



Missing!

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Field(s) of Interest: Forensics and crime scenes

Brief Overview:

In this lesson, students will get the opportunity to have hands-on experience with techniques used by police and forensic detectives when approaching crime scenes. Through these interactive activities, students will discover new detective skills, while also applying skills they use on a daily basis.

Agenda:

- Introduction (5 min)
- Module 1: Key to the Code (20-25 min)
- Module 2: The Nose Knows (5-10 min)
- Module 3: Prints and Clues (15 min)
- Conclusion (5 min)

Main Teaching Goals/Key Terms:

- Encryption
- Decryption
- Sensory Cells
- Odorology
- Forensics Odor Profiling
- Dermatoglyphics
- Unique patterns (loop, swirl, arch)

Background for Mentors

Module 1

- Encryption
- Codes and Ciphers
- Decryption

Encryption is the process of converting information or data into code or scramble, especially as a method to prevent unauthorized access. One method of encryption is the use of **codes and ciphers**. A **code** is a set of symbols, such as letters or numbers, that are used to replace words in a message. A **cipher** is making a word or message secret by changing or rearranging the letters in the message.

While the use of encryption methods is very essential in protecting the information of various industries, the use of these methods could also be used to hide important evidence from police during a crime investigation.

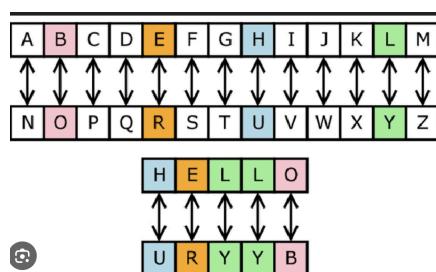


Figure 1: Cipher example

i ..	q --o-	y -o--] -o--	7 -oooo
j o--o	r o--o	z -oo-	; -oo-	8 -ooo-
k o--o	s ooo	" -o--o	1 o----	9 ----o
l o--o	t -	(-o--o	2 oo---	0 -----
m --	u oo-) oo--oo	3 ooo--	
n -o	v ooo-	{ -o--oo	4 oooo-	
o ---	w o--o	} o--ooo	5 ooooo-	
p o--o	x o--o	[-o--o	6 -oooo	

Figure 2: Symbol Code example

Despite these messages being hidden, it is possible to gain access through a method called **decryption**, which converts encrypted data back into its original and readable format.

Module 2

- Sensory cells
- Odorology
- Forensic Odor Profiling
 - VOCs

While there are many methods for finding leads in a crime scene, one useful method is using our sense of smell. The many things around us release small molecules, which stimulate **sensory cells** in our nose when we breathe. These sensory cells have unique odor receptors, which help us distinguish unique smells, and remind us of smells we have come across in the past.

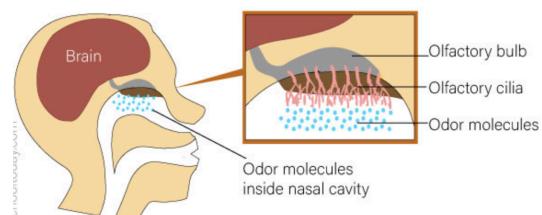


Figure 3: Visual on how we smell

While the human nose is useful, there are many smells we are often blind to, leading us to require stronger methods of smell identification. **Odorology** is a technique that uses specially-trained dogs to identify human scents. These special trained dogs also have the capacity of tracking down the smells of substances, which can be concealed to avoid human detection.

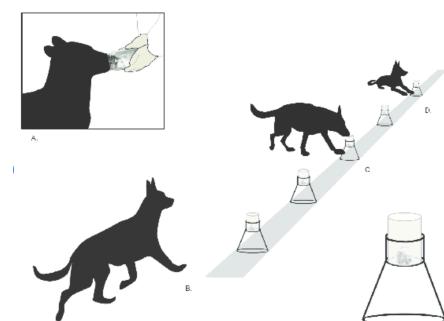


Figure 4: odorology dog training

Smell can also be analyzed by forensics through a method recognized as **Forensic Odor Profiling**. This method allows forensics to identify and analyze **volatile organic compounds** (VOCs), which are gasses released by objects, substances, and humans.

Module 3

- Dermatoglyphics
- Unique patterns (loop, swirl, arch)
- Volar Pads
- Automated Fingerprint Identification (AFI)

Dermatoglyphics is the study of the ridges, lines, and shapes that can be found in our palms, finger tips, and the soles of our feet. Dermatoglyphics is used to analyze fingerprints as each finger has a **unique pattern**. If you observe each of your fingerprints, you will notice that each contains a unique **loop, swirls, or arch**.



