyanoacrylate Fuming Procedures

Cyanoacrylate fuming, commonly known as Super Glue®, can be used for latent print development on surfaces such as plastics, electrical tape, garbage bags, Styrofoam™, carbon paper, aluminum foil, finished and unfinished wood, rubber, copper and other metals, cellophane, rubber bands, and smooth rocks. It works best on nonporous surfaces. When fuming, this method proves easier if a test print is placed in the tank or cabinet and watched and used as a “timer” for development.
Part 2 Cyanoacrylate Fuming Procedures

- Cyanoacrylate Fuming Procedure:
  1. Place the object(s) that the prints are on into a fuming tank or cabinet (any suitable container with a proper ventilation system) by suspending it from the upper portions of the cabinet, so that all surfaces will be exposed to the fumes.
  2. Place two or three drops of liquid cyanoacrylate into a small (porcelain) dish and place the dish in the fuming cabinet.
  3. Allow the items to be exposed to the fumes until a whitish colored print pattern appears on their surfaces.
  4. The developed print may be enhanced by dusting with regular or magnetic print powder after fuming.
Part 2 Cyanoacrylate Fuming Procedures

- Microburst Method of Cyanoacrylate Fuming Procedure:
  These steps should take place in a fuming chamber:
  1. Place the aluminum dish on a heating surface and turn the heater to the highest setting.
  2. When the dish is hot, place enough liquid cyanoacrylate to cover the bottom surface of the dish (approximately 3 g for a small chamber).
  3. When the cyanoacrylate begins to fume at a steady pace, place the specimen(s) in the chamber and secure the chamber door.
  4. Allow for exposure of the specimen(s) to the fumes. Fuming time varies depending on the size of the chamber; however, in most instances, fuming times ranging from 30 seconds to 4 minutes.
  5. After the procedure is complete, remove the specimen(s) from the chamber to view for latent prints. If necessary, the fuming process can be repeated. If a humidified chamber is available, set the humidity between 70% and 80% for best results.
Part 2 Cyanoacrylate Fuming Procedures

• The accumulation of cyanoacrylate glue fumes on some parts of a firearm could have an unfavorable effect during a subsequent firearms examination.

• In those instances when a firearms examination is to be undertaken or is anticipated, each chamber opening (e.g., the cylinder of a revolver) and each barrel opening should be covered with a small piece of tape (just large enough to cover the opening) before fuming with glue.

• Ensure that the area to be covered by the tape is processed by other appropriate methods, prior to covering. Remove the tape after the cyanoacrylate glue fuming process.
Part 3 Ninhydrin

- Ninhydrin is usually used to develop latent prints on porous surfaces.
- It reacts with the amino acids in perspiration, and thus print residue, giving a bluish-purple print.

Figure 36
Ninhydrin print
Part 3 Ninhydrin

Figure 37
Ninhydrin print on a check
Part 3 Ninhydrin

- Ninhydrin Procedure:
  1. Fill a spray bottle with a ninhydrin solution and spray the surface the latent print is on. Spray from a distance of approximately 6 inches.
  2. Allow the solution to evaporate, and then repeat.
  3. After spraying, the surface may shortly be heated with an infrared lamp or steam iron. In order to do this, the ninhydrin must be completely dry. Care must be taken not to overheat and not to touch the heat source to the object. This step will accelerate print development.
  4. If desired, step 3 may be omitted and the specimen may be left at room temperature until the print develops. Doing this instead often yields more satisfactory results.

When this reaction is complete, the developed latent prints will appear on the surface of the item as shown on previous slides. In addition to being sprayed, objects may be dipped in or painted with ninhydrin solution for print development as well.
Part 4 Chemical Techniques

- Latent fingerprints may also be lifted using chemical methods.
- Chemical refers to the use of liquid solutions in visualizing prints that are very difficult to develop using physical methods, such as powders.
- Chemical lifting usually employs the use of specific reagents and rinses to develop and analyze a latent print.
- One method, iodine fuming, interacts with the ridge components, leaving a dirty-brown colored appearance on nonporous surfaces. This method may also leave a yellow stain with grease or oils on porous surfaces.
- Latent prints developed with iodine fumes are not stable and must be photographed immediately.
Part 4 Chemical Techniques

Figure 38
Examples of iodine fuming
Part 4 Chemical Techniques

• Iodine Crystal Fuming Procedure:
  1. Place iodine crystals in a ceramic or glass dish.
  2. Place the specimen to be processed in a fuming chamber.
  3. Apply heat to the crystals and observe development.
  4. Remove the specimen(s) from the chamber when sufficient development has occurred.

