DAY 1: FINGERPRINTS, SHOE PRINTS, HAIR/FIBERS

PRINCIPLES OF FINGERPRINTS

- A fingerprint is an **individual** characteristic; no two people have been found with the **exact** same fingerprint pattern.
- A fingerprint **pattern** will remain **unchanged** for the **life** of an individual; however, the print itself may change due to permanent scars and skin diseases.
- Fingerprints have general characteristic **ridge** patterns that allow them to be systematically identified.

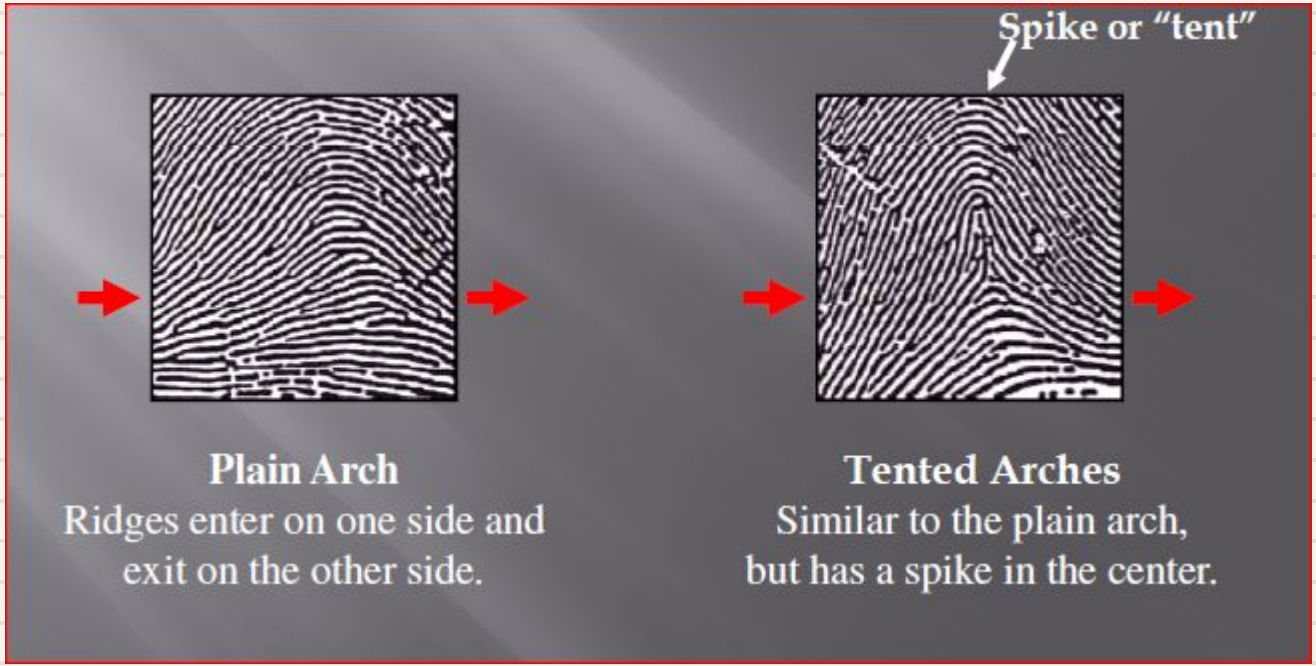
FINGERPRINTS CLASSES

There are 3 specific classes for all fingerprints based upon their visual pattern:

- **Arch**
  - Plain arch
  - Tented arch
- **Loop**
  - Radial Loop
  - Ulnar loop
- **Whorl**
  - Plain whorl
  - Central pocket whorl
  - Double loop whorl
  - Accidental

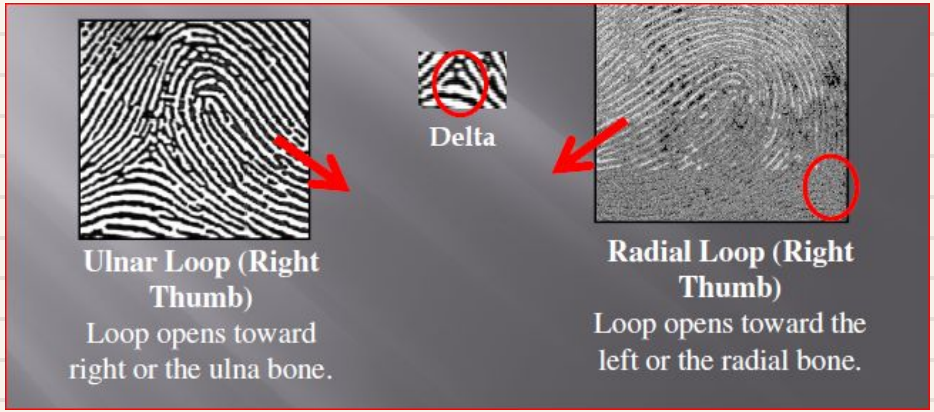
FINGERPRINