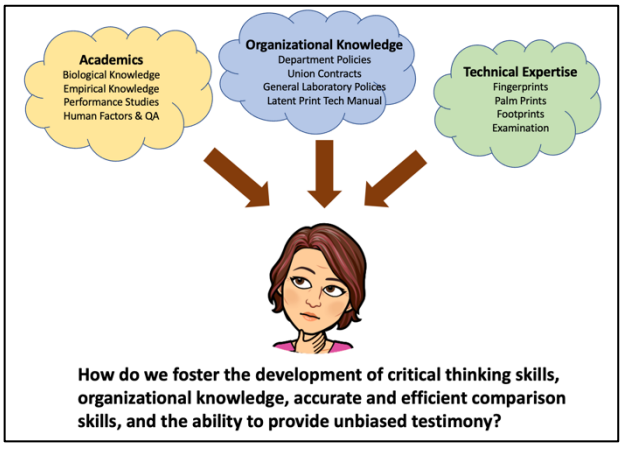
**Evolve Forensics**
**Latent Print Examination Training Program**

Evolve Forensics is pleased to offer a latent print examination training program that supports both the trainee and the trainer(s) in an agency. This training program incorporates current training recommendations by the National Institute of Standard and Technology, Organization of Scientific Area Committees for Forensic Science (OSAC) and American Academy of Forensic Sciences, Academy Standards Board (ASB) as of 2024.

The Evolve Forensics LPE Training Program is structured to naturally build on concepts in both a technical track (supports examination process) and an academic track (supports testimony). In the technical track, the trainee is first introduced to the skin to set expectations for the manner in which the various features manifest in the skin itself. From the skin, the trainee explores inked impressions of the skin to learn the diagnostic features within each sub-section of the hands and feet. Recognition of anatomical region and distal orientation of partial hand and foot impressions is reinforced with comparison exercises.

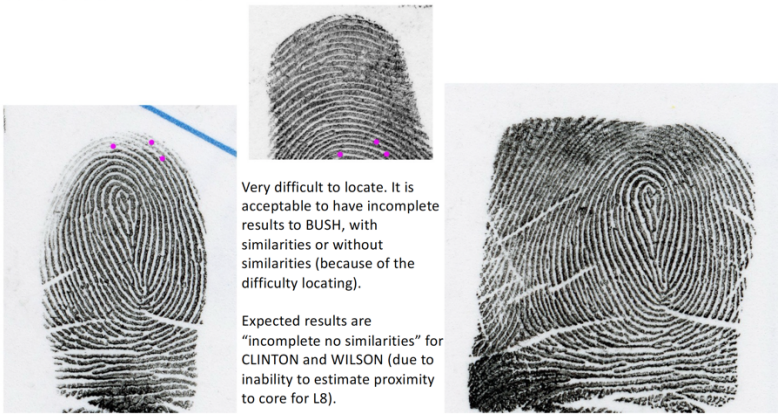
After completion of inked comparisons, the trainee expands their feature detecting capabilities by exploring latent prints under a variety of distortion factors. Latent print comparison exercises gradually increase in difficulty, leading the trainee to casework-like conditions. Casework conditions are not simply about the comparison and source opinions, but also about suitability decisions, search parameter decisions, distortion interpretation, and latent print isolation techniques.




In tandem with the technical track is the academic track. The academics support both the examination process and testimony. For many agencies, developing the training content for advanced topics can seem insurmountable. In this program, the heavy lifting has been done for the agency. Lecture videos and notes are provided to lead the trainee through complex concepts such as the biology of the skin and error rates.

## *What support is provided to the agency?*

Detailed keys for the comparison exercises are provided. The keys include ground truth, expected opinions/results, and image mark-ups as appropriate. The image mark-up keys allow trainers to quickly provide guidance to trainees and promote consistent mentoring from any senior staff responsible for guiding the trainee through the program. An example of an image key is provided below.




*Example of an image key for a sample in a comparison exercise.*

If a package is purchased (three packages are detailed on next page), the agency will also receive forty (40) hours of consulting with Alice White for assistance implementing the program. The consulting hours expire 2 years from date of purchase. Additional consulting hours can be purchased at $125.00 per hour.

Instructor guides are also provided for each module. The instructor guides provide additional context for the trainer, implementation notes, suggestions for helping the trainee, suggested performance expectations, and suggestions for additional in-house exercises that would facilitate learning.

## *Who can use this training program?*

This training program is designed for implementation by a law enforcement agency for in-house, employee training. Once purchased, the agency can train as many employees as desired. This training program is not for use by training or educational institutions (e.g., police colleges or universities), for agencies to train employees of other agencies (e.g., a state lab may not purchase and train local agencies with the materials), or for individuals/companies who provide training.

## *Who designed and developed this training program?*

This training program was designed by Alice White. Alice White developed a latent print training program at the Las Vegas Metropolitan Police Department that is still recognized as one of the most progressive and extensive training programs in the United States. Alice has an in-depth knowledge of OSAC and ASB training requirements and has been a contract instructor since 2006. A detailed biography for Alice White can be located here https://evolveforensics.com.

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## *What are the pricing options?*

Since agencies have a variety of needs, a variety of pricing options are provided. First, the content is broken down as Lecture or Practical within the modules. An agency can elect the Lecture Content only (Package #1); the Practical Content only (Package #2); or the entire program (Package #3). Consulting hours expire 2 years from date of purchase.

- Package #1 – Lecture Content only + 40 hours consulting = $7,500.00
- Package #2 – Practical Content only + 40 hours consulting = $17,500.00
- Package #3 – Complete Content + 40 hours consulting = $24,000.00

In the detailed training outline that follows, the lecture content and practical content are color-coded as follows:

- Blue – Lecture Content
- Orange – Practical Content

Alternatively, agencies can purchase individual modules to supplement an existing training program. The following list details the price for individual modules:

| Module | Title | Cost |
|---|---|---|
| 1 | Features of the Ridged Skin | $1,000.00 |
| 2 | Introduction to Fingerprint Comparisons | $3,250.00 |
| 3 | Introduction to Lower Phalange Print Comparisons | $1,000.00 |
| 4 | Introduction to Palm Print Comparisons | $2,750.00 |
| 5 | Introduction to Footprint Comparisons | $1,250.00 |
| 6 | Advanced Ink Comparisons | $2,000.00 |
| 7 | Biological Stability of Ridged Skin | $750.00 |
| 8 | Feature Variation in the Ridged Skin | $500.00 |
| 9 | Empirical Observations Regarding Friction Ridge Impressions | $500.00 |
| 10 | Research Findings Regarding Friction Ridge Impressions | $500.00 |
| 11 | Feature Detection in Latent Prints | $2,500.00 |
| 12 | Casework Examination Process | $6,500.00 |
| 13 | Examiner Performance Research | $1,000.00 |
| 14 | Human Factors and Quality Management | $500.00 |
| 15 | Testimony | $1,000.00 |

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## Timeline and Synchronization of Modules

The proposed timeline below shows the suggested order and layering of the training modules in the training program. Completion times are estimates and will be affected by the pace of the trainee and the availability of trainers. Please note that competency tests and supervised casework are included on the schedule as reminders for the agency to include these elements at the end of training, but are not provided by Evolve Forensics as part of this training package.

