Fingerprinting 101

So simple, even a caveman could do it.

By Erin Radebe

I have to admit the first time I conducted this lab, using chemical methods to develop fingerprints with my students, we had about a 25% success rate for developing the prints. Through a lot of trial and error with my sister, Megan Hart (who also happens to teach forensic science) and our students, we have figured out some tricks to obtain better quality latent prints from chemical development methods.

First, I want to address safety concerns with this lab. Students absolutely must wear gloves (nitrile or latex) for all of these stations. These chemicals react with prints, so they will react with fingers. Students should follow all prudent lab safety rules, including wearing goggles, apron and appropriate lab attire. Iodine and Superglue fuming should ONLY be conducted in a fume hood. Superglue should not be placed on a hot plate because it can get too hot and generate HCN (a toxic gas). There are serious risks with using Superglue if you do not use the materials in an appropriate fashion.

Before my students start the lab I have them place their prints on several small squares of printer paper and aluminum foil. They label the prints, being careful not to touch the center where they left the latent print. They then place the prints into a plastic bag. I also have them apply hand sanitizer to their hands, and then leave a second set of prints on small squares of paper and aluminum foil, label, and place them in the bag. This way once they start the lab they do not have to constantly take their gloves on and off to leave prints. The prints in the pictures that are displayed here are intentionally not labeled. If you want to extend this lab, you can have students try to develop prints collected from a mock crime scene. Students can also compare the prints from multiple types of paper. They can try developing latent prints on wood, plastic, and cardboard as well. In addition, at the end of the lab, one lab team of students can also swap their ten cards and a latent print with another group. They can try to figure out to whom the latent print belongs.

Background

Our fingerprint unit consists of six 90-minute blocks, lasting approximately two and half weeks. We introduce the fingerprint unit by teaching student to classify prints by type (arches, tented arches, loops, central pocket loop whorls, double loop whorls, regular whorls and mixed/accidental whorls) using exemplar prints. During the second block, students ink their own prints on a ten print card and classifying each print. Students also calculate their Henry Classification number and compare their number with class data. During the third block, we teach minutia by enlarging inked fingerprints on the photocopier for students to identify details within a real fingerprint. Students highlight and label different types of minutia. During the next two blocks, students dust and lift latent prints. We give students different surfaces, types of tape, magnetic powder, and non-magnetic powder, different colors of powder, different types of brushes and even develop latent prints off the sticky side of tape using wet powder. We then analyze student findings and discuss the limitations of dusting prints. During the sixth block, we introduce chemical methods and students participate in a lab using chemical methods to develop latent prints. Students then analyze culminating scenarios and select which chemical method would be best to use and why.

Note: We purchase most of our fingerprinting materials from Evident due to their variety and high quality.

Ninhydrin Station:

As my students explained in their experiment, ninhydrin binds to amino acids in latent prints and can be used to develop prints left on paper. You can make your own solution by dissolving ninhydrin in ethanol, but I have found that the pre-made solution from Flinn works much better. Since you use so little for each print, one bottle can easily be used for several classes. Originally, I had the students leave their prints on squares of printer paper and then dip the paper in the ninhydrin solution with forceps (photo 1). They placed the paper on a watch glass (photo 2) in the fume hood until the solvent evaporated. This method works, but we found that placing the ninhydrin in a spray bottle and spraying the prints yields much better prints (photo 3). If you spray the ninhydrin, it is important to use a fume hood. The prints can be left hanging upovernight to develop or you can expedite the process by holding the prints over a steam bath using tongs (photo 4). (photo 5, sample ninhydrin print)

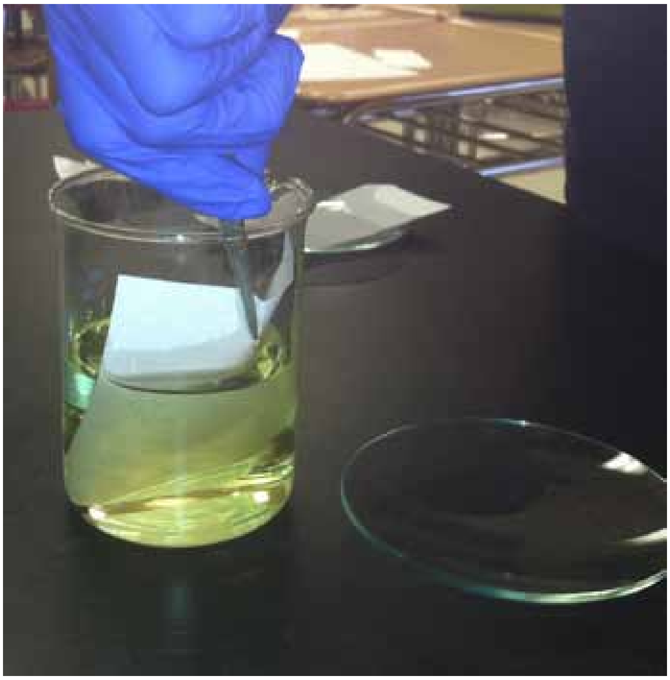

Photo 1. Dipping the latent print left on the small paper square into the beaker

Photo 3. Using steam over a water bath to speed up the development of ninhydrin prints