• Iodine Spray Reagent Fuming:
  - When spraying iodine spray reagent, the finest mist possible is the most effective method of application.
  - If the spray is heavy, it will overdevelop the area being processed.
  - An artist-type air brush is very effective in this process.
  - To increase the surface contact, a circulation procedure may be used by having a small fan in the chamber.
Small particle reagent (SPR) is a reagent used for processing latent prints on items that are wet when recovered.

It is most often used where powders are ineffective.

This reagent also works effectively on items that have been soaked in liquid accelerants.

This technique requires a large work area that will be subject to messy conditions.

The developed ridge detail may be lifted after being photographed.
Part 5 Special Solutions

- Illumination and Combination Methods
  - Illumination and combination methods typically rely on oblique angle lighting to improve the visibility of latent prints.
  - However, alternative light sources (ALS) use different wavelengths to improve the visible quality of latent prints.
  - ALS can be used to “excite” prints, or make them fluoresce, after treatment with chemicals or fluorescent powder.

Figure 39
Alternative light sources
Part 5 Special Solutions

Figure 40
Illumination of prints
Part 6 Procedures to Follow After Print Development

• After prints are developed, the following procedure should be followed:

1. Photograph where appropriate. The photos should be taken with a scale. Overall photos should be taken of the item where the print was developed, as well as close-ups showing the print itself. If possible, a one-to-one photo should be taken.

2. Upon completion of the photography, the decision must be made whether the entire item will be taken or whether the print will be lifted from the item. When appropriate, the entire item or object should be retained for use in court. **Note:** Remember, the print is the evidence, not necessarily the surface that the print was developed from.
3. Where a lift is made and placed onto a latent fingerprint card, the following information should be present:
   a. Case/report number
   b. Date and time
   c. Scene address
   d. Person making the lift
   e. Type of object
   f. Place of lift (Note: A sketch should be made on the card near the lift.)
Part 6 Procedures to Follow After Print Development

4. Take elimination prints from victims and witnesses where appropriate.

5. Care and transportation of the evidence should be undertaken professionally.
   a. Ensure the chain of custody is recorded to provide accountability.
   b. If items need to be secured, ensure proper securing of the items by top and bottom or in a place least likely to damage the item or fingerprints. It may be necessary to protect the developed prints by placing a clear tape over the prints.
Unit 5
Fingerprint Comparison and Identification
Unit 5 Fingerprint Comparison and Identification

• The United States uses fingerprint classification and comparison systems based on ten-print cards.
• In the United States and United Kingdom, the classification system is a variant of the system developed by Sir Edward Henry.
• Argentina and other South American countries use a system based on the one developed by Vucetich.
• The process of fingerprint comparison and identification is discussed in this unit.
Part 1 Fingerprint Comparison and Identification

• A fingerprint comparison is performed by observing if two impressions have ridge characteristics of similar shapes which occupy the same relative positions in both patterns.
• A fingerprint identification is the process of determining that the same finger made two or more fingerprint impressions based on the friction ridge details of both impressions.
• When a fingerprint lift is made, the latent print examiner must conduct a comparison, where appropriate, in hopes of completing an identification.
Part 1 Fingerprint Comparison and Identification

• When latent fingerprints are developed, the best choice of prints for comparison will be determined by the latent print examiner.
• There are also characteristics that may indicate to the latent print examiner that, in fact, the print submitted may not be of a finger. It could be from a palm or even a toe or foot.
• Advanced training is crucial for the latent print examiner.
• However, if the latent print examiner does not have a known exemplar to compare with, entering the latent fingerprint into a database such as the Automated Fingerprint Identification System (AFIS) will be the alternative.
Part 2 Fingerprint Classification

- The purpose of fingerprint classification is to establish a set protocol to utilize for searching, filing, and comparison purposes.
- Fingerprints are classified from general characteristics to specific.
- Classification depends on the pattern, the flow of the pattern, and direction.
- Currently, the United States uses the Henry Classification system with an FBI Extension.
- The Henry System categorizes ten-print fingerprint records into groupings based on whether the print is an arch, loop, or whorl pattern.
- The following slide shows the ten-print card. The classification process typically begins with the inking and rolling of each fingertip and fingers in individual spaces on the card.
Part 2 Fingerprint Classification

Figure 41
Ten-print card
Part 2 Fingerprint Classification

• The upper prints are impressions of each finger taken individually. The fingers are rolled from side to side to obtain the entire ridge detail.

