LABORATORY ACTIVITY 4.2:
Developing Latent Fingerprints

One job of the crime scene investigator is to find latent fingerprints—those that are left by perspiration or grease and are not immediately visible to the naked eye—and develop them, that is, treat them so they can be seen and inspected. There are several physical and chemical methods of visualizing latent fingerprints.

Materials

- ceramic tiles
- white powder
- fingerprint brushes
- 2-inch cellophane tape
- black or gray fingerprint powder
- white paper
- smooth black paper
- beaker and cover
- glossy white or photo paper
- iodine crystals
- forceps
- starch solution
- ninhydrin solution in atomizer
- zinc chloride solution
- gloves
- heat gun
- UV lamp
- silver nitrate solution
- "fixer"
- paper towels
- microscope slides
- plastic bags
- Styrofoam cups
- fuming chamber and cover
- superglue
- copying machine
- clear acetate sheets
- red markers

SAFETY ALERT! CHEMICALS USED

Always wear goggles and an apron when working in the labaratory

SAFETY NOTE *Also wear goggles when using the zinc chloride solution. Recommend wearing gloves and apron. Do not ingest or inhale. Iodine is toxic by inhalation and ingestion.*

Physical Methods

Dusting and Lifting Latent Fingerprints

1. Clean an area on a black tile.
2. Gently press your thumbprint on the edge.
3. Select a contrasting powder (white) and its brush. *Make sure you do not mix brushes.* When using the brush to apply powder, first fluff it up by rolling the handle rapidly between your fingers or palms.
4. Lightly touch the brush to the powder. Tap off any excess in a petri dish or on a newspaper.

Classroom Activity: You may now wish to set up a mock B & E in the classroom and ask the students to sketch the "crime scene," and locate where to look for fingerprints, and identify the best methods to use.

If you use the fingerprint lab early in the school year, you might have the students make a latent print in some out-of-the-way place so that, at the end of the year, they can see if it still can be visualized. This will test the longevity of undisturbed fingerprints.

Procedure Notes: A good start on this first part of the lab is to use a chalkboard and have the students press their fingers into chalk dust, then press them against the board. The prints can also be lifted easily off the board.

The dusting activity is a messy one to clean up. You will find black powder everywhere.

Fired, glossy kitchen/bathroom tiles (or pieces) make excellent substrates for practicing lifting, and your lab benches won't get as messy. They come in a variety of colors.

Black dusting powder can be purchased from companies that supply forensic science materials, such as Lightning Powder Company, Inc. (www.redwop.com). Black fingerprint powder costs about $6 for 2 oz, $18 for 8 oz. A good substitute is toner from your copier. Be aware that some people are allergic to either or both powders. Fine charcoal can be used, as can soot, but these are messy to collect.

Magnetic and fluorescent powders are also available. The former is not as messy, but is more expensive.

For white dusting powder, talcum powder or chalk dust works well; gray powder can be made by mixing the black and white powders. About 1 percent of fine aluminum powder added to the mix increases adhesion.

There are brushes made specifically for fingerprint work. Good all-purpose brushes are about $4 each. Soft paint brushes or cosmetic brushes may work, but developing is difficult enough even with the right brush.

Lifting tape can be a clear Scotch brand or similar tape; a 2-inch width works best. You will need white paper or card stock and black smooth paper (copier cartridges are wrapped in such paper). Local printers usually carry a black glossy paper. For skin, use glossy photo paper or a similar white, very glossy paper. See your local print shop.

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Dusting technique

Dusting for fingerprints

5. Move the brush gently back and forth over the print surface. If a print begins to appear, continue brushing in the direction of the ridges. *If you brush too hard, the print will be wiped away or smeared and become useless.*
6. Gently blow off the excess powder from the print.
7. This takes practice; you may need to repeat several times before you get a good visible print. *Hint: If you are having difficulty getting enough oil on your fingers to make a latent print, run your fingers through your hair several times.* Once your print looks clear, move on to step 8.
8. Cut 3 inches of lifting tape.
9. Attach the tape to the base of the print. Holding the tape taut and beginning at the base of the print, gently begin pressing the tape down as you move upward and beyond the print. This should eliminate air bubbles and smearing.
10. Gently pull back the tape, lift the print, and place it on a 2-inch square of contrasting (black) paper. Place the square with the print in your notebook and label which finger it came from and how you developed it.
11. Follow the same procedure using the following: white tile with black powder; glass and metal with gray, white, or black powder.
12. Lift and tape the prints and place them in your notebook. Keep in mind that you may have to develop and lift several prints to get one that is clear enough to identify characteristics.
13. Use porous surfaces such as white paper or an index card and repeat the above procedure. Place the tape on the dusted print to protect it and place it in your notebook. Label your print.
14. A latent fingerprint on the surface of human skin can sometimes be lifted and developed. Try pressing several fingers on your wrist.
15. Press a 1-inch square of glossy photographic paper against the prints on your skin for 2 to 3 seconds. Try a clean microscope slide.
16. Develop with an appropriate powder. Protect it with tape. Most people find it very difficult to lift prints from skin; you may not be

able to find very many ridge characteristics. Save one or more latents from your skin for subsequent chemical developing (below).