Figure 5: Different fingerprint patterns

But why is this the case? The formation of fingerprints starts as early as six weeks in embryonic development due to the formation of **volar pads**. Volar pads are temporary tissue that swells and appears on the palms of the hands and soles of the feet during fetus development. While each volar pad shifts to a unique pattern, the height and size are influenced by genetics, this is why many siblings have very similar fingerprint patterns!

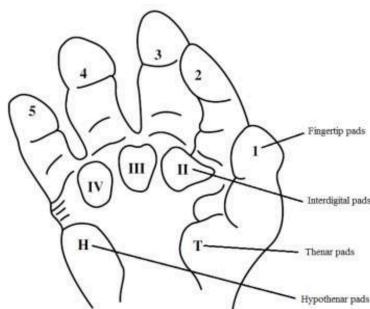


Figure 6: Volar pads on hands

Given that each person has a unique set of fingerprints, police are able to run fingerprints through a system known as **Automated Fingerprint Identification (AFI)**. AFI is a specialized database which uses fingerprints to find records, allowing police to identify and track down suspects.

Introduction

<p>Concepts to Introduce</p> <ul style="list-style-type: none">● Forensics: relating to or denoting application of scientific methods and techniques to investigate crime<ul style="list-style-type: none">○ Mention popular (appropriate) shows that incorporate forensics<ul style="list-style-type: none">■ E.g. Carmen Sandiego, Scooby Doo, Blue's Clues, Detective Conan● Get the mentees thinking about how they would solve a mystery. Let them brainstorm, and tie their ideas back to methods used in the lesson.	<p>Questions to Pique Interest</p> <ul style="list-style-type: none">● Who here likes mysteries?● If you were a detective, how would YOU solve a mystery?<ul style="list-style-type: none">○ What information would you collect?○ Who would you interrogate?● How do you think detectives solve crimes with so little evidence?
<p>Scientists, Current and Past Events</p> <ul style="list-style-type: none">● Dr. Edmond Locard<ul style="list-style-type: none">○ Father of forensic science○ Created the Locard Exchange Principle, which states criminals always leaves behind evidence at a crime scene● The perpetrators of the \$4.5 billion bitcoin theft in 2016 were finally caught in 2022 with the help of encryption and decryption techniques.	<p>Careers and Applications</p> <ul style="list-style-type: none">● Digital Forensic Analysts● Forensic Biologists● Toxicologists● Police Office● Forensic Investigator● Chemist

Module 1: Key to the Code

In this activity, students will be making decoders which they will use on an encrypted message. This module will give students the opportunity to understand how encryption conceals messages, but how it is possible to use deception to reveal them. Students will work individually to build their decoder, but can work alone/groups to figure out the code.

Teaching Goals	Materials
<ol style="list-style-type: none">1. Steganography: A method of concealing a message within a text or object2. Encryption: The process by which a readable message is converted to an unreadable form to prevent unauthorized parties from reading it.<ol style="list-style-type: none">a. Codes: a set of symbols that are used to replace words in a messageb. Ciphers: making a word or message secret by changing or rearranging the letters in the message3. Decryption: the process of converting encrypted data back into its original readable format	<p>Per student</p> <ul style="list-style-type: none">• 1 Outer Ring Template• 1 Inner Ring Template• 1 pair of Scissors• 1 Paper fastener• 1 pencil

Different Methods for Teaching

Connecting to Real Life:

- Liken encryption and decryption to a lock and key! When you want to keep something private and safe, you put a lock on it. In this scenario, encryption acts as the lock that protects the information. Only people who have the right key, or decryption, can unscramble the message to read it.
- Another way of describing it is like a secret language. Imagine a language only a few people know; only they can read and understand it. Encryption and decryption is very similar to this, but just on a much smaller scale. They're translating the message into a "language" that only very specific people can decipher.

Make it Visual:

- A picture is worth a thousand words. If the mentees struggle with the concept of steganography, sketch a quick picture. Hide a word in the picture and ask the mentees to see if they can locate it. Not only does this provide them with an example, but it's also a great way to engage them in the lesson and prepare them for the coming activity.

Procedure

1. Cut out both the small and big template
2. Using scissors, cut a small hole in the middle of each template
3. Lay the small circle in the large circle and use a paper fastener to secure both together
4. On both the big and small circles, use the small divisions to write out the alphabet
Important: exclude x and z
5. Once we have made our decoder, we can look back at the secret message, which should tell us which letter on the small circle matches with the big circle

Ex: a=d

6. Once we match the letters, we can decode our message!



Figure 1: Putting together the two templates

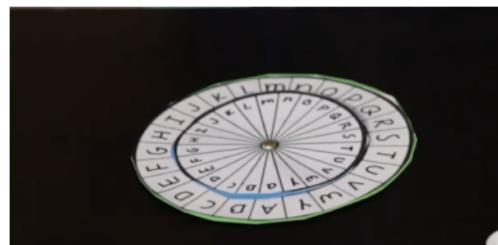


Figure 2: Expected Final Product

Classroom Notes

This activity may be challenging for larger sites, so divide the mentees into smaller groups, each headed by a mentor. Mentees may get frustrated if they have trouble decoding the message. In this case, remind them the process of decoding can be like solving a puzzle and go through the steps with them together.

