



Latent Prints

Learning Objectives: Students will learn how to dust for fingerprints. They also investigate how tiny particles of matter stick to each other, based on the electrical charges in them.

GRADE LEVEL

4–8

SCIENCE TOPICS

Atoms and Molecules
Physical Properties
Organic and Biochemistry

PROCESS SKILLS

Comparing and
Contrasting
Classifying
Organizing Data

GROUP SIZE

1–2

SNEAK PEAK inside ...

ACTIVITY

Students use mechanical pencil lead to create a working fingerprint powder.

STUDENT SUPPLIES

see next page for more supplies

mechanical pencil leads
small paintbrushes
tape, paper, etc....

ADVANCE PREPARATION

see next page for more details

cut paper in half, etc....

OPTIONAL EXTRAS

DEMONSTRATION

Modeling the Procedure (p. G - 25)

EXTENSIONS

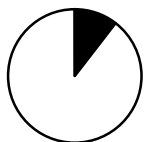
Fingerprints on Other Surfaces (p. G - 29)

Test Other Powders (p. G - 30)

Catch a Thief (p. G - 30)

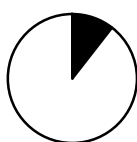
TIME REQUIRED

Advance Preparation



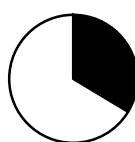
5 minutes

Set Up



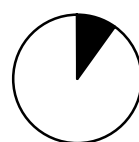
5 minutes

Activity



20 minutes

Clean Up



5 minutes

SUPPLIES

Item	Amount Needed
mechanical pencil leads	3 per group
clear tape	1 roll per group
paper (notebook or printer paper works fine)	½ sheet per group
white paper (printer paper works fine)	1 sheet per student
sealing plastic bags (e.g., Ziploc™)	1 per group
small paintbrush (e.g., watercolor brush)	1 per group
markers, pens, or other hard cylinders	1 per group
various fingerprinting surfaces—metal, clear plastic, coated cardboard, and glass work best (soda cans, 2-liter bottles, plastic water bottles, aluminum foil, glass food containers, crayon and marker boxes, etc.)	varies

For Extension or Demonstration supplies, see the corresponding section.

ADVANCE PREPARATION

Supplies Preparation

Paper:

- ❑ Cut 8 ½" x 11" notebook or printer paper in half, "hamburger style" (8½" x 5½" inches)

SETUP



For each group

- ❑ 3 sticks of mechanical pencil lead (3 sticks per group)
- ❑ roll of clear tape
- ❑ sealing plastic bag
- ❑ marker or other hard cylinder
- ❑ small paintbrush
- ❑ 5 ½" x 8 ½" paper
- ❑ white paper

At a central location (or with the teacher)

- ❑ Various fingerprinting surfaces

INTRODUCING THE ACTIVITY

Let the students speculate before offering answers to any questions. The answers at right are provided for the teacher.

Choose questions that are appropriate for your classroom.

Look closely at your fingertips, then at the fingertips of the person sitting next to you. How are they similar and how are they different? Is the fingerprint pattern different between different fingers on the same hand?
Answers will vary.

Who can drink this soda without leaving a fingerprint on it? (or “use this pencil,” “dial this number on my phone”, “use my keyboard,” etc.)
Student volunteers may wear gloves, use a cloth between their finger and the object, wipe the object after use, or claim they won’t leave prints.

Why do our fingers leave prints behind? What surfaces do our fingers leave prints on?

Depending on grade level, students will give many suggestions. To provoke discussion, ask questions about a variety of surfaces—cloth, paper, metal, plastic, glass, wax paper, ice, car tires, cardboard, leather, fleece, etc.

How can we find fingerprints that are left behind?