### Months 1 – 3

| | Month 1 | Month 2 | Month 3 |
|---|---|---|---|
| Practical | 1 Features | 2 Fingerprints | 3 Lower Phalanges |
| Academic | 7 Biological Stability | 8 Feature Variation | |

### Months 4 – 6

| | Month 4 | Month 5 | Month 6 |
|---|---|---|---|
| Practical | 4 Palm Prints | 5 Footprints | 6 Adv. Ink Comps |
| Academic | 9 Empirical | 10 Friction Ridge Research | |

### Months 7 – 9

| | Month 7 | Month 8 | Month 9 |
|---|---|---|---|
| Practical | 11 Feature Detection | | 12 Casework Exam. Proc. |
| Academic | 13 Examiner Performance | | |

### Months 10 – 12

| | Month 10 | Month 11 | Month 12 |
|---|---|---|---|
| Practical | 12 Casework Examination Process | | Test* |
| Academic | 14 Human Factors & QA | 15 Testimony | Test** |

*Comparison Competency should be developed and provided by the agency to verify trainee meets the agency's performance expectations. Not provided by Evolve Forensics with this program.

**Testimony Competency should be developed and provided by the agency to verify the trainee meets the agency's performance expectations. Not provided by Evolve Forensics with this program.

### Months 13 – 15

| | Month 13 | Month 14 | Month 15 |
|---|---|---|---|
| Practical | Supervised Casework*** | | |

***The trainee should undergo at least three months of supervised casework to demonstrate the trainee meets casework performance expectations. Not provided by Evolve Forensics with this program.

# EF Module 1 – Features of the Ridged Skin

## 1.0 Introduction

In order to understand what is seen in a friction ridge impression, the surface of the skin must be studied first. This module explores the common friction ridge features found on healthy friction ridge skin. This exploration considers the robustness of the features (three-dimensional attributes) and the expected impact of deposition pressure on the attributes of the features when the skin contacts a surface. The features introduced in this module include: ridges, minutiae, ridge flows, pattern elements (recurves and triradii), regular creases, irregular creases, and incipient ridges. In additional to exploring the features of the skin, the trainee will learn how the features of the friction ridge contribute to search diagnosticity and source diagnosticity.

This module reviews common methods used to collect exemplar prints from intact friction ridge skin and the challenges and limitations associated with each method. This module will also review common distortions seen in inked prints in order to prepare the trainee for comparison ink-to-ink comparison exercises.

## 1.1 Learning Outcomes

1.1.1 Identify ridges, minutiae, ridge flows, pattern elements, regular creases, irregular creases, and incipient ridges in images of the friction ridge skin.

1.1.2 Describe the attributes of the ridges, minutiae, ridge flows, pattern elements, regular creases, irregular creases, and incipient ridges.

1.1.3 Predict the recordability of ridges, minutiae, ridge flows, pattern elements, regular creases, irregular creases, and incipient ridges when the skin contacts a surface.

1.1.4 Describe the impact of deposition pressure on the recording of the attributes of ridges, minutiae, ridge flows, pattern elements, regular creases, irregular creases, and incipient ridges.

1.1.5 Describe the expected search diagnosticity of ridges, minutiae, ridge flows, pattern elements, regular creases, irregular creases, and incipient ridges.

1.1.6 Describe the expected source diagnosticity of ridges, minutiae, ridge flows, pattern elements, regular creases, irregular creases, and incipient ridges.

1.1.7 Recognize different methods of collecting exemplar prints.

1.1.8 Describe the basic process for each method of collecting exemplar prints for fingers, palms, and feet.

1.1.9 Describe typical sources of distortion for each collection method (e.g., over-inking, under-inking, incomplete rolls, too much pressure, too little pressure, overlays, shearing stress or torque (slippage), smearing, stitching errors, and digital artifacts).

## 1.2 Methods of Instruction

### 1.2.1 Lecture – Features of the Friction Ridge Skin

This lecture introduces the trainee to the typical surface features of the friction ridge skin and aspects of their three-dimensional nature that affect the recording of these features. This lecture introduces the attributes of the various features of the friction ridge skin and their usefulness assigning search parameters, excluding potential donors, and including potential donors. This lecture reviews which features tend to be shared in the human population and which features tend to show more variation from one donor to another. This lecture also marks the beginning of distortion interpretation by discussing the

impact of deposition pressure on the recording of the three-dimensional structure of the friction ridge skin.

### 1.2.2 Exercise – Identifying Features of the Friction Ridge Skin

The trainee will identify the features of the friction ridge skin in images of the ridged skin. The trainee will also markup ridge flows, pattern elements, regular creases, and irregular creases in exemplar hand impressions and exemplar foot impressions.

### 1.2.3 Lecture – Recording the Friction Ridge Skin

The lecture introduces typical methods for intentionally recording the friction ridge skin and types of distortion related to the recording process. The lecture will demonstrate the effects of over-inking, under-inking, incomplete rolls, too much pressure, too little pressure, overlays, shearing stress or torque (slippage), smearing, stitching errors, and digital artifacts. The issues related to the exemplars will discussed again when addressing distortion issues with latent prints.

# EF Module 2 – Introduction to Fingerprint Comparisons

## 2.0 Introduction

This module includes the exploration of exemplar fingerprints and the comparison of inked fingerprints. The exploration of the fingerprints includes an introduction to fingerprint pattern classification, fingerprint pattern distributions, expected handedness of patterns, search diagnosticity of feature sets in fingerprints, and source diagnosticity of feature sets in fingerprints. Additionally, this module introduces variation in appearance between impressions from the same source and coincidental feature set similarities in impressions from different sources.

## 2.1 Learning Outcomes

2.1.1 Describe the relationships (ridge counts, angles, and distances) between recurves, triradii, and regular creases in rolled fingerprints.

2.1.2 Assign pattern type, including sub-class and tracing, to rolled fingerprints.

2.1.3 Predict left-right handedness based on ridge flow and pattern element relationships and appropriately assign uncertainty to the prediction.

2.1.4 Describe United States/Western Europe fingerprint pattern frequency data.

2.1.5 Describe the purpose, content, and organization of a typical tenprint card.

2.1.6 Compare rolled impressions of the fingers, provide source opinions, and articulate the basis the opinion (e.g., similarities or differences in ridge flow, pattern elements, or minutiae configurations).

2.1.7 Compare flat impressions to rolled impressions of the fingers, provide source opinions, and articulate the basis the opinion (e.g., similarities or differences in ridge flow, pattern elements, or minutiae configurations).

2.1.8 Describe how angle of contact affects ridge flow curvature and the visibility of patterns elements in fingerprints.

2.1.9 Compare fragmentary impressions to rolled of the fingers, provide source opinions, and articulate the basis the opinion (e.g., similarities or differences in ridge flow, pattern elements, or minutiae configurations).

2.1.10 Recognize variations in appearance (differences) between fingerprints from the same source.

2.1.11 Recognize coincidental similarities in appearance between fingerprints from different sources.

## 2.2 Methods of Instruction

### 2.2.1 Lecture – Fingerprint Classification and Comparison

This lecture introduces the basic rules for fingerprint classification. The trainee will mark-up enlarged fingerprints and discuss relationship of triradii, recurves, and creases. The trainee will practice indicating handedness and assigning pattern classification. In addition, the lecture introduces comparison strategies for the matching and rolled and flat search exercises in this module, including the use of anchors and the organization of tenprint records. This lecture will tie in concepts from Module EF1 regarding distortion factors in exemplar prints.

### 2.2.2 Exercise – Fingerprint Classification

Assign pattern classification of 30 fingerprint cards. Place an asterisk (*) next to any of the following: radial loop, outer tracing whorl on a left hand, or inner tracing whorl on right hand to highlight digits where unexpected loop or whorl sub-classes are more likely to occur.