Module 2: The Nose Knows

In this module, students will volunteer to come to the front of the class and describe an unknown smell, and try to match it to one of the four known smells. This activity can be repeated as many times as possible with a different student, but ideally 3. This activity will reveal to students the importance of smell, and how it can help police find leads in a crime scene.

Teaching Goals	Materials
<ol style="list-style-type: none">1. Sensory Cells: Help us distinguish unique smells, and remind of smells we have smelled in the past2. Odorology: a technique that uses specially-trained dogs to identify human scent3. Forensic Odor profiling: identification and analysis of gasses<ol style="list-style-type: none">a. Volatile Organic Compounds (VOCs): gasses released by objects, substances, and humans.	(before site) <ul style="list-style-type: none">• 4 known smell vials• 1 mystery smell vial

Different Methods for Teaching

Relate to mentees' personal lives:

- Try to ask questions that will help the mentees relate the questions to their lives outside of school. For the **Odorology** teaching goal you can ask mentees about any pets they have at home and if their pets have a strong sense of smell. You can also more specifically discuss how even house dogs have strong senses of smell.
- You can also have mentees think about the odors they can smell at home and relate these smells to **Forensic Odor Profiling**. Ask the mentees if their parents, guardians, or anyone in their family wears a perfume or cologne and relate this scent to a scent that can help identify a person.

Procedure

1. Have students volunteer to smell the mystery smell vial
2. Have them smell each vial, describe the smell, and figure out which smells most like the mystery vial
3. Repeat with 2-3 more students



Figure 1: Ideally what the bottles will look like just with film canisters



Figure 2: Students will smell each vial and describe the scent

Classroom Notes

Not getting the chance to smell the vials may upset some students. It may be useful to walk around to each table during the last module with a single smell vial and give all students the opportunity to smell. This is not needed, but it can be useful for classroom control.

Module 3: Prints and Clues

In this module, students will be working independently to create a paper copy of their fingerprints. Through this activity, students will be able to recognize the patterns in their prints, and compare it to their peers.

Teaching Goals	Materials
<ul style="list-style-type: none">- Unique Pattern Fingerprints are a unique form of identification as each individual has a unique set of fingerprints<ul style="list-style-type: none">- Loop- Whirl- Arch- Volar Pads: temporary tissue swellings that appear on the palms of the hands and soles of the feet during a fetus's development. They play a key role in the formation of fingerprints- Automated fingerprint identification systems (AFIS): specialized databases police are able to use for fingerprints to help track down records and link people to crime	<p>Per student</p> <ul style="list-style-type: none">- 1 Paper- 1 Pencil- 5 strips of clear tape

Different Methods for Teaching

Have the mentees work together:

- To help break down the concepts of **Unique Patterns** and **Volar Pads**, have mentees compare their fingerprints with each other. By comparing their fingerprints they can see firsthand how none of their fingerprints are the same and will be able to identify the different types of patterns that they have on their fingerprints.

Breaking down more complex topics:

- As mentees may not know what databases are or what Crime Scene Investigation is, we can separate out a complex teaching goal, like **Automated fingerprint identification systems (AFIS)**, into individual concepts that are more relatable for mentees.
- **AFIS** can be broken down into two individual concepts: taking evidence from a crime scene and searching for information online. Rather than discussing how fingerprints specifically are in a database that are in police records, mentors can talk about how police can find evidence at a scene and then use the internet to search for information on this evidence.

Procedure

1. Have mentees trace out their hand onto paper
2. On a small square of paper, use pencil to draw a square box and fill in
3. After filling in, rub finger in box until fully coated
4. Place a piece of tape on finger until fingerprint transfers, and place tape onto paper
5. Repeat for all five fingers



Figure 1: This is a video example of how students should use pencil and paper to get their fingerprints



Figure 2: In the video, they then used tape to transfer their fingerprint to a clean spot on paper



Figure 3: This is the idea of the end result. The goal is to have students compare fingerprints to each other



Figure 4: End result

Classroom Notes

The main point of this activity is to have students see that while they all have patterns in their fingerprints, they are each unique, which is why police can use prints to identify people.

Conclusion

Take the opportunity to have students reflect on the three different methods they have put into practice and express the importance of each method. Emphasize that while all methods help police and forensics solve crimes, they all reveal different kinds of clues, and are necessary in their own way.