Biology Behind the Crime Scene
Week 2: Lab #2 Fingerprinting

Adapted from Ward's Kit

There is little need to mention the importance of obtaining fingerprints in criminal investigations. Fingerprints have long been considered one of the most valuable types of physical evidence that can be found at a crime scene. A definitive method of identifying a criminal is the fingerprint. Fingerprints are unique to each person – even identical twins have different fingerprints. In today's laboratory exercise, you will take fingerprints, analyze your own fingerprints, calculate the statistics of overall fingerprint patterns present in the class, make different kinds of prints that may be found at a crime scene, and develop those prints using common development techniques. There are three different types of fingerprints: visible prints, plastic (or impression) prints, and latent prints. The term "latent fingerprints" however can have two meanings: it can mean ANY fingerprints found at a crime scene or it can mean specifically fingerprints left from bodily oils and perspiration that cannot be seen with the naked eye and must be "developed" in order to be seen. We will consider only the invisible prints as "latent prints." Visible prints can be seen by the naked eye and can be left in substances from ink to paint to blood. Plastic prints are ridge impressions of the fingerprint left in a soft substance such as putty, dust, or soap.

Investigators normally need a portable, permanent copy of the fingerprints. A photograph can generally fulfill this need. Of the three types of fingerprints, visible fingerprints can be photographed directly, and plastic (or impression) fingerprints can usually be photographed under special lighting conditions. It is only the invisible latent fingerprints that are difficult to photograph. They must first be made visible.

See the other handout, "Simplified Fingerprint Analysis," for additional background on fingerprints. Be prepared for quiz questions on this background material as well as this handout. Today you will be working in your normal 6 groups of 4 people unless otherwise noted.

I. PreLab Preparation

Before the lab, print out and read over the 2 handouts in their entirety. Remember to do a handwritten pre-lab with Purpose/Objectives, Materials, and Procedures sections.

Purpose and Objectives:

- to learn some of the basic techniques that can be used to develop different types of fingerprints
- to diagram and point-by-point match the minutiae of your own fingerprints
- to apply fingerprint analysis techniques to examine and compare "evidence"

Materials:

Fingerprinting video	National Treasure DVD
Metal spoons with codes	Soda cans
String	Carbon dust
Large jars with lids	Fingerprint brushes
Superglue	Newspaper
Rulers (1 per student)	Packing tape
Fingerprint card sheets	Play-doh or Silly Putty
Magnifying glasses	Gloves, etc.
Ink pads	

II. Laboratory Procedures

Latent Prints

The cyanoacrylate fuming method (often called the super glue method) of developing latent fingerprints has proven to be an effective tool for professional investigators, and the quality of its results has made it a popular one. It is currently used in most state and metropolitan police forces across the country.

Latent fingerprints are composed of several chemicals exuded through the pores in the fingertips and are left on virtually every object touched. The primary component of latent fingerprints is ordinary sweat. Sweat is mostly water, and will dry after a fairly short period of time. The other components of latent fingerprints are primarily solid, however, and can remain on a surface for a much longer period of time. These other components include organic compounds like amino acids, glucose, lactic acid, peptides, ammonia, riboflavin, and isoagglutinogens as well as inorganic chemicals like potassium, sodium, carbon trioxide, and chlorine.

The basic concept behind all of the chemical techniques is to apply something that will chemically react with one of the constituent chemicals of latent fingerprints to the area suspected of containing such a fingerprint. The resulting reaction will give all present latent fingerprints a new chemical composition. This new chemical composition will make the latent fingerprints easily rendered visible, and they can then can either be lifted or photographed. Super glue reacts with the traces of amino acids, fatty acids, and proteins in the latent fingerprint and the moisture in the air to produce a visible, sticky white material that forms along the ridges of the fingerprint. The final result is an image of the entire latent fingerprint. This image can be photographed directly, or after further enhancement. To enable such a reaction to take place, the cyanoacrylate must be in its gaseous form. The whole reaction can take over two hours, with the exact time determined by the size of the tank, the concentration of the gaseous cyanoacrylate in the air, the humidity of the air, and numerous other factors. Since it is in practice very difficult to calculate this amount of time in advance, the reaction must be monitored to insure that it is not allowed to continue for too long. If it runs unchecked, the latent fingerprints can overdevelop; the chemical images of the ridges will slowly grow wider until they overlap, obscuring vital detail. There are a few methods by which the process may be accelerated; using a heater, circulating the fumes,

using a chemical accelerant such as sodium hydroxide in contact with the super glue to form fumes faster, and adding water vapor since the reaction needs moisture to occur.