### 2.2.3 Exercises – Basic Fingerprint Matching

The following five matching exercises include pairs of rolled impressions of the same fingers. The rolled impressions are not duplicates – they are different rolled recordings of the same finger. The basic matching exercises are organized by general pattern type. These exercises introduce variation in appearance of rolled impressions from the same source skin, reinforce distal orientation of fingerprints, and the use of feature combinations to exclude or include possible mates.

2.2.3.1 BIC1a – Whorls

2.2.3.2 BIC1b – Whorls

2.2.3.3 BIC2a – Loops

2.2.3.4 BIC2b – Loops

2.2.3.5 BIC3 – Arches and Low Count Loops

### 2.2.4 Exercises – Intermediate Fingerprint Matching

Each of the following six matching exercises include pairs of rolled impressions of the same fingers. The rolled impressions are not duplicates – they are different rolled recordings of the same finger. The intermediate matching exercises are organized by pattern sub-type. These exercises introduce variation in appearance of rolled impressions from the same source skin, reinforce distal orientation of fingerprints, and the use of feature combinations to exclude or include possible mates.

2.2.4.1 IIC1 – Double Loop Whorls

2.2.4.2 IIC2 – Plain Whorls

2.2.4.3 IIC3 – Central Pocket Whorls

2.2.4.4 IIC4 – Left Loops

2.2.4.5 IIC5 – Right Loops

2.2.4.6 IIC6 – Arches

### 2.2.5 Exercises – Basic Fingerprint Searching – Rolled Fingerprints

The following three comparison exercises incorporate the search process and the use of typical tenprint records. The “questioned” fingerprints in these comparisons are rolled fingerprints. Not all questioned prints can be identified. These exercises introduce searching techniques and exclusions. These exercises reinforce variation in appearance of rolled impressions from the same source skin, distal orientation of fingerprints, and the use of feature combinations to exclude or include possible donors.

2.2.5.1 IIRFS-1

2.2.5.2 IIRFS-2

2.2.5.3 IIRFS-3

### 2.2.6 Exercises – Intermediate Fingerprint Searching – Flat Fingerprints

The following three comparison exercises reinforce the search process and the use of typical tenprint records. The "questioned" fingerprints in these comparisons are flat fingerprints with less available anchors. Not all questioned prints can be identified. These exercises reinforce searching techniques and exclusions. These exercises continue to reinforce variation in appearance of impressions from the same source skin, distal orientation of fingerprints, and the use of feature combinations to exclude or include possible donors.

2.2.6.1 IIFFS-1

2.2.6.2 IIFFS-2

2.2.6.3 IIFFS-3

### 2.2.7 Lecture – Comparison of Tips and Edges of Fingers

This lecture introduces fragmentary impressions of the fingers and the comparison result of "incomplete" and "discontinued". The impact of variable angles of contact on friction ridge impressions and strategies for comparing impressions of the tips and edges of fingers will be discussed. Judging the completeness of exemplar impressions and appropriate use of "incomplete" comparison results will be discussed and demonstrated.

### 2.2.8 Exercises – Advanced Fingerprint Searching – Fragmentary Fingerprints

These search exercises involve the comparison of tips and edges of fingers to typical tenprint records. These exercises develop skill sets related to searching without anchor points, judging the completeness of exemplar impressions, and appropriate use of "incomplete" comparison results. Not all questioned prints can be identified or excluded, and the completeness of the exemplar prints to support a source opinion for each questioned print should be properly assessed.

2.2.8.1 FFPS-1

2.2.8.2 FFPS-2

2.2.8.3 FFPS-3

# EF Module 3 – Introduction to Lower Phalange Print Comparisons

## 3.0 Introduction

The lower portions of the fingers can present challenges during comparison due to the lack of recurves and triradii. This module will explore impressions of the proximal and medial portions of the fingers and thumbs and the comparison of inked impressions of the proximal or medial portions of the fingers and thumbs. The comparisons include different recordings of the proximal or medial portions of the digits (not duplicates of the same rolled impression).

## 3.1 Learning Outcomes

3.1.1 Describe the shape, creases, ridge flows, and pattern elements associated with the lower phalanges of the digits.

3.1.2 Compare and contrast the attributes of the ridges and minutiae in the distal segments of the digits versus the lower segments of the digits.

3.1.3 Assign search parameters to partial impressions of the lower phalanges, consider the uncertainty of the search parameters, and describe the feature set that supports the search parameter decision.

3.1.4 Explain how deposition pressure, angle of contact, and hand flexion affect the recording of the lower phalanges.

3.1.5 Compare impressions of the lower phalanges, provide source opinions, and articulate the basis the opinion (e.g., similarities or differences in ridge flow, minutiae configurations, or creases).

3.1.6 Assess the completeness of lower phalange exemplar prints.

3.1.7 Recognize variations in appearance (differences) between lower phalange prints from the same source.

3.1.8 Recognize coincidental similarities in appearance between lower phalange prints from different sources.

## 3.2 Methods of Instruction

### 3.2.1 Lecture – Introduction to Lower Phalanges of the Hands

This lecture introduces the features typically present in the proximal and medial phalanges and challenges associated with impressions of the lower portions of the fingers and thumbs. The trainee will be shown examples of proximal and medial phalange impressions that contain sufficient corresponding region, insufficient corresponding region, and no corresponding region with a rolled impressions of the same finger in the complete friction ridge exemplars. The impacts of deposition pressure, angle of contact, and hand flexion on the lower phalanges will be illustrated. Challenges with determining identification, exclusion, and incomplete will be discussed.

### 3.2.2 Exercises – Lower Phalange Comparisons

These search exercises involve the comparison of questioned prints of the lower phalanges to CFRE records.

3.2.2.1 LPC-1

3.2.2.2 LPC-2

3.2.2.3 LPC-3

# EF Module 4 – Introduction to Palm Print Comparisons

## 4.0 Introduction

The trainee will begin to learn comparison strategies for palm prints by comparing partial inked palm prints to full recordings of the palms. The goals of this module are to: 1) introduce palm orientation skills and marking; 2) introduce variability in appearance of palm impressions; 3) reinforce efficient search parameters and target data selection; and 4) reinforce recognition of incomplete exemplars. The trainee should be evaluated on their ability to assign search parameters and associate the correct person to questioned palm prints.

## 4.1 Learning Outcomes

4.1.1 Describe the shape, creases, and ridge flows associated with each sub-region of the palm.

4.1.2 Describe the pattern classifications, pattern element relationships, and typical recurve ridge counts for the palms.

4.1.3 Describe United States/Western Europe palm pattern frequency data for each sub-region of the palms.

4.1.4 Describe the common number of triradii, locations of triradii, and predictive triradius angles associated with each sub-region of the palms.

4.1.5 Explain how deposition pressure, angle of contact, and hand flexion affect the recording of the features of the palms and feature relationships within a palm print.

4.1.6 Explain how abduction/adduction and rotation of the thumb affect the recording of the features in the thenar region.

4.1.7 Assign search parameters to partial palm impressions (distal orientation, palm sub-region, and left-right), consider the uncertainty of the search parameters, and describe the feature set that supports the search parameter decision.

4.1.8 Compare questioned palm prints to exemplar palm prints, provide source opinions, and articulate the basis for the opinions (e.g., similarities or differences in ridge flow, pattern elements, or minutiae configurations).