• The lower prints are smaller impressions which are taken by simultaneously printing all the fingers of each hand, excluding the thumb.

• The thumb is printed separately from the other fingers.

• All of the lower prints are pressed impressions that are not rolled, but pressed straight down.
Part 2 Fingerprint Classification

- The sample to the right shows an example of a ten-print card that was poorly prepared.
- Notice how the rolled fingerprints are not a complete representation of the full ridge detail, and the bottom right and left boxes cut off the fingerprints of the little fingers on both hands.

Figure 42
Ten-print card, poorly prepared
Part 2 Fingerprint Classification

The Henry System assigns each finger a number for classification purposes. The numbers are assigned according to the position of the finger on the hand. The right thumb is number 1 and fingers are numbered in order with the left pinky finger as number 10. This system then assigns a numeric value to fingers which contain a whorl pattern. Fingers which have a non-whorl pattern are assigned a value of zero. The values are illustrated in the table below:

<table>
<thead>
<tr>
<th>Finger Number</th>
<th>L Pinky</th>
<th>L Ring</th>
<th>L Middle</th>
<th>L Index</th>
<th>L Thumb</th>
<th>R Thumb</th>
<th>R Index</th>
<th>R Middle</th>
<th>R Ring</th>
<th>R Pinky</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value (if Whorl)</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>16</td>
<td>16</td>
<td>8</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>
Part 2 Fingerprint Classification

• Then, a ratio is calculated according to a specific formula.
• The Henry Classification System formula is identified as follows:
  \[ \frac{1 + (\text{sum of whorled, even finger value})}{1 + (\text{sum of whorled odd finger value})} = \text{primary grouping ratio} \]
• This ratio then becomes an individual’s classification group. However, limitations in moving the Henry System to the FBI’s Automated Fingerprint Identification and Imaging System (AFIS) led to the creation of the Integrated AFIS (IAFIS).
Part 2 Fingerprint Classification

- The ACE-V method refers to the four steps used in the analysis and comparison of a latent print with a known print:
  - Analysis
  - Comparison
  - Evaluation
  - Verification
Part 2 Fingerprint Classification

- The comparisons involve several examinations which are called Levels I, II, and III.
- **Level I** detail refers to the overall pattern & ridge flow.
- **Level II** detail refers to the comparison of minutiae.
- **Level III** detail refers to the pore numbers, locations, and shape & size of ridge features.
- An identification is made if every feature on a crime scene print is consistent with the known print.
- If there are unexplained differences with the known print, an exclusion is reported.
- If there are not enough features for a definite conclusion, an inconclusive determination is reported.
Part 3 Integrated Automated Fingerprint Identification and Imaging System (IAFIS)

• An automated fingerprint identification system, commonly known as AFIS, is merely an elaborate filing and searching system.
• An AFIS does not make identifications.
• The identification is determined by the latent print examiner who enters the appropriate information into AFIS and then allows the system to search the database which returns a list of potential candidates to search against.
• It is then the job of the latent print examiner to begin with the first candidate on the list and use the comparison process to attempt an identification.
Part 3 Integrated Automated Fingerprint Identification and Imaging System (IAFIS)

• In some instances, an identification will not be made.
• If a person has not been booked and his or her fingerprints taken, those prints will not be in the AFIS.
• With the help of AFIS, examiners can now do in seconds what used to take literally months under the manual system of filing and searching.
• AFIS has become a standard piece of forensic fingerprint identification equipment.
Part 3 Integrated Automated Fingerprint Identification and Imaging System (IAFIS)

In 1989, the FBI released the IAFIS. The Henry Classification and other binary methods of matching fingerprints are not employed in the IAFIS, which allows for more flexible searching. The new system also allows searches for additional descriptive information.

Follow this link to the FBI Website and review the information on the FBI IAFIS:

http://www.fbi.gov/about-us/cjis/fingerprints_biometrics/iafis/iafis
End of Module 6C

Forensic Science Teacher Professional Development