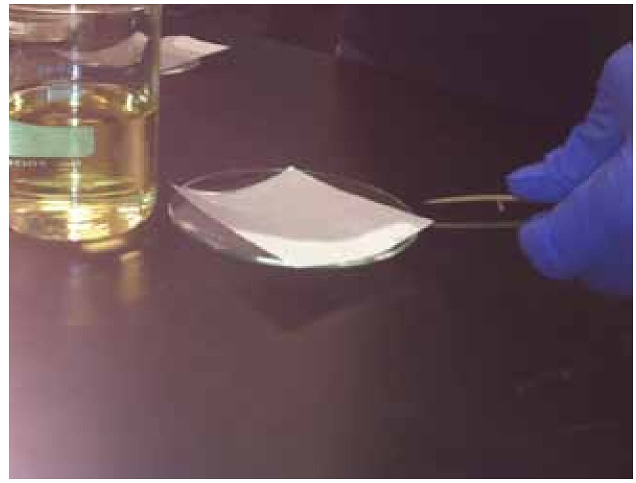

Photo 2. Laying the print wet with ninhydrin on the watch glass to dry

Photo 4. Student spraying ninhydrin in the fume hood on the paper samples.

Photo 5. Sample ninhydrin print with use of hand sanitizer

Superglue Station:

The cyanoacrylate in Superglue also binds with amino acids in latent prints left on non-porous surfaces, such as aluminum, glass, or plastic. I suggest purchasing the individual use, mini super glue tubes. They usually come in a ten pack. Students can then immediately dispose of them. For years, I had the class put their prints in a large fish tank and then fume the whole class at once. Some prints turned out and some did not. Now I use a 1 L beaker as my containment vessel. I have my students leave prints on a small square of aluminum foil and tape it to the bottom of the 1L beaker. I heat a 100mL beaker half filled with water. This provides the steam for the Superglue fuming process. I also heat a metal tray (metal weigh boat) on a candle warmer. Once the water is boiling, we carefully move it with oven mitts to the candle warmer. We quickly pour the contents of one individual use Superglue tube into the metal tray and cover with the inverted 1 L beaker (photo 6). We allow this to fume for 10 minutes (photo 7). We turn off the candle warmer. It is important to right the beaker in the hood. If you take the beaker out of the hood and then flip it over, the fumes can still be trapped inside, and you will inhale them, and you do not want to breathe that in. Since Superglue also binds with amino acids in latent prints, students can also leave prints on foil before and after using hand sanitizer so they can compare the quality of the prints. (photos 8 & 9 sample Superglue print)

Iodine Station:

Iodine prints have always been the most reliable for my students. Iodine gas binds to the oils left behind in latent prints. The set up for iodine is similar to the Superglue station. Students place prints on small squares of paper and tape the paper to the top of a 1L beaker. Before the hot plate is turned on, I place a piece of aluminum foil over the hot plate. Iodine fumes can leave a stain on some surfaces and this helps with easy clean up. We allow the hot plate to begin to heat up. We place a few crystals of iodine into a ceramic evaporating dish (photo 10) and place it on a hot plate on medium to high heat and cover immediately with the 1 L beaker (photo 11). I have students turn off the hot plate once they can see their prints (photo 12) It is very important to open the beaker away from the body and inside of a fume hood. Even when cool, there are still iodine vapors and you do not want to inhale them. Iodine prints will fade if left untreated. Originally, I had students spray the prints after fuming with starch, which will preserve the prints. However, now I have the students leave the prints out to allow the prints to disappear because it shows the students that prints can be collected without permanently damaging the document or artifact. We read an article on Da Vinci's prints being used to authenticate a painting (**http://www.dailymail.co.uk/news/article-1219988/New-Leonardo-da-Vinci-portrait-discovered-matched-artists-fingerprint.html**).