4.1.9 Assess the completeness of exemplar palm prints.

4.1.10 Recognize variations in appearance (differences) between palm prints from the same source.

4.1.11 Recognize coincidental similarities in appearance between palm prints from different sources.

## 4.2 Methods of Instruction

### 4.2.1 Lecture – Palm Interdigital

This lecture focuses on the distinguishing characteristics of the interdigital region of the palm, to include pattern distributions from published research. The lecture will describe how deposition pressure, angle of contact, and hand flexion affect the recording of the feature sets in the interdigital region and strategies for assessing the completeness of exemplar palm prints.

### 4.2.2 Exercises – Palm Interdigital Comparisons

Eighty (80) pairs of palms are provided as part of the training program. It is suggested that the trainee highlight the pattern elements (recurves and triradii) and regular creases in the interdigitals prior to competing the comparison exercises. The highlighting will

reinforce the concepts discussed in the lecture and tune the examiner to features sets that distinguish left from right palm interdigitals and distal orientation. Three comparison exercises require the trainee to compare questioned interdigital prints to standard palm records. Approximately half the questioned prints are oriented “up”, the remaining must be oriented (using proper symbols) by the trainee.

4.2.2.1 PIC-1 (All questioned prints can be identified.)

4.2.2.2 PIC-2 (All questioned prints can be identified.)

4.2.2.3 PIC-3 (Not all questioned prints can be identified.)

### 4.2.3 Lecture – Palm Hypothenar

This lecture focuses on the distinguishing characteristics of the hypothenar region of the palm, to include pattern distributions from published research. The lecture will describe how deposition pressure, angle of contact, and hand flexion affect the recording of the feature sets in the hypothenar region and strategies for assessing the completeness of exemplar palm prints.

### 4.2.4 Exercises – Palm Hypothenar Comparisons

Eighty (80) pairs of palms are provided as part of the training program. It is suggested that the trainee highlight the pattern elements (recurves and triradii) and ridge flows in the hypothenars prior to competing the comparison exercises. The highlighting will reinforce the concepts discussed in the lecture and tune the examiner to features sets that distinguish left from right palm hypothenars and distal orientation. Three comparison exercises require the trainee to compare questioned hypothenar prints to standard palm records. Approximately half the questioned prints are oriented “up”, the remaining must be oriented (using proper symbols) by the trainee.

4.2.4.1 PHC-1 (All questioned prints can be identified.)

4.2.4.2 PHC-2 (All questioned prints can be identified.)

4.2.4.3 PHC-3 (Not all questioned prints can be identified.)

### 4.2.5 Lecture – Palm Thenar

This lecture focuses on the distinguishing characteristics of the thenar region of the palm, to include pattern distributions from published research. The lecture will describe how deposition pressure, angle of contact, hand flexion, and thumb abduction/adduction and rotation affect the recording of the feature sets in the thenar region. Additionally, strategies for assessing the completeness of exemplar palm prints will be discussed.

### 4.2.6 Exercises – Palm Thenar Comparisons

Eighty (80) pairs of palms are provided as part of the training program. It is suggested that the trainee highlight the pattern elements (recurves and triradii) and ridge flows in the thenars prior to competing the comparison exercises. The highlighting will reinforce the concepts discussed in the lecture and tune the examiner to features sets that distinguish left from right palm thenars and distal orientation. Three comparison exercises require the trainee to compare questioned thenar prints to standard palm records. Approximately half the questioned prints are oriented “up”, the remaining must be oriented (using proper symbols) by the trainee.

4.2.6.1 PTC-1 (All questioned prints can be identified.)

4.2.6.2 PTC-2 (All questioned prints can be identified.)

4.2.6.3 PTC-3 (Not all questioned prints can be identified.)

### 4.2.7 Exercises – Mixed Palm Comparisons

To comparison exercises require trainee to compare questioned palm prints to standard palm records. Not all questioned prints can be identified. Search parameters must be assigned and documented (using proper symbols) by the trainee.

4.2.7.1 PMC-1

4.2.7.2 PMC-2

# EF Module 5 – Introduction to Footprint Comparisons

## 5.0 Introduction

Partial foot impressions are occasionally recovered from crime scenes or items of evidence. Feet also display a myriad of features across their volar surface. This module explores exemplar recordings of the feet. This exploration includes the typical features of the feet and the diagnosticity of these features. Special focus will include distinguishing palm impressions from foot impressions.

## 5.1 Learning Outcomes

5.1.1 Describe the shape, creases, and ridge flows associated with each sub-region of the feet (toes, hallucal, interdigital, thenar, hypothenar, and calcar sub-regions).

5.1.2 Describe the pattern classifications and pattern element relationships typical of feet.

5.1.3 Describe United States/Western Europe foot pattern frequency data for each sub-region of the feet.

5.1.4 Describe the common number of triradii, locations of triradii, and predictive triradius angles associated with each sub-region of the feet.

5.1.5 Explain how deposition pressure and angle of contact affect the attributes of shape and visibility of ridge flows and pattern elements for foot impressions.

5.1.6 Assign search parameters to partial foot impressions (distal orientation, foot sub-region, and left-right), consider the uncertainty of the search parameters, and describe the feature set that supports the search parameter decision.

5.1.7 Compare questioned footprints to exemplar footprints, provide source opinions, and articulate the basis for the opinions (e.g., similarities or differences in ridge flow, pattern elements, or minutiae configurations).

5.1.8 Assess the completeness of exemplar footprints.

5.1.9 Compare questioned footprints to exemplar footprints, provide source opinions, and articulate the basis for the opinions (e.g., similarities or differences in ridge flow, pattern elements, or minutiae configurations).

5.1.10 Recognize variations in appearance (differences) between footprints from the same source.

5.1.11 Recognize coincidental similarities in appearance between footprints from different sources.

5.1.12 Distinguish foot impressions from palm impressions.

5.1.13 Discuss feature sets or case conditions that warrant requests for foot exemplars.

## 5.2 Methods of Instruction

### 5.2.1 Lecture – Footprints

This lecture introduces the sub-regions of the feet, the distinguishing feature sets of each sub-region, and strategies for assigning search parameters for foot impressions. This lecture will review the key findings from the reading material regarding foot ridge flows and pattern distributions. This workshop will introduce strategies and challenges associated with distinguishing palm impressions from foot impressions.

### 5.2.2 Exercises – Footprint Comparisons

Ten (10) pairs of feet are provided as part of the training program. It is suggested that the trainee highlight the pattern elements (recurves and triradii) and ridge flows in the feet prior to competing the comparison exercises. The highlighting will reinforce the concepts discussed in the lecture and tune the examiner to features sets that distinguish left from right feet and distal orientation. The two comparison exercises below require the trainee to compare questioned footprints to exemplar footprints. All questioned prints can be identified. Approximately half the questioned prints are oriented “up”, the remaining must be oriented (using proper symbols) by the trainee.

5.2.2.1 FTC-1

5.2.2.2 FTC-2

### 5.2.3 Exercises – Palm Print and Footprint Comparisons

Two comparison exercises require the trainee to compare questioned palm prints and footprints to exemplar palm prints and footprints. Not all questioned prints can be identified. The questioned prints should be labeled with anatomical region (palm or foot and left or right) prior to comparison. Approximately half the questioned prints are oriented “up”, the remaining must be oriented (using proper symbols) by the trainee.

5.2.3.1 PPFTC-1

5.2.3.2 PPFTC-2

# EF Module 6 – Advanced Ink Comparisons

## 6.0 Introduction

This module includes comparison of all regions of the ridged skin of the hands. The trainee should establish and document search parameters, complete the comparisons, and provide source opinions or results (identification, exclusion, incomplete, or discontinued) for each subject compared. For each incomplete result, the trainee should indicate if similarities were found, and the additional exemplars needed to complete the comparisons.