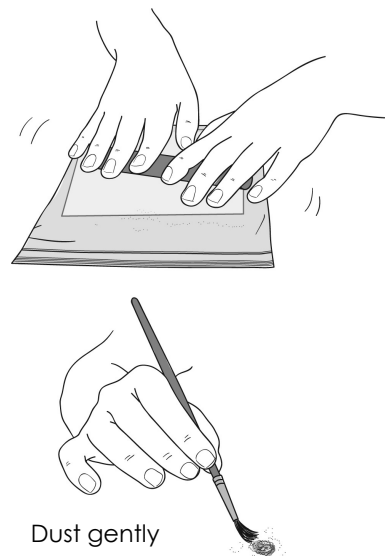
Depending on students’ exposure to crime shows, they may have many answers, including using UV light, lasers, powders, iodine, etc. Not every method shown on TV is actually used in the real world.

Students will discover the methods behind fingerprinting crime scenes using crushed mechanical pencil lead as fingerprint powder.

TEACHER DEMONSTRATION

Modeling the Procedure

If you wish, demonstrate how to crush the graphite and how sticky the graphite powder is when spilled. You can also demonstrate proper brushing technique (lightly brushing).



CLASSROOM ACTIVITY

Have students follow the Scientific Procedure on page G - 33, working in groups of 1–2. Below are suggestions to help the teacher facilitate the activity.

NOTES

Latent Prints SCIENTIFIC PROCEDURE

This handout is
on p. G - 33.

1. Fold your piece of paper in half. Then place it inside the plastic bag, with the folded edge down.
2. Place three pencil leads inside of the paper, then seal the bag.
3. Roll the marker over the lead until it is crushed into a fine powder.
4. Find a smooth surface, like a soda can, plastic bottle, or piece of aluminum foil. Press your finger onto the surface.
 - Can you see your fingerprint?
5. Open the bag carefully. Dip the paintbrush into the powder. Carefully brush the powder where you left your print.



Running Suggestions

- ❑ It takes a bit of practice to get the prints up, but most students can do it. Work with students to get it right and make allowances for those prints that don't come up right away.
- ❑ If students have dry or cold (non-sweaty) hands that don't leave great prints, have them pick up more oil by rubbing the bridge of their nose or their temples or running their fingers through their hair.
- ❑ Encourage students to keep the graphite powder in the plastic bag—it's messy and difficult to get back if it's spilled
- ❑ Tell students what they can and cannot dust (creating a "mock" crime scene helps with this) so they don't dust everything around!
- ❑ Caution students to keep their fingers powder-free, since they'll need clean fingers to leave more fingerprints.
- ❑ Students should not touch the sticky side of the tape!
- ❑ When students leave a print, make sure they remember where it is for when they later dust and lift the print. It's easy to lose the prints because they are invisible. Students can leave their prints in the corner of the surface.
- ❑ Make sure they grind the graphite well. Large chunks are not effective as fingerprint powder.

Ongoing Assessment

- ❑ What surfaces work better than others? Why do you think some work better than others?
- ❑ Are fresh fingerprints or old fingerprints easier to see?

Safety and Disposal

- ❑ Save the paintbrushes for reuse.
- ❑ All other materials may be thrown into the trash when done.

CLASSROOM DISCUSSION

Ask for student observations and explanations. Let the students guide the discussion and present their hypotheses before discussing explanations.

Choose questions that are appropriate for your classroom.

What helps the powder stick to the latent prints?

The size and type of powder particles are important. If students recognize that size is important, ask if finer powder would work better or not. If they suggest the type of powder, ask them if other powders might also work.

Are the forces of attraction between the powder and print very big or very small? How do you know?

Very small, since students can brush the powder away so easily. But the forces must still be big enough to hold the particles to the fingerprint. The cumulative action of many tiny forces is very important in chemistry.

Why didn't the powder stick to the surface the print is on? Or did it?

The powder sticks less to the surface (glass, plastic, etc.) than to the print because the surface is made of different chemicals. Forensic scientists use the difference in how chemicals stick to each other to find fingerprints.

What if I wanted to find prints on black surfaces?

Another color of fingerprint powder is necessary.

The extensions listed expand on some of the questions asked in the discussion. Following this activity with an extension helps to reinforce the concepts learned in this activity.

EXPLANATION

This background information is for teachers. Modify and communicate to students as necessary.