Analysis Questions

1. Which surfaces were easier to develop and lift prints from? Which surfaces are most difficult?
2. Choose your best developed print and identify ridge characteristics.

Chemical Methods

Iodine Fuming

Caution: Iodine is toxic by ingestion or inhalation. This procedure should be performed under a hood.

1. Place a fingerprint on two pieces of paper or index card.
2. Put each print in a beaker containing several crystals of iodine and cover the beaker. Solid iodine sublimes; that is, it passes directly from the solid phase to the vapor phase without going through the liquid phase. Both mothballs and dry ice also do this.
3. When the prints become visible, remove them with forceps or tweezers. Make sure you re-cover the beaker so fumes don't escape. Watch carefully as your prints develop. Leaving them in for too little time will not give enough detail; leaving them in for too much time will give you a big brown blotch.
4. Dip one of the prints in a starch solution. Allow to air dry.
5. Cover both prints with clear tape to preserve them.
6. Wash your hands thoroughly with soap and water.

Iodine fuming

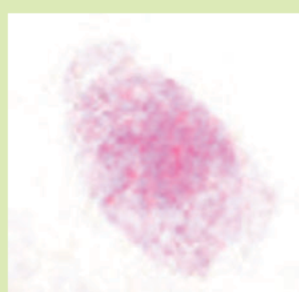
Analysis Questions

1. What happened when you put the print in the starch solution? Why?
2. Identify five ridge characteristics on each print. Place the prints in your notebook. Label. Check them in a day or two and note any changes. Explain.

Ninhydrin

Caution: Ninhydrin will stain skin and clothing. Wear gloves if possible.

1. Place several fingerprints on a piece of paper.
2. Hang the paper in a hood or well-ventilated place and spray it with the ninhydrin solution.
3. Wait 24 hours for the print to develop, or warm gently with a hot plate.



Ninhydrin print

Procedure Notes: All the chemicals listed here are pretty standard; your chemistry department should have iodine crystals (I_2). If not, they are available from standard chemical suppliers such as Flinn Scientific, P.O. Box 219, Batavia, IL 60510; (800) 452-1261; www.flinnsci.com. *Note that iodine is toxic by inhalation and ingestion.*

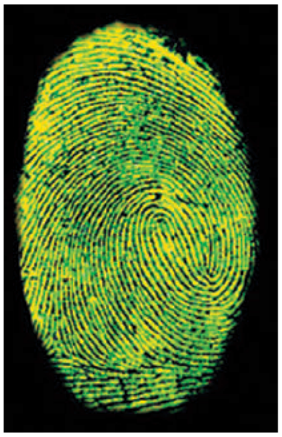
For cornstarch or any starch product, make up a 2 percent solution by adding 2 g of starch to about 100 ml cold water and bringing to a boil while stirring. Cool.

Sometimes it works better to put the starch in a spray bottle, than to dip the prints in a bowl of starch. Try both.

Ninhydrin is available from most scientific supply houses, such as Carolina Biological Supply Company (www.carolina.com), as a biological. Make up a 5 percent solution in acetone or alcohol (stir 5 g into 95 ml acetone or alcohol). *Caution: Ninhydrin is a body tissue irritant.*

For zinc chloride solution, add 3 g zinc chloride ($ZnCl_2$), 25 ml ethyl alcohol, and 5 ml acetic acid to 70 ml of water. *Caution: Zinc chloride is a severe skin irritant; work with gloves in the preparation.*

A black light (ultraviolet lamp) positioned over a dark box eliminates the need for darkening the room and makes the procedure a lot safer. Carolina Biological Supply sells a portable long- and short-wave lamp. Fisher Science Education (www.fisheredu.com) has a line of good UV lamps also. Lightning Powder sells a battery-operated (AA) long-wavelength UV, but visualization is severely limited in many applications of chromatography. *Caution: Do not look directly into a black light; the UV radiation can harm your eyes.*



Fluorescent print

fluorescence: the absorption of light at one wavelength (often in the ultraviolet range) and its reemission at a longer wavelength (often in the visible part of the spectrum)

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Analysis Question

1. Identify five ridge characteristics. Place the print in your notebook. Label.

Further Development with the Ninhydrin Print (*optional*)

1. Dip your ninhydrin prints in a zinc chloride solution. This should turn the print orange, making it easier to visualize. *Caution: Zinc chloride solution is a skin irritant; you may wish to wear gloves.*
2. Place the print under a black light (ultraviolet [UV] lamp).
3. Allow the print to dry and place it in your notebook. Label the print and describe what you saw under the black light. The zinc chloride treatment causes the prints to fluoresce. Basically, **fluorescence** occurs when a material absorbs light and reemits it at wavelengths longer than those of the light source. Substances are added to textiles and papers to cause them to fluoresce white (optical brighteners). Many fingerprint powders now contain fluorescent agents.