## 6.1 Learning Outcomes

6.1.1 Recognize the regions of skin recorded in complete friction ridge exemplars that are not recorded in typical tenprint and palm print records.

6.1.2 Assign and document search parameters for partial inked impressions (anatomical sub-region, distal orientation, and left-right as appropriate), consider the uncertainty of the search parameters, and describe the feature set that supports the search parameter decision.

6.1.3 Compare partial inked impressions to exemplar prints, provide source opinions or results, and articulate the basis for the opinions or results (e.g., similarities or differences in ridge flow, pattern elements, or minutiae configurations).

6.1.4 Assess the completeness of exemplar prints and indicate additional exemplars required to complete comparisons if needed.

## 6.2 Methods of Instruction

### 6.2.1 Exercises – Advanced Ink Comparisons

Eight comparison exercises require the trainee to analyze and compare questioned prints from the hands. Each exercise includes sixteen questioned prints to be compared to three sets of exemplar prints. The trainee will document search parameters, the feature set that supports the search parameter decision, and what would be required of exemplar prints to support an exclusion if no similarities are located in a subject's exemplar prints. The questioned prints will be compared to subjects and opinions and results recorded in the worksheet.

6.2.1.1 AIC-1

6.2.1.2 AIC-2

6.2.1.3 AIC-3

6.2.1.4 AIC-4

6.2.1.5 AIC-5

6.2.1.6 AIC-6

6.2.1.7 AIC-7

6.2.1.8 AIC-8

# EF Module 7 – Biological Stability of Ridged Skin: Basis for Persistency and Limits of Persistency

## 7.0 Introduction

This module explores the embryological development of the hands, feet, and friction ridge skin and the impact of anomalies during their formation. This module will emphasize the expected influence of developmental stability, developmental noise, and fluctuating asymmetry on the attributes of each feature of the friction ridge skin. The link between developmental stability and search diagnosticity and the link between developmental noise and source diagnosticity will be illustrated via impressions and research data from twins. Additionally, this module will introduce the concept of relevant population and appropriately qualified statements regarding feature variation in the population.

## 7.1 Learning Outcomes

7.1.1 Identify the following three layers of the skin and describe their primary functions: epidermis, dermis, and hypodermis.

7.1.2 Explain the relationships between the following: primary ridges, surface ridges, secondary ridges, surface furrows, dermal papillae, and basement membrane.

7.1.3 List the main cell types found in the epidermis and explain the primary function of each cell type.

7.1.4 Identify the five layers of the epidermis and describe the sequence of changes that take places as keratinocytes differentiate.

7.1.5 Describe the importance of regulation of keratinocyte mitosis and the role of transient amplifying cells in maintaining the height of the friction ridges.

7.1.6 Support the theory of persistency of the arrangements of the mature ridges during middle adulthood with the physical connections that stabilize the positions of the ridges and physiological processes that maintain the three-dimensional structure of the surface ridges and furrows.

7.1.7 Describe the expected stability of all features and attributes of features found in the friction ridge skin.

7.1.8 Identify and describe the appearance of areas of healing or diseased skin in impressions of friction ridge skin.

7.1.9 Identify and describe the appearance of scars in impressions of the friction ridge skin.

7.1.10 Describe and explain changes that take place in the friction ridge skin during adolescent growth.

7.1.11 Describe and explain changes that can take place in the friction ridge skin during the aging process.

7.1.12 Compare impressions taken from the same source where one impression was taken as an adult with healthy skin and the other impression was recorded under one or more of the following conditions: before completion of adolescent growth, after the aging process has started, during wound healing, after scar formation, or during a disease state.

## 7.2 Methods of Instruction

### 7.2.1 Lecture – Biological Stability of Friction Ridge Skin

The lecture introduces the anatomy and physiology of the friction ridge skin. General anatomy topics include the following: epidermis, dermis, basement membrane, hypodermis, primary ridge, secondary ridge, keratin, keratinocyte, melanocyte, leukocyte, dermal papilla, sweat glands and Merkel cell. General physiological topics include the following: keratinocyte mitosis, transient amplifying cells, layers of the epidermis, differentiation of the keratinocytes, and regulation of cell mitosis.

Additionally, this lecture will review scars and unstable features. Descriptions and examples of the following will be covered in this lecture: healing skin, scar formation, eczema/psoriasis, epidermal warts, calluses, blisters, and flattening of friction ridges due to pharmaceuticals. Lastly, this lecture will review the natural changes that take place in the friction ridge skin due to adolescent growth and the aging process.

### 7.2.2 Exercises – Exploring Changes in Friction Ridge Skin

This exercise includes matching same source impressions of the friction ridge skin. In this exercise, one impression was recorded during middle adulthood while the skin was healthy. The corresponding impression was recorded under one or more of the following conditions: before completion of adolescent growth, after the aging process has started, during wound healing, after scar formation, or during a disease state.

1.2.1.1 BS-1

1.2.1.2 BS-2

1.2.1.3 BS-3

1.2.1.4 BS-4

# EF Module 8 – Feature Variation in the Ridged Skin: Basis for Discriminating Power of Feature Sets within Populations

## 8.0 Introduction

This module explores the embryological development of the hands, feet, and friction ridge skin and the impact of anomalies during their formation. This module will emphasize the expected influence of developmental stability, developmental noise, and fluctuating asymmetry on the attributes of each feature of the friction ridge skin. The link between developmental stability and search diagnosticity and the link between developmental noise and source diagnosticity will be illustrated via impressions and research data from twins. Additionally, this module will introduce the concept of relevant population and appropriately qualified statements regarding feature variation in the population.

## 8.1 Learning Outcomes

8.1.1 Describe the sequence and timing of the formation of the hands and feet (to include volar pads and regular creases) and how this process influences ridge flows and pattern elements in the friction ridge skin.

8.1.2 Explain how anomalies is hand or foot formation can create atypical creases, ridge flows, and pattern elements.

8.1.3 Describe the morphogenesis of the primary ridges including the patterning of the capillary beds and free nerve endings in the dermis and the organization of the Merkel cells into bands in the epidermis prior to primary ridge formation.

8.1.4 Describe causes of dysplasia during ridge formation.

8.1.5 Define and explain the concepts of genotype, environment, and phenotype.

8.1.6 Explain the concept of developmental stability and sources of developmental stability during embryological development.

8.1.7 Explain the concept of developmental noise and sources of developmental noise during embryological development.

8.1.8 Describe the concepts of inherent developmental variation and fluctuating asymmetry and explain the relationship between inherent developmental variation, fluctuating asymmetry, and developmental noise.

8.1.9 Describe the relationship between developmental stability and search diagnosticity.

8.1.10 Describe the relationship between development noise and source diagnosticity.

8.1.11 Compare different study designs and articulate reasons for differences with respect to percentages of monozygotic twins, dizygotic twins, siblings, and unrelated individuals that share the same pattern or ridge count on the same digit.

8.1.12 Discuss the overall findings of the similarities and differences in minutiae between monozygotic twins and non-twins and how ridge flows and pattern elements can influence minutiae similarities via pattern force.

8.1.13 Explain the concepts of False Acceptance Rate, False Rejection Rate, and Equal Error Rate in biometric studies and describe the impact of twins on these rates in the biometric studies reviewed in the module.

8.1.14 Explain how genotype, environment, and developmental stability contribute to feature set similarities observed in the corresponding regions of twins' friction ridge skin.