In this experiment, students learn the chemistry of fingerprinting by investigating how fingerprints stick to surfaces. They also practice “lifting” such prints off of the surface to preserve a physical record of the print.

BACKGROUND FOR ALL GRADES

Fingerprints

Fingerprints are the unique, permanent pattern of ridges and valleys on the underside of our hands. Because fingerprints can uniquely identify people, **forensic scientists** and police officers collect fingerprint evidence to understand who was present at a crime scene.

Why do people leave fingerprint evidence at all? Since a thin layer of skin oils and sweat almost always covers human hands, people often transfer a copy of their fingerprints to the smooth surfaces that they touch. Such prints, called **latent prints**, are oily, sweaty copies of the tiny ridges on each finger. The oils and sweat stick to surfaces for quite a long time before they degrade or are wiped away by another contact. Latent prints are so common that almost every metal or plastic surface that someone has touched will have some latent prints.

The Chemistry of Latent Prints

Because the sweat and oil patterns of latent prints are very faint and very small, most latent prints are invisible to the human eye. To find them, forensic scientists apply special powders that stick to the oil and moisture in the fingerprints. These powders are designed to stick to the prints but not to the surface the prints are on.

The powder sticks because the oil and sweat in fingerprints have slightly **charged molecules**. These charged molecules are attracted to other charged molecules on the surfaces you touch. This is basically the same process by which balloons can be rubbed so that they stick to a person’s hair, that is, a kind of “static cling” on the molecular level.

The Power of Graphite

In this experiment, students dust their prints with a fine fingerprinting dust made from **graphite**, the form of carbon found in pencil leads. Professional grade black fingerprint powders often contain graphite, too. Graphite is a good choice for many reasons. First, the arrangement of atoms in graphite has small fluctuating charges that are attracted to the charged atoms in the fingerprint oil. Second, graphite makes very fine powders and these small dust particles tend to get physically trapped in the oil print pattern that “sticks up” from the flat surface. Third, graphite doesn’t stick to metal, glass, or plastic surfaces very much. This means that when students brush over the latent print with graphite, the graphite sticks to the print but comes off the surface.

Special powders

Graphite does have some shortcomings. For example, it doesn't work very well on black surfaces, clothes, paper, or wood. Forensic scientists would use a different technique depending on the type of surface they are analyzing.

- ❑ **Colored powders**—Graphite is black and won't reveal prints on black surfaces. Grey, white, red, and other colored powders are used for different colored surfaces.
- ❑ **Fluorescent powders**—Because some fingerprints are old (i.e., dry) or very faint, very little powder will stick to them. For these prints, scientists use special fluorescent powders that give off extra light under ultraviolet radiation. The extra light coming off the prints makes it easier to photograph them as evidence.
- ❑ **Magnetic powders**—For very fragile, incomplete, or old prints, the act of brushing the powder over the print may actually destroy it. In these cases, police officers use a magnet suspended over the print. The magnet directs magnetic powder onto the print without disturbing the print.
- ❑ **Other techniques**—Forensic scientists also apply special chemicals to some prints to find them. For example, iodine gas can be passed over latent prints to turn them brown. In addition, spraying the prints with ninhydrin and heating the surface to 220°F makes the latent prints turn purple.

EXTENSIONS

Extension A: Fingerprints on Other Surfaces

Try using graphite to find fingerprints on other surfaces, such as rubber, paper, aluminum foil, cloth (scraps), wood, skin, wax paper, etc.

Extra Supplies

- ❑ porous or absorbent fingerprinting surfaces: cardboard, paper, cloth, wood, etc.
- ❑ non-sticky or bumpy fingerprinting surfaces: waxed paper, rubber, banana peels, orange peels, golf balls, window screens, skin, etc.

Extra Instructions

- ❑ Students should collect and compare the prints from the different surfaces to the prints from the surfaces in the main activity.

Explanation

These surfaces are more difficult for a few reasons. The graphite will tend to stick to paper and cardboard, so the difference between how well it sticks to the fingerprint and the surface is lessened. In addition, these porous surfaces tend to absorb the skin oils more, making the print harder to dust. Waxed paper resists the adherence of latent prints. Golf balls and rubber are textured, so the print may stick only to the exposed ridges.

