In this activity, students will help solve a “crime” by attempting to match fingerprints from their classmates to the scene of a (fictional) crime. They will explore methods for identifying differences in fingerprints.

OVERVIEW

Topic: Physical properties of body systems and parts

Real-World Science Topics
• An exploration of fingerprint analysis
• An exploration of the physical properties of the skin
• An exploration of crime scene analysis and forensics

Objective
Students will gain an understanding of the physical properties of the skin and fingers as well as the basic techniques for fingerprint analysis.

Materials Needed for Teacher Demonstration
• bag of candy (optional)
• dry-erase markers
• empty glass jar
• overhead transparency

Materials Needed for Student Teams
• ink pad
• magnifying glass
• small blank pieces of paper
• fingerprint handout

Teacher Preparation
Before teaching the activity, you will need to set up a “crime scene,” and you will need the help of one student. Select a student that you know will keep a secret, and complete the preparations when students are not in the classroom. To set up a crime scene, have the selected student place ink on all of the fingers of one hand. The student should then grab a glass jar and leave clearly distinguished inked fingerprints on the jar. Then, have the student give you a clearly distinguished fingerprint from his or her right-hand index finger on a clean piece of paper. Use this print to make enlarged copies of the fingerprint with a scanner or photocopier. Print one copy of the enlarged fingerprint onto an overhead transparency, and then print paper copies of the fingerprint for each student in the class.
WHODUNNIT? (1 HOUR)

The student helper should make sure to thoroughly wash his or her hands after helping set up the activity so that ink stains are not visible on any fingers. Instruct your student volunteer to complete the activity as any other student would, and to not give any clues about the crime. If you wish, you may have the student volunteer hide a bag of candy in his or her desk or backpack. This candy can be revealed at the end of the activity and shared with the class.

Standards Met

NATIONAL SCIENCE STANDARDS ADDRESSED

CONTENT STANDARD A:
As a result of activities in grades 5-8, all students should develop

• Abilities necessary to do scientific inquiry
• Understandings about scientific inquiry

CONTENT STANDARD C:
As a result of activities in grades 5-8, all students should develop an understanding of

• Structure and function in living systems
• Diversity and adaptations of organisms

CONTENT STANDARD E:
As a result of activities in grades 5-8, all students should develop

• Understandings about science and technology

CONTENT STANDARD F:
As a result of activities in grades 5-8, all students should develop an understanding of

• Populations, resources, and environments
• Science and technology in society

NATIONAL MATH STANDARDS ADDRESSED

• Describe, extend, and make generalizations about geometric and numeric patterns.
• Represent and analyze patterns and functions, using words, tables, and graphs.
• Identify, compare, and analyze attributes of two- and three-dimensional shapes and develop vocabulary to describe the attributes.
• Recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life.
• Design investigations to address a question and consider how data-collection methods affect the nature of the data set.
WHODUNNIT? (1 HOUR)

NATIONAL TECHNOLOGY STANDARDS ADDRESSED

CREATIVITY AND INNOVATION

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:

• Apply existing knowledge to generate new ideas, products, or processes.
• Use models and simulations to explore complex systems and issues.
• Identify trends and forecast possibilities.

Sources


Indianapolis Marion County Public Library Kids’ Blog on Fingerprints, http://www.imcpl.org/kids/blog/?p=2620
1. **Warm-up Activity:** To begin, inform the class that a crime has been committed. Ideally, you should use a fair amount of dramatic flair. Show students the crime scene, which has been pre-prepared with the help of one student. (See *Teacher Preparation.*) The crime scene should be something simple; do not try to simulate a real crime. Instead, mention that your jar of candy (or similar trivial item) has disappeared from your desk. Say that the suspect did leave the glass jar behind, and the jar luckily has very visible fingerprints on it. Next, tell students that you were able to make a copy of a fingerprint from the index finger of the thief, which you have enlarged and printed out. Show students both the glass jar with fingerprints and the enlarged copy of the fingerprint on the overhead transparency, as shown below. (In the photo below, a sheet of white paper was inserted into the jar to make the prints more visible.)

Tell students that they will help solve the crime of the missing candy. To do this, they will all submit a fingerprint sample from the index finger of their right hands, which they will compare to the sample you obtained from the glass jar. Before they can do this, though, they must learn some basics about fingerprints. Ask students to share what they know about fingerprints. Students will likely know that all fingerprints are unique, and this is why they can be used to help us solve crimes.
2. Tell students that while it is true that all fingerprints are unique, there are certain patterns and shapes that can be identified in all fingerprints. Use dry-erase markers to highlight the shapes present in the fingerprint on the overhead transparency. Point out arches, whorls, and loops, as shown in the image below. (See the Background Information section of this activity for more information on patterns in fingerprints.)
3. Next, divide students into small groups of two to four students per group. Hand out the supplies to each group: Student Handout, a magnifying glass, an ink pad, and small pieces of paper (as shown below).

Instruct students to work together to obtain samples of fingerprints from the index finger of their right hands. To do this, they should help each other roll the index finger gently but firmly across the ink, checking to make sure the pad of the finger is thoroughly covered with ink. They should then roll the finger across the paper in the same manner. Model this process for students, and circulate as they work to make sure students are obtaining clear samples.

4. Once all groups have created fingerprint samples, instruct students to write their names on the back side of the piece of paper with their fingerprint sample. Instruct them to write gently so that their names do not show through the paper. Then, collect the samples. Quickly place a number on the front side of each sample. For example, if there are 27 students in your class, number the samples from 1 to 27. Then, tape the samples to the board, leaving enough space so that several students can study the samples at one time. Pass out copies of the fingerprint from the glass jar and instruct students to study the print while they are waiting for you to complete this step. Students should make observations of the loops, whorls, and arches of the suspect’s fingerprint. Students can also complete questions 1 and 2 on their Student Handout at this time.