8.1.15 Explain how developmental noise and fluctuating asymmetry contribute to feature set differences observed in the corresponding regions of twins' friction ridge skin.

8.1.16 Discuss the potential impact of twins on examiner accuracy.

8.1.17 Discuss the concept of relevant population and appropriately qualified statements regarding the population under consideration in an operational setting.

## 8.2 Methods of Instruction

### 8.2.1 Lecture – Feature Variation in Friction Ridge Skin

This lecture introduces the embryological development of the hands, feet, and friction ridge skin. The embryological development will focus on which features tend to display developmental stability within the human population and which features tend to be subject to developmental noise. The concepts of developmental stability and developmental noise will be tied to search diagnosticity and source diagnosticity of feature sets. Twin studies will be introduced to illustrate the effects of DNA, the environment, and developmental noise on the variation of the features of the friction ridge skin. Twin prints and close non-matches will illustrate the concepts that can limit variation of the features and induce errors by examiners and biometric systems. Strategies for testimony and review of common overstatements will also be discussed.

# EF Module 9 – Empirical Observations Regarding Friction Ridge Impressions

## 9.0 Introduction

This module summarizes the functional use of impressions of the friction ridge skin historically, within different operational settings, as impacted by events, and as guided by various professional organizations and working groups.

## 9.1 Learning Outcomes

9.1.1 Recall the contributions, limitations, and controversies of the following historical figures that influenced the use of impressions of the friction ridge skin: William Herschel, Henry Faulds, Francis Galton, Juan Vucetich, Edward Henry, Edmond Locard, Mary Holland, Harris Hawthorne Wilder, Inez Whipple, and David Ashbaugh.

9.1.2 Recall the basic circumstances of the following historical events that promoted the use of friction ridge impressions as a means of identification in the late 1800's/early 1900's: Troup Committee, Will West and William West case, Belper Committee, collection of fingerprints by New York Civil Service, establishment FBI fingerprint bureau, and the establishment of the International Association for Identification.

9.1.3 Recall developers and basic elements of the Henry Classification System (developed by Azizul Haque, Chandra Bose and Edward Richard Henry) and National Crime Information Center (NCIC) Classification System (Federal Bureau of Investigation).

9.1.4 Recall the general structure, function, and uses of biometric systems.

9.1.5 Summarize the progression of the International Association for Identification's position regarding minimum minutia thresholds to support an identification and the reporting of probabilistic results.

9.1.6 Describe the purpose and scope of the Organization of Scientific Area Committees (OSAC) and the American Academy of Forensic Science Standards Board (ASB).

## 9.2 Methods of Instruction

### 9.2.1 Lecture – Empirical Observations

This lecture summarizes the individuals, events, and organizations detailed in the learning outcomes for the module. Additionally, this lecture will review common over-statements during testimony regarding the history of the use of friction ridge impressions, common over-statements regarding observations from AFIS searches, and properly qualified statements regarding history and AFIS during testimony.

# EF Module 10 – Research Findings Regarding Friction Ridge Impressions

## 10.0 Introduction

Friction ridge examiners in the United States and many other countries are often asked why there is not a specific minutiae (point) standard for making an identification or why a statistical value, similar to DNA, is not reported for friction ridge impressions. Attempts to develop reliable statistical models for friction ridge impressions have occurred over the last 100 years, but the complex dependencies of minutiae make a stable model elusive. This module will review probability and statistics theory as necessary to support the objectives for this topic. This module will focus on published research on the distribution of minutiae in the friction ridge skin and introduce the general approaches for published fingerprint statistical models.

## 10.1 Learning Outcomes

10.1.1 Explain the inherent limitations of mathematical models that predict or explain natural phenomena.

10.1.2 Define the following concepts and the relationships between population, parameter, sample, and statistic.

10.1.3 Describe the difference between independent and dependent variables.

10.1.4 Describe the impact of ridge flow and pattern elements on minutiae densities and orientations in the friction ridge skin.

10.1.5 Explain the weighting of the following categories of minutiae: pattern-force, counter-pattern force, compound, and unbound (non-pattern force).

10.1.6 Explain the relationship between a probability of random correspondence (PRC) model and a likelihood ratio (LR) model.

10.1.7 Explain the difference between a score-based model and a likelihood ratio model.

10.1.8 Discuss rates of misleading evidence for statistical models.

10.1.9 Explain general strengths and limitations of statistical models for friction ridge.

10.1.10 Discuss the impact of close non-matching friction ridge impressions on model performance.

10.1.11 Explain how the statistical models support the consideration of minutiae configurations to support an identification, rather than a strict minimum count of minutiae.

## 10.2 Methods of Instruction

### 10.2.1 Lecture – Friction Ridge Research

This lecture explains basic concepts in statistics and probability. A high level overview of fingerprint models, including strengths and limitations, will be provided. Performance of models will be presented and linked to expectations of model performance given the impact of developmental stability on the formation of minutiae during embryological development. Lessons learned from minutiae studies and statistical models will also be viewed in light of historical statements within the United States that a specific minimum number of corresponding minutiae is not scientifically defensible from the perspective of minutiae data.

# EF Module 11 – Feature Detection in Latent Prints

## 11.0 Introduction

The recognition and documentation of the features in a friction ridge impression are at the very core of the latent print examination process. This module will cover common distortion factors that impact the recognition of features in friction ridge impressions.

*Implementation Note 1: The trainee should be provided with general introduction to the processing techniques typically encountered in the agency prior to starting this module.*

*Implementation Note 2: The trainee should be provided with training regarding digital imaging software used at the agency (e.g., Photoshop) prior to starting this module.*

## 11.1 Learning Outcomes

11.1.1 Explain the following concepts related to skin contact with a surface: stick region, incipient slip, gross slip, shearing stress and torque.

11.1.2 Describe the visual cues that indicate the skin experienced shearing stress or torque during a contact event with a surface.

11.1.3 Describe the visual cues that indicate the skin changed angle of contact or deposition pressure while experiencing shearing stress or torque during a contact event with a surface.

11.1.4 Recognize latent prints in which the residue is predominantly oil-based, water-based, a mixture of oil water components, or blood-based.

11.1.5 Describe the potential variations in the distribution of residue in the skin, (before a contact event occurs) and the potential impact on the resulting impression under different levels of deposition pressure.

11.1.6 Recognize and describe how residue is redistributed among the ridges and furrows when the skin slides on a surface.

11.1.7 Recognize and explain how the shape, firmness, and texture of surfaces can affect the appearance of friction ridge impressions.

11.1.8 Recognize and explain how existence, interaction, displacement, or removal of surface contaminants can affect the appearance of friction ridge impressions.

11.1.9 Describe the visual cues that indicate an impression has been impacted by overlays, double taps, or wobbling of the skin on the surface.

11.1.10 Recognize and discuss missing and false minutiae due to the distortion factors covered in this module.

## 11.2 Methods of Instruction

### 11.2.1 Lecture – Basic Distortion Interpretation

This lecture introduces the following concepts related to skin contact with a surface: stick region, incipient slip, gross slip, shearing stress, and torque. Additionally, this lecture will demonstrate the effects of shearing stress and torque on the skin and the appearance of latent prints deposited while the skin is experiencing shearing stress or torque. In more complex examples, this lecture will demonstrate the impact of changes in angle of contact or deposition pressure while shearing stress or torque are applied to the skin. This lecture will include strategies for tracing ridges and marking minutiae using GYROB on latent prints exhibiting these distortion factors.