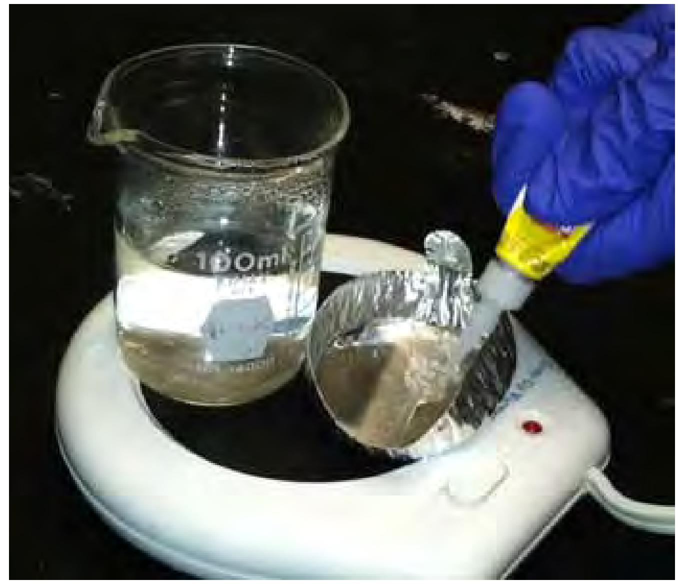

Photo 6. Hot water in beaker and metal tray with superglue on candle warmer

Photo 7. Superglue fuming in 1L beaker in the fume hood. The white residue is the superglue.

Photo 8. Sample superglue print on aluminum foil

Photo 9. Sample superglue print on aluminum foil

Photo 10. Iodine crystals in an evaporating dish. Not much is needed for fuming.

Photo 11. Placing the beaker with the prints taped inside over the evaporating dish with iodine crystals.

Photo 12. Iodine fuming in the fume hood.

We talked about how iodine might be used in cases with rare or valuable documents because it would allow for the prints to be visible for a period of time before the iodine fades away, leaving the document relatively the same. If you want your students to document their iodine print when it is visible, you can have them take a photo of it with a digital camera. (photo 13 sample iodine print)

Photo 13. Sample iodine print

Silver Nitrate Station:

Silver nitrate processing can be really tricky! I have students only do this process as an optional station. This allows students who are further ahead to try another method while the other students are completing the rest of the lab. Silver nitrate reacts with salt present in sweat that is left as part of a latent print. Silver nitrate can be used on porous surfaces such as paper or wood. In most cases, iodine or ninhydrin are used in place of silver nitrate because they tend to be more reliable methods. We have found that spraying the silver nitrate (0.1M aqueous solution) in the fume hood helps to produce the best prints (photo 14). Students can dip it into the silver nitrate solution and lay it on a watch glass, but that tends to produce uneven results and unclear prints (if any). After the silver nitrate dries while hanging in the hood, we place them in the window sill (photo 15). The light reacts with the silver chloride to produce a dark red-brown print (photo 16). The print can take anywhere from twenty minutes to an hour to appear. If students leave the print exposed to the sun too long, the entire sample will turn black and the print will no longer be visible. In the past, my students have tried using a UV lamp to get the print to appear quicker. Though that works, it still takes patience and uses up the life of the UV bulb. One year, students put their samples on a watch glass and then placed them in an empty goggle cabinet with the UV light on that cleans the goggles. The light in the cabinet was on for about 1minute. The prints that did develop turned out excellent. This only works if you are willing to clear out a goggle cabinet or happen to have an extra one. In general, the sunlight works quite well for the prints that do develop. Once students see the prints, I have them place them in an empty shoe box so the prints do not get overexposed. They can also document the print with a camera. Pictures turn out surprisingly clear! (photo 17 sample silver nitrate print)