5. Allow students to approach the board to study the samples, using their magnifying glasses to search for the fingerprint of the suspect. Students should try to match the fingerprint from the glass jar to the correct fingerprint sample. Tell students that if they think they have made a match, they should quietly write down the number of the sample. Tell them to not shout out the answer. In this way, all students will have a chance to solve the “crime” and discover the suspect.
6. **Wrap-up Activity:** Once all students have written down the number of the sample that they believe belongs to the suspect, bring the class back together as a large group. Ask for student volunteers to share the number of the sample they selected. If more than one number comes up, allow students to carefully study all of the chosen samples to help narrow their guess to one sample. (You may want to work with students to help them do this.) When they have narrowed it down, turn the sample over and reveal the name. At this point, the student who was selected as the suspect should come forward and admit to the crime (preferably with some dramatic flair). If you opted to have your student volunteer hide a bag of candy, the student can now reveal the candy. Now that the “crime” is solved, the candy can be shared with the class. Prompt student discussion of the activity by having students think about the shapes or patterns that helped them recognize the fingerprint of the suspect. Have students discuss how these properties can be used to help solve a crime.

**Whodunnit? Extension Activities**

1. Have students help each other to take a complete set of fingerprint samples. Then, instruct students to examine all ten of their fingerprints and identify all of the arches, loops, and whorls.

2. Instruct groups to brainstorm other ways each human is unique. They should then describe how each of these unique physical properties could help solve a crime or identify a suspect. For example, we all have a unique combination of features, such as nose size, eye color, hair color, height, and so on. When used together, these features help police solve a crime. To extend even further, pretend that you were the witness to a crime. List several features of an imaginary suspect, and have your students draw composite sketches. Then, compare composite sketches and discuss the similarities and differences. Mention that composite sketches can help identify a suspect, but they can be dependent upon the observational skills of the witness and the drawing skills of the artist.
Why are fingerprints useful for solving crimes?
Because every human has a unique set of fingerprints, they can be useful for solving crimes or identifying suspects. With a few exceptions, we leave fingerprints every time we touch something. In the United States, the Federal Bureau of Investigation (FBI) began the systematic collection of fingerprints in the 1920s. Today, most schools take fingerprints of all students to aid in cases of missing children. Some schools use fingerprints for other purposes too, such as linking a student with his or her lunch account.

What are common features of all fingerprints?
While it’s true that each fingerprint is unique, there are common shapes and patterns that can be identified in every fingerprint. Those shapes are loops, whorls, and arches. It is the arrangement of these shapes that makes each print unique. As you help your students identify the features in the suspect’s print, look for each of the following shapes:

- Loops are the most common type of shape in fingerprints. A loop has lines (or ridges) that enter and exit on the same side of the finger (rather than spanning across the entire finger). Loops can enter from either side of the finger.
- Whorls are essentially circles. A whorl can be only one ridge, or it can encompass several ridges. A double-loop whorl is composed of two loops that nearly intersect, forming a shape much like the yin-yang symbol.
- Arches are the least common shape. An arched print has lines that enter the finger on one side and exit the finger on the opposite side. Plain arches have a gentle curve, while tented arches have a point or ridge in the arch.

What are some drawbacks to using fingerprints to assist in solving crimes?
Fingerprint collection is not foolproof. When samples are left at a crime scene, it is not always a complete print. They can also be smudged or overlapped with prints from other people, making it difficult to identify just one print.

A fingerprint collected from a crime scene must then be compared to fingerprints within a database. If a criminal has not been fingerprinted before, there will be no matches within the database. It is also possible for a false match to be made. It is estimated that up to 1000 false matches are made every year. Problems can also exist within the samples of a database. When samples are taken, a slight change in pressure can cause the skin on the finger to roll or shift, leaving behind an inaccurate print. In spite of these drawbacks, fingerprints remain a powerful tool for identifying individuals.

Key Vocabulary:
arch: a line in a fingerprint that enters on one side of the finger and exits on the opposite side
fingerprint: the unique mark left by a finger; often used to identify people
loop: a line in a fingerprint that enters and exits from the same side of the finger
whorl: a line in a fingerprint that forms a complete circle
1. Draw a picture of your fingerprint sample. Make it larger than actual size, and label any of the following that you find on your sample:
   - Arches
   - Whorls
   - Loops
   [Pictures will vary.]

2. What things will you look for when you search for the fingerprint from the suspect?
   [Answers will vary according to the fingerprint of the suspect, but should name specific features of the suspect’s fingerprint.]

3. Write the number of the sample that you believe matches the suspect’s fingerprint. Why do you believe this is the correct fingerprint?
   [Answers will vary, but will mention similarities between the suspect’s print and the print the student selected.]

4. What challenges did you face in your selection process?
   [Sample answer: One challenge was that two of the samples looked very similar. To solve this problem, I reviewed the suspect’s print from the overhead and then narrowed down my choice.]

5. Why are fingerprints useful for helping solve crimes?
   [Sample answer: Every fingerprint is unique, so it can only belong to one person. If a person leaves a fingerprint at the scene of a crime, it can help police identify the person.]

6. What might be some other ways that fingerprints could be used?
   [Sample answer: Fingerprints can be used to allow access to a building. I have seen credit card machines that make people use fingerprints to identify themselves. They can help control identity theft.]
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   - Whorls
   - Loops
2. What things will you look for when you search for the fingerprint from the suspect?

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4. What challenges did you face in your selection process?
5. Why are fingerprints useful for helping solve crimes?

6. What might be some other ways that fingerprints could be used?