Extension B: Test Other Powders

Test a variety of powders on glass, metal, or plastic surfaces.

Extra Supplies

- ❑ talc powder (preferably unscented)—works well on plastics, metals
- ❑ chalk—takes some work to make the particle size small, but works on most surfaces
- ❑ flour, cornstarch—choose a brand with a fine particle size
- ❑ dry tempera paint—a bit messy, but a very fine powder that sticks well to prints
- ❑ black paper

Extra Instructions

- ❑ Students should repeat the procedure of the main activity, except dust their prints with different powders
- ❑ When students lift their prints with the tape, they should stick their prints onto a sheet of black paper.
- ❑ Students should compare prints from this activity to the prints from the main activity.

Extension C. Catch a Thief

Set up a crime scene in your classroom. Turn your students into detectives as they develop fingerprints to try to find out who stole the object (e.g., treats, toys, etc.). Instruct your students to identify the prints of the thief and find the stolen item.

Extra Supplies

- ❑ empty plastic container
- ❑ candy, toys, or other “stolen” items you intend to share with the class
- ❑ a willing student “thief”
- ❑ stamp pads (1 per group) (optional)
- ❑ paper

Extra Instructions

- ❑ Before class, have your student accomplice put his or her fingerprints all over an empty box. It works best if he or she rubs his or her temples to get very oily fingers.
- ❑ Develop the prints on the box yourself, using the graphite powder. It's best if you do this before class, in case the prints don't develop well for some reason.
- ❑ Show students the empty plastic box. Explain to students you had some treats for them stored in the box, but now they are missing because someone in the class stole them.
- ❑ Show students the fingerprints from the box. Explain that they will use fingerprinting techniques to identify who in class stole the treats.
- ❑ Students should collect prints from everyone in class. They may either use the ink pads to collect prints or use the technique described in the main activity. The ink pads create cleaner prints, but create the risk of fingerprints being deposited all over the classroom.
- ❑ Encourage students to keep their data collection page neat and labeled.

CROSS-CURRICULAR CONNECTIONS

SOCIAL STUDIES

Fingerprinting History

Research Henry Faulds, Francis Galton, and William Herschel, who are commonly seen as the pioneers of fingerprinting technology.

Accuracy of Fingerprinting

Research a story in which a person was falsely identified as a criminal using fingerprint evidence. What are the problems with using fingerprinting to identify criminals?

MATHEMATICS

Sorting Surfaces

Instruct students to sort their fingerprints in order of best to worst. What surfaces gave the cleanest prints? What do these surfaces have in common? What surfaces gave the worst prints? By sorting and looking for correlations, students should see what types of surfaces are most likely to support identifiable prints.

ART

Fingerprint Pictures

Use fingerprints and ink pads to create multiple pictures.

RESOURCES

Web – <http://www.fbi.gov/hq/cjisd/iafis.htm>

The Integrated Automated Fingerprint Identification System, a national fingerprint and criminal history system maintained by the Federal Bureau of Investigation (FBI).

Web – <http://www.hcso.tampa.fl.us/SOD/ffingerprintid.htm>

A Web site on fingerprint identification run by the Federal Bureau of Investigation (FBI).

Web – http://www.ridgesandfurrows.homestead.com/early_pioneers.html

Web site lists the biographies of early pioneers of the study of fingerprinting, including Henry Faulds, Francis Galton, and Sir William Herschel.

Web – http://www.bbc.co.uk/history/historic_figures/faulds_henry.shtml

Details the story of Henry Faulds, Francis Galton, and Sir William Herschel and the conflicting claims of who was responsible for first using fingerprinting as a means of identification.

Emberly, Ed, *Ed Emberly's Fingerprint Drawing Book*

Reading level: all ages

An amazing number of drawings and figures created using fingerprints and a pen.

Jones, Charlotte, *Fingerprints and Talking Bones*

Reading level: 5th to 8th grade

Never gory or gross and often even funny, especially when explaining things such as the reason police analyze a murder victim's stomach contents. Includes a glossary, cool crime facts, and a bibliography.