### 11.2.2 Exercises – Basic Distortion Minutiae Mark-Up

The trainee will trace the ridges and mark the minutiae in 15 ground truth latent samples displaying shearing stress and torque (including examples displaying changes in angle of contact or deposition pressure during the contact event). The trainee is expected to mark the minutiae in so far as possible in the latent print using GYR, then use the exemplar print to help interpret the ridge paths and minutiae in the latent print. During comparison with the exemplar print, the trainee will document any added minutiae (O – orange) or non-corresponding minutiae (B – blue).

### 11.2.3 Lecture – Advanced Distortion Interpretation

This lecture will demonstrate the effects of residue, surfaces, overlays, double taps, and wobble on the skin and the appearance of latent prints. Strategies for detecting ridge or furrow transitions will be discussed and demonstrated. Areas of latent prints that are prone to false or missing minutiae due to these distortion factors will be highlighted. This lecture will include strategies for tracing ridges and marking minutiae using GYROB.

### 11.2.4 Exercises – Advanced Distortion Minutiae Mark-Up

The trainee will trace the ridges and mark the minutiae in 15 ground truth latent samples displaying issues related to residue, surfaces, overlays, double taps, or wobble. The trainee is expected to mark the minutiae in so far as possible in the latent print using GYR, then use the exemplar print to help interpret the ridge paths and minutiae in the latent print. During comparison with the exemplar print, the trainee will document any added minutiae (O – orange) or non-corresponding minutiae (B – blue).

# EF Module 12 – Casework Examination Process

## 12.0 Introduction

This module synthesizes the practice comparison exercises with the complexities of casework. This module will begin with an introduction to logic to highlight the strengths and weaknesses of inferences made during the examination process. Casework practices will include learning and applying the latent print suitability criteria established by the agency (or as introduced in the EF Training Program), strategies for the comparison process, and formulating appropriate opinions and results. Trainees will practice these skills in mock latent print training cases.

*Implementation Note 1: This module will introduce explicit suitability criteria and the expected answers for the practical exercises are centered around these criteria. If the agency uses different criteria for establishing suitability, all samples must be re-analyzed by the agency to determine expected answers for the trainee.*

*Implementation Note 2: The expected source opinions or results are based on the use of the suitability criteria and judgement of Evolve Forensics. If the agency uses different criteria for supporting source opinions or results, all samples must be re-compared by the agency to determine expected opinions or results for the trainee.*

*Implementation Note 3: The trainee should also be learning the process for completion of casework per agency requirements.*

## 12.1 Learning Outcomes

12.1.1 Explain the relationship between knowledge, expertise, and critical thinking.

12.1.2 Describe the following forms of logic: deductive, inductive, and abductive.

12.1.3 Discuss the limitations of different forms of logic in relation to forming inferences during the examination of friction ridge impressions.

12.1.4 Assess the benefits and limitations to discreet opinions versus continuous statistical results regarding sources of friction ridge impressions.

12.1.5 Establish, support, and document search parameters for latent prints (anatomical region, orientation, and uncertainty).

12.1.6 Categorize friction ridge impressions as “suitable” or “not suitable” based on agency (or EF Training Program) suitability criteria.

12.1.7 Recognize friction ridge impressions that display debatable suitability and explain causes for debatable suitability.

12.1.8 Properly isolate and label suitable latent prints.

12.1.9 Select effective target groups, efficiently and thoroughly search through exemplar prints, and exploit diagnostic feature sets to include or exclude possible donors.

12.1.10 Compare (side-by-side) latent prints and exemplar prints and detect similarities and differences.

12.1.11 Properly weigh the similarities and differences between impressions from the same source

12.1.12 Properly weigh the similarities and differences between impressions from the different sources

12.1.13 Determine when additional exemplars are required to complete comparisons.

12.1.14 Formulate and support appropriate source opinions and results.

12.1.15 Follow agency case documentation procedures.

## 12.2 Methods of Instruction

### 12.2.1 Lecture – An Introduction to Logic and Reasoning

This lecture introduces the following concepts: knowledge, expertise, critical thinking, deductive logic, inductive logic, and abductive logic. Discreet opinions will be compared to continuous statistical results, with strengths and limitations highlighted. This lecture will also introduce faulty forms of logic that impact the way both examiners and attorneys understand forensic results.

### 12.2.2 Lecture – Establishing Search Parameters for Latent Prints

This lecture ties together the use of features and the impact of distortion when establishing search parameters for latent prints. The lecture will demonstrate establishing and documenting search parameters in preparation for the Basic and Intermediate Latent Print Comparison Exercises.

### 12.2.3 Exercises – Basic Latent Print Training Cases

Four training cases require the trainee to analyze latent prints and document suitability and search parameters. All latent prints are suitable for comparison. There is only one latent print per image. The latent prints in these cases display low or moderate distortion factors and contain feature sets exhibiting moderate or high search diagnosticity. The latent prints will be compared to subjects and opinions and results recorded per agency casework policy.

12.2.3.1 BLTC-1
12.2.3.2 BLTC-2
12.2.3.3 BLTC-3
12.2.3.4 BLTC-4

### 12.2.4 Exercises – Intermediate Latent Print Training Cases

Four training cases require the trainee to analyze latent prints and document suitability and search parameters. All latent prints are suitable for comparison. There is only one latent print per image. The latent prints in these cases display moderate to high distortion factors and contain feature sets exhibiting low to moderate search diagnosticity. The latent prints will be compared to subjects and opinions and results recorded per agency casework policy.

12.2.4.1 ILTC-1
12.2.4.2 ILTC-2
12.2.4.3 ILTC-3
12.2.4.4 ILTC-4

### 12.2.5 Lecture – Latent Print Isolation Techniques and Suitability

This lecture introduces complex lift cards and photographs (i.e., images or lifts with numerous friction ridge impressions that must be isolated), Evolve Forensics suitability criteria, and acceptable practices for isolating suitable latent prints. The instructor will walk the trainee through a representative sample of casework images. Strategies and reasoning supporting suitability and isolation techniques will be discussed for each latent print.

### 12.2.6 Exercise – Latent Print Isolation and Suitability

This exercise ties together all the basic skill sets associated with suitability decisions: recognition of anatomical region and orientation, application of suitability criteria, and appropriate isolation and labeling of suitable latent prints. The trainee will analyze 20 complex lift cards or photographs independently to determine suitability. The trainee is expected to document search parameters and label the individual impressions appropriately. The trainee should discuss results with a trainer.

### 12.2.7 Exercises – Advanced Latent Print Training Cases

The trainee will be provided eight training cases containing latent prints on complex photographs or images of lift cards. The trainee must determine which latent prints are suitable for comparison and isolate the suitable latent prints appropriately. The latent prints in this exercise display a range of distortion factors and contain feature sets exhibiting a range of search diagnosticity. The latent prints will be compared to subjects (including twins to introduce close non-matches) and opinions and results recorded per agency casework policy.

12.2.7.1 ALTC-1
12.2.7.2 ALTC-2
12.2.7.3 ALTC-3
12.2.7.4 ALTC-4
12.2.7.5 ALTC-5
12.2.7.6 ALTC-6
12.2.7.7 ALTC-7
12.2.7.8 ALTC-8

# EF Module 13 – Examiner Performance Research

## 13.0 Introduction

The admissibility of expert opinions regarding the source of a friction ridge impression generally rests on the court's determination of the validity, or trustworthiness, of the expert opinion. In this module, the trainee will learn about the general nature of expertise and the human visual system, differences between expert and novices examining latent prints, and performance studies that have illuminated the strengths and weaknesses of experts.