Since the chemical deposits left by the reaction are white, there may not be enough contrast for an effective photograph to be taken if the surface they are on is also white. If this is the case, a simple method exists that solves the problem. This is the technique of dusting. Different colored dusts may be brushed onto the image of the fingerprint, and they will cling to the sticky white chemical from which it is formed, effectively changing its color. The super glue technique produces outstanding results on all non-porous surfaces like metal, glass, and plastic; it will sometimes work on porous surfaces too, but not as well.

By using the super glue method, fingerprints can be obtained from uneven surfaces and hard-to-dust surfaces such as bottles, knives, guns and dead bodies. Other surfaces such as porous surface like paper require a different chemical such as ninhydrin or iodine to develop the print. When dusting uneven or difficult surfaces, there is only one chance to lift the print perfectly. If the fingerprint is developed with cyanoacrylate (or super glue fuming) the print will be semi-permanent, therefore allowing the examiner to re-dust and re-lift the print if necessary. Sometimes it is hard to visualize fingerprints on multi-colored surfaces because the fingerprint powder does not give a significant amount of contrast. This would be another case in which cyanoacrylate or super glue fuming would be used.

**NOTE: The chemical cryanoacrylate in superglue is a noxious chemical.

A. Make and Start to Develop a Latent Print:

Developing fingerprints with Superglue, which is made of a chemical called cryanoacrylate, takes a few hours. By starting this process first, we will be able to examine the developed fingerprints toward the end of the lab.

Step 1: Take a "coded" metal spoon and wipe it with a paper towel.
Step 2: Rub your right thumb over your arm or forehead to "grease it up."
Step 3: Hold the spoon in your left hand in front of you as if you were about to eat from it.
Step 4: Press your right thumb on the "bottom" of the bowl part of the spoon. You may want to put a print on the back of the bowl as well.
Step 5: Figure out an alias for yourself that you will use on your fingerprint card in Part B. Make sure to record the code from your spoon in your notebook and write your alias next to it.
Step 6: Tie a piece of string securely to the long handle of the spoon.
Step 7: Your group should get a lid from one of the jars in the fume hood and tie each spoon to one of the hooks on the lid.
Step 8: One group member should empty the entire tube of superglue into the aluminum foil boat on the bottom of the jar and then put the cover with the spoons on it back on the jar. Make sure you note the jar number and time you put them in to develop. It will take about 1 ½ - 2 hours for them to develop so while they develop, continue on with part B.

This is done in a fume hood to avoid inhaling the noxious chemicals in the Superglue. THIS PROCEDURE SHOULD BE PERFORMED ONLY IN THE LAB.

B. Take Your Visible Fingerprints:

Each student will get a fingerprint card. Please make up all personal information that you put on the card, using the same alias you decided upon in Part A – USE ONLY FAKE NAMES & INFORMATION.

Step 1: Get a fingerprint card.
Step 2: Make up the personal information that goes on the card [name, age, etc.] – NO REAL NAMES OR INFORMATION; use only FAKE names and information.
Step 3: Watch the cheesy instruction video about how to take fingerprints.
Step 4: Split your group into pairs.
Step 5: Tape the fingerprint card to the table so it stays still.
Step 6: Follow the directions from the instructional video to help you and your partner ink each finger and put your fingerprints on your fingerprint cards. Your instructors are available to help you if you forget any directions.
Step 7: Thoroughly wash your hands.

C. Analyze Fingerprint Patterns:

Your instructor(s) have gone over the three classes fingerprints may take based on their different overall patterns: loops, arches, and whorls and their sub-patterns. This information is also available in the "Simplified Fingerprint Analysis" handout that you should also have with you.

Step 1: Analyze your own fingerprints for these patterns for all 10 fingers [down to the sub-pattern type] and write them in your notebook.
Step 2: Once you have figured out your overall patterns, share with your instructor whether you have any loops, arches, or whorls on any of your 10 fingers. Your instructor will put them in a spreadsheet projected at the front of the class.
Step 3: Once all fingerprint pattern data are collected, the percentages of the patterns that exist in the classroom will be calculated. Compare it to the percentages of certain patterns for the overall U.S. population found on the first page of the "Simplified Fingerprint Analysis" handout. Make sure to write the class percentages in your notebook.

D. Discover Identifying Characteristics by Making a Visible Print with ink:

The individuality of a fingerprint is not determined by its overall pattern but rather the ridge characteristics or minutiae. Your instructor has discussed the minutiae that distinguish fingerprints. This information is also available in the "Simplified Fingerprint Analysis" handout. In a judicial proceeding, a point-by-point comparison between a fingerprint taken from the crime scene and an inked impression of one of the suspect's fingers must be demonstrated to prove the fingerprint from the crime scene belongs to that suspect. The average fingerprint has as many as 150 minutiae however, much fewer are required to meet the criteria of individuality. The exact number is debated because no comprehensive statistical study has ever determined the frequency of occurrence of minutiae and their location. Typically between 8 and 16 are suggested as being sufficient which means partial prints recovered from a crime scene are still able to be matched to a suspect.