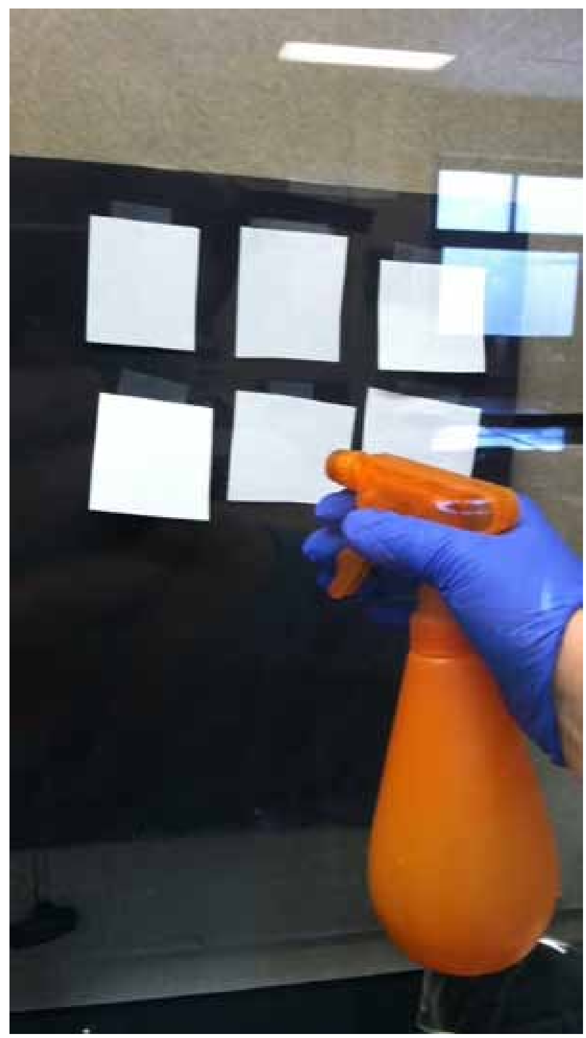

Photo 14. Spraying silver nitrate prints in the fume hood

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Photo 15. Silver nitrate prints in watch glasses sitting in window sill to be exposed to sunlight.

Photo 16. Silver nitrate print after 10 minutes exposed to light. Some ridge lines are starting to appear.

Photo 17. Sample silver nitrate print after allowed to develop in window sill

Name(s)____ Date____________________

FINDING LATENT PRINTS USING CHEMICAL METHODS

NINHYDRIN

- Place developed print here:

- Describe what the print looks like and the quality of the minute characteristics

- Likert scale 0-5
    - 0- no print
    - 1- some evidence of reaction but no clear ridge lines
    - 2- can see some ridges but cannot make out minutia
    - 3- can see some minute characteristic but only in a portion of the print
    - 4 - can identify the type of print and several minute characteristics but some a portion of the print is unclear
    - 5 - as good as a high quality inking

- With what component of a latent print does the chemical bind?

- Does the chemical method alter or destroy the evidence for possible future testing? If so, how?

Name(s)____ Date______________________

IODINE

- Place developed print here:

- Describe what the print looks like and the quality of the minute characteristics

- Likert scale 0-5
  - 0- no print
  - 1- some evidence of reaction but no clear ridge lines
  - 2- can see some ridges but cannot make out minutia
  - 3- can see some minute characteristic but only in a portion of the print
  - 4 - can identify the type of print and several minute characteristics but some a portion of the print is unclear
  - 5 - as good as a high quality inking

- With what component of a latent print does the chemical bind?

- Does the chemical method alter or destroy the evidence for possible future testing? If so, how?

Name(s)____ Date_____________________

SUPERGLUE FUMING

- Place developed print here:

- Describe what the print looks like and the quality of the minute characteristics

- Likert scale 0-5
    - 0- no print
    - 1- some evidence of reaction but no clear ridge lines
    - 2- can see some ridges but cannot make out minutia
    - 3- can see some minute characteristic but only in a portion of the print
    - 4 - can identify the type of print and several minute characteristics but some a portion of the print is unclear
    - 5 - as good as a high quality inking

- Does the chemical method alter or destroy the evidence for possible future testing? If so, how?

Name(s)____ Date_____________________

CULMINATING SCENARIOS

SCENARIO 1: An alleged 16th century map is discovered. Historians would like to authenticate the map. They would like to see if there are latent prints on the map they can use to map back to suspected cartographer. Which chemical method would be the best to use and why?

SCENARIO 2: A new house still under construction is vandalized. The builders would like to know who may have caused this property damage. He hopes there may be fingerprints on a 2x4 piece of wood near the damaged part of the house. Which chemical method would be the best to use and why?

SCENARIO 3: A ransom note is left at a family's house stating their son has been kidnapped and will be returned if an amount of money is paid to the kidnapper. The police hope the kidnapper may have touched the paper without gloves and hopes a latent print may be recovered. Which chemical method would be the best to use and why?

SCENARIO 4: A body is found in the woods. There is little evidence except a soda bottle nearby. Although the bottle could be unrelated trash, the police want to rule out the possibility that it belongs to the perpetrator. They hope there may be latent prints that can be recovered. Which chemical method would be the best to use and why?

SCENARIO 5: A gun is found in a dumpster. A person was shot in the neighboring apartment building the night before. The detective hopes that this gun may be the weapon used in this homicide. The detective wants the gun tested for possible latent prints on the plastic grips and portions of the gun. Which chemical method would be the best to use and why?