## 13.1 Learning Outcomes

13.1.1 Describe the general characteristics of experts.

13.1.2 Explain the stages of human vision and perception, with special focus on processes that impact the interpretation of friction ridge impressions.

13.1.3 Explain some of the differences between experts and novices during the ACE process.

13.1.4 Define the following terms with respect to error rate testing: accuracy, reproducibility, repeatability, and reliability.

13.1.5 Explain the following types of error rates: sensitivity, specificity, false positive rate, false negative rate, positive predictive value, negative predictive value, false positive discovery rate, and false negative discovery rate.

13.1.6 Discuss the application and significance of confidence intervals to the results of error rate testing.

13.1.7 Discuss the design and results of selected error rate studies.

13.1.8 Explain the concepts of "foundation validity" and "validity as applied" as discussed in the 2016 PCAST Report "Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature Comparison Methods".

## 13.2 Methods of Instruction

### 13.2.1 Lecture – Importance of Expertise in Friction Ridge Examinations

This lecture provides a general overview of expertise, including the general characteristics associated with experts, regardless of profession. The lecture will review the basic process of human visual perception as visual data passes through the four stages of vision: image-base processing, surface-based processing, object-based processing, and category-based processing. These stages will be described and aspects that strengthen and limit an expert's perception of ridges in friction ridge impressions will be highlighted. The lecture will review select published research that compared novices to friction ridge experts in the examination of friction ridge impressions and highlight the need for appropriate training.

### 13.2.2 Lecture – Understanding Error Rates and the 2016 PCAST Report

This lecture introduces the following concepts related to error rate testing: accuracy, repeatability, validity, sensitivity, specificity, false positive rate, false negative rate, positive predictive value, negative predictive value, false positive discovery rate, and false negative discovery rate. This lecture will also provide a general overview of the purpose of confidence intervals and discuss the results of published error rate research. This lecture will also discuss the 2016 PCAST Report, "Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature Comparison Methods," related to friction ridge discipline.

# EF Module 14 – Human Factors and Quality Management

## 14.0 Introduction

Human factors are a natural part of the examination process and may impact the performance of the examiners. This lesson will include factors from the following four sources of errors listed in the 2012 Expert Working Group on Human Factors in the Analysis of Latent Prints report, Latent Print Examination and Human Factors: Improving Practice through a Systems Approach. The sources of errors that will be discussed in the lecture include analyst actions, analyst conditions, supervisory issues, and organizational issues. The trainee will apply these human factors to specific case studies of mistakes and violations.

*Implementation Note: The trainee should be provided with an overview of agency specific policies and procedures related to the agency quality management system.*

## 14.1 Learning Outcomes

14.1.1 Define human factors in a forensic context.

14.1.2 Describe analyst actions that can contribute to errors.

14.1.3 Describe analyst conditions that can contribute to errors.

14.1.4 Describe supervisory failures that can contribute to errors.

14.1.5 Describe organizational failures that can contribute to errors.

14.1.6 Introduce the concept of high reliability organizations.

14.1.7 Discuss failures related to the Shirley McKie and Marion Ross erroneous identifications in Scotland and the Brandon Mayfield erroneous identification in the United States.

14.1.8 Introduce forgery and fabrication cases to illustrate human factors.

14.1.9 Discuss quality management techniques deployed in forensic laboratories to minimize errors and improve analyst performance.

## 14.2 Methods of Instruction

### 14.2.1 Lecture – Human Factors and Quality Management

This lecture reviews analyst actions, analyst conditions, supervisory failures, and organizational failures that can impact the latent print examination process. Numerous latent print examples illustrate the issues, including how a quality management system can help mitigate these failures. Publicized errors and violations will be introduced and framed in the context of human factors.

# EF Module 15 – Testimony

## 15.0 Introduction

On any given day, the admissibility of an expert's testimony may be challenged. This lesson will review the history of expert testimony; applicable federal, state, and local rules for expert opinion testimony; the purpose of motions *in limine* to exclude expert testimony; the process and purpose of evidentiary hearings; and common regional challenges to the admissibility of friction ridge evidence. During trials, direct and cross-examination both serve purposes within the criminal justice process. This module will highlight the roles of prosecution and defense and the expectations of experts testifying under direct and cross.

*Implementation Note: The trainee should be provided with an overview of agency specific policies and procedures regarding subpoenas and discovery, expectations regarding tracking of qualifications, and relevant state and local laws guiding admissibility.*

## 15.1 Learning Outcomes

15.1.1 Summarize the history of expert testimony in the United States.

15.1.2 Explain the significance of the following cases as they relate to friction ridge evidence: *U.S. v. Mitchell* (1999), U*.S. v. Llera-Plaza* I and II (2002), *Commonwealth of MA v. Patterson* (2005), *New Hampshire v. Langill* (2008), and *U.S. v Rose* (2008).

15.1.3 Describe the application of the *Frye* Test to the admissibility of expert testimony and variations of the *Frye* Test.

15.1.4 Describe the application of the Federal Rules of Evidence to the admissibility of expert testimony.

15.1.5 Describe the application of the five *Daubert* factors to the admissibility of expert testimony and discuss the application of Daubert to the friction ridge discipline.

15.1.6 Explain how *General Electric v. Joiner* (1997) and *Khumo Tire v. Carmichael* (1999) clarified and expanded the scope of the *Daubert* factors.

15.1.7 Describe the purpose for motions *in limine* to exclude expert testimony and process and purpose of evidentiary hearings.

15.1.8 Summarize common challenges to the admission of friction ridge evidence or expert opinion testimony.

15.1.9 Define hearsay.

15.1.10 Describe the confrontation clause of the Sixth Amendment to the United States Constitution and the reformation of the confrontation clause via the following court decisions: *Crawford v. Washington* (2004); *Melendez-Diaz v. Massachusetts* (2009); *Bullcoming v. New Mexico* (2011); *Illinois v. Williams* (2012).

15.1.11 Describe the types of testimony experts are allowed to provide.

15.1.12 Explain the difference between facts and opinions (inferences).

15.1.13 Explain the concept of "ultimate issue" and limitations of expert testimony on ultimate issues in a case.

15.1.14 Explain the importance of testifying within their expertise and the possible consequences of testifying beyond their expertise.

15.1.15 Explain the importance of chain of custody of evidence.

15.1.16 Explain the importance of cross-examination as guaranteed by the Sixth Amendment of the United States Constitution.

15.1.17 Describe how learned treatises (books or written authorities) in the friction ridge discipline may be used to impeach expert testimony and formulate responses to common questions stemming from learned treatises.

15.1.18 Describe what a “leading question” is and how leading questions are used during cross-examination.

15.1.19 Describe the general process attorneys use to develop, promote, and employ their theory of a case and the expert witness’s ethical obligation to stay transparent and within the supportable bounds of their discipline during testimony.

## 15.2 Methods of Instruction

### 15.2.1 Lecture – Admissibility Issues

This lecture introduces the history of expert testimony; applicable federal rules and case law affecting expert opinion testimony; the purpose of motions *in limine* to exclude expert testimony; the process and purpose of evidentiary hearings; and common challenges to the admissibility of friction ridge evidence.

### 15.2.2 Lecture – Direct and Cross Examination

This lecture introduces the direct and cross examination process, including general approaches used by prosecution and direct to build their theory of a case. The primary focus of this lecture will be the role and expectations of the expert under examination. An extensive case testimony example from 2017 (with testimony regarding a wide range of topics) is provided in the lecture and the trainer and trainee should discuss the strengths and weaknesses of the testimony.