While you are working your instructor may play in the background the superglue fuming scene in the movie "National Treasure." How realistic is it?

Step 1: Wash your hands again.
Step 2: Take any one of your fingers and dab it on the ink pad, then make TWO visible prints with the same finger, side-by-side in your lab notebook; leave space between them for lines.
Step 3: Examine the first visible print. Can you identify its overall pattern? Note your observations in your notebook.
Step 4: Examine the first visible print again. Can you identify any minutiae?
Step 5: Using lines drawn with a ruler and the same technique shown on the "Simplified Fingerprint Analysis" handout or on Page 165 of the *Forensic Science* text, diagram the 2 prints with point-by-point comparisons of at least 4 minutiae. Remember, these minutiae must be the same – the same type in the same spot. You must have a legend that identifies the type of minutiae compared [ex., 1 = ridge ending, 2 = enclosure, etc.]. Every minutiae located in the first print must have its own number even if you found the same minutiae in two different places.

E. Make and Lift Another Latent Print:

The sweat in a fingerprint evaporates relatively quickly while the other compounds remain in the print for a longer period of time. The super glue method is an excellent way to develop older fingerprints because the sweat has evaporated and the super glue fumes only need the amino acids, proteins and fatty acids to develop the fingerprint. Fingerprint powders, however, adhere to the sweat and therefore the powders have a difficult time adhering to only the amino acids, proteins and fatty acids so this method is better for newer prints.

Developing fingerprints with carbon dust may appear easy, but it takes a light hand and patience.
DO NOT INHALE THE CARBON DUST: GO EASY & TRY NOT TO GET IT IN AIR.

Step 1: Take a metal soda can: rinse it with distilled water and wipe it with a paper towel.
Step 2: Rub your right thumb over your arm.
Step 3: Press your right thumb on various parts of the can, including the indented bottom.
Step 4: Take your can to the dusting station setup at the side bench, where newspaper has already been setup for you.
Step 5: Take a brush and dip it in the carbon dust. Gently shake off excess back into container. Use the dust sparingly – less dust is better: you waste less material and get less in the air
Step 6: Gently brush/tap the surface of the can where you've put your fingerprints. You may find that gently tapping some dust around the indent in the bottom of the can produces a nice, clear print on the indented bottom.
Step 7: Find a nice, clear print. See if you can identify the overall pattern of the print. Write your observations in your notebook.
Step 8: Take a piece of packing tape and VERY CAREFULLY place it on top of a print you wish to lift off. Don't disturb other prints. Press down gently, and then carefully lift the tape. Put the lifted print in your notebook.
Step 9: Repeat Steps 7 – 9 until you manage to get a clear carbon dust print into your notebook. It may take several tries. Recycle your can when you are finished.
Step 10: Identify and diagram at least 2 minutiae in the clearest lifted print in your notebook.

F. Make a Plastic Print in Play-Doh (or Silly Putty)

Step 1: Roll out a small piece of Play-Doh with your hands. Take any one of your fingers and press it firmly into a piece of Play-Doh.
Step 2: Examine the plastic print. Can you identify its overall pattern? Note your observations in your notebook.
Step 3: Examine the plastic print again. Can you match any 1 of the minutiae to your rolled print of the same finger? Note your observations in your notebook.

G. Identifying "Suspects" with Developed Prints from part A.

Step 1: When your whole group has reached this far, remove your spoons from the jar in the fume hood, noting the time they came out in your notebook. Pile your fingerprint cards and spoons together and exchange them with another group of 4 who have reached this far.
Step 2: Examine the developed prints on the spoons from the other group.
Step 3: Compare the 4 spoons with the right thumb prints of the fingerprint cards of the 4 members of the other lab group at your table.
Step 4: As a group, can you correctly identify which print was made by which student? For each coded spoon, write down the code and the suspect's alias of your determined fingerprint "match." Note in your notebook WHY your group decided on which suspect for each, including at least 2 minutiae for each print.
Step 5: Check with the other group to see if you are correct. WRITE DOWN which matches were correct and which were incorrect. Be honest. You will lose points if you falsify data.
Step 6: Return the spoons and fingerprint cards to the other group, and get your spoon back. You may take your spoon and fingerprint card home with you if you would like. If not, place the spoons in the container marked by the instructor so they can be reused.

Conclusion of Results and Clean-Up:

For your Conclusion of Results, write a sentence about the results from each of the different sections in the lab (i.e. Part A and G are one result). Then write a conclusion about these results (i.e. why/how is fingerprinting important to crime scene investigations). Remember to keep it objective.

Clean your area and return materials to their appropriate place. Discard any materials as instructed. Remember to get your lab notebook signed.