Fingerprinting, Great Explorations in Math and Science (GEMS),

Lawrence Hall of Science

Reading level: 4th to 8th grade

Detailed plans for three class sessions, fully supported with handouts and answer keys, including fingerprint samples. Recommended by NSTA.

VOCABULARY

charged molecules: molecules that have small positive and small negative charges

fingerprint: unique, permanent pattern of ridges and valleys on the underside of a finger

forensic scientist: scientist who analyzes evidence to solve crimes

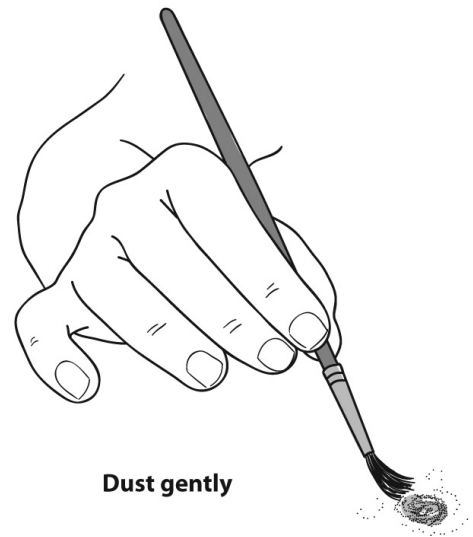
graphite: a form of carbon used in pencils

latent print: a fingerprint that is present but not visible

Latent Prints

SCIENTIFIC PROCEDURE

1. Fold the piece of paper in half. Then place it inside the plastic bag, with the folded edge down.
2. Place three mechanical pencil refills between the two halves of the folded paper. Seal the bag tightly.
3. Use the sides of a round marker like a rolling pin; roll over the bag until the pencil refills are crushed into a fine graphite powder.
4. Find a smooth surface, like a soda can, plastic bottle, or piece of aluminum foil. Press your finger onto the surface.
 - Can you see your fingerprint?
5. Open the bag carefully. Dip the paintbrush into the graphite powder. Carefully brush the powder where you left your print.
 - Now can you see your fingerprint?
6. Press a piece of clear tape over your print. Rub the tape to make it stick.
7. Pull off the tape with your print and stick it onto a piece of white paper.
 - What does your print look like?
8. Label the print with the name of the surface you used to make your print.
9. Repeat steps 4 through 8 with other surfaces.
10. Clean up your area.
 - Follow your teacher's directions.



This worksheet is available online at www.oms.edu/k8chemistry.

Latent Prints

Recommended group size: 1–2

Number of Students: Number of Groups:

Supplies	Amount Needed	Supplies on Hand	Supplies Needed
mechanical pencil leads	3 per group		
clear tape	1 roll per group		
paper (notebook or printer paper works fine)	½ sheet per student		
sealing plastic bags (e.g., Ziploc™)	1 per group		
small paintbrush (e.g., watercolor brush)	1 per group		
markers, pens, or other hard cylinders	1 per group		
various fingerprinting surfaces—metal, clear plastic, coated cardboard, and glass work best (soda cans, 2-liter bottles, plastic water bottles, aluminum foil, glass food containers, crayon and marker boxes, etc.)	varies		
white paper	1 sheet per student		
Extension A			
porous or absorbent fingerprinting surfaces: cardboard, paper, cloth, wood, etc.	varies		
non-sticky or bumpy fingerprinting surfaces: waxed paper, rubber, banana peels, orange peels, golf balls, window screens, skin, etc.	varies		
Extension B			
talc powder (preferably unscented)	¼ cup per group		
chalk	¼ cup per group		
flour, cornstarch	¼ cup per group		
dry tempera paint	¼ cup per group		
black paper	1 sheet per student		

Supply Worksheet continues on next page.

Extension C			
empty plastic container	1 per class		
candy, toys, or other "stolen items" the class can share	varies		
a willing student culprit	1 per class		
stamp pads (optional)	1 per group		
Teacher Demonstration			
no extra materials needed			



Dust gently