Prints developed by fuming

Lifting prints from can

Procedure Notes: A superglue developing tank can be made from an aquarium, even one with cracked sides (tape them with duct tape). Line three sides with aluminum foil to prevent eventual clouding by cyanoacrylate polymer (superglue) and insert a 40-watt lightbulb and socket, covered by a tin can with a few holes punched in it. Place aluminum foil or a bottle cap on top of the can. Insert a small container of water in the tank (this catalyzes faster development of prints) and a rack to hold objects to be fumed. Use a cover for the aquarium (a piece of cardboard will do) because the fumes are quite irritating to the eyes and throat. Place the chamber in a hood or where there is good ventilation.

Superglue (Cyanoacrylate) Fuming

Caution: Do not get superglue on your skin and do not breathe the fumes, because they irritate the mucous membranes. Keep your face away from the top of the developing chamber when you slowly remove the lid. Open the lid towards the back of the hood.

1. Wipe clean a microscope slide, a portion of a plastic bag, or a piece of Styrofoam cup. Write your initials on the sample.
2. Add fingerprints.
3. Place in the developing chamber.
4. Squeeze three or four drops of superglue on the aluminum foil or tin can that rests upon the heater (a lightbulb with a can over it).
5. Replace the lid on the chamber and turn on the light.
6. Prints should be visible after five to ten minutes. Carefully remove the item from the chamber. Be sure you do not breathe the fumes or allow them to get in your eyes as you lift up the lid.

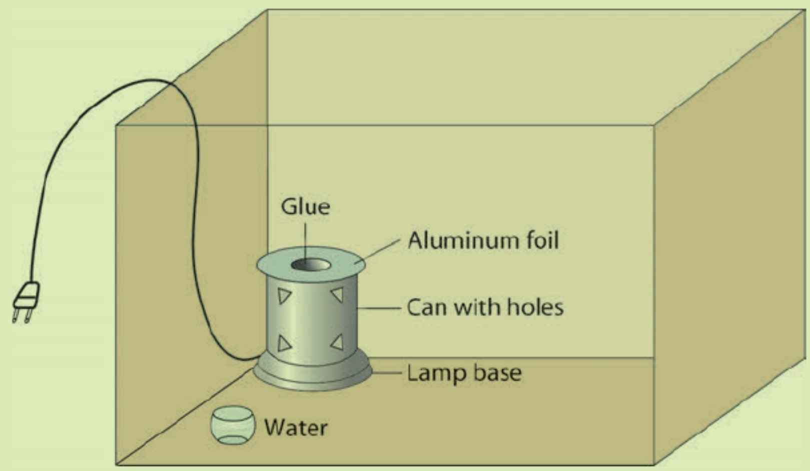


Figure 4.10 Superglue developing tank

7. You can enhance the prints even more with powder.

Analysis

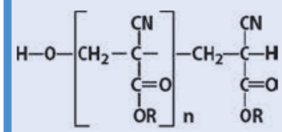
1. Using a magnifying glass, identify ridge characteristics.
2. Label each print and how it was developed. Place in your notebook.

Silver Nitrate (*optional*)

1. Place a fingerprint on a piece of paper.
2. Using forceps, immerse it in the silver nitrate solution for 5 to 10 minutes.
3. Remove the paper with forceps and drain the excess liquid.

   You may want to wear gloves for this one because silver nitrate will darken your skin when it is exposed to sunlight.
4. Sandwich the fingerprint paper between paper towels and dry it. Then expose the print to bright sunlight or long-wave UV light. *Caution: Do not look directly at the UV light. UV radiation can harm your eyes. Wear UV goggles, if available.*
5. Watch the development carefully so that it does not become overexposed.
6. To develop or "fix" the print, immerse it in the fixer solution for 15 to 20 minutes.
7. Remove and blot dry with paper towels.
8. Place in your notebook, label, and identify five ridge characteristics.

   This is a good method to use on older fingerprints. The silver nitrate reacts with the sodium chloride that is left after other materials from the print have evaporated or deteriorated. It also works well with fingerprint impressions on wood. Try it on a Popsicle stick, wood splint, or some other small piece of wood.



A cyanoacrylate polymer has a structure such as this, with R = a methyl, ethyl, or butyl group. Polymerization is catalyzed by a base, even water.

Procedure Notes: Make up a 1 percent solution of silver nitrate, 1 g $AgNO_3$ in 100 ml H_2O, and store it in the dark. *Caution: Silver nitrate is a corrosive solid, quite toxic by ingestion.* For a fixer, use 20 g of sodium thiosulfate ("hypo") plus 14 g of sodium bisulfite per 100 g of water. *Sodium bisulfate is a corrosive solid. Avoid skin contact, inhalation, and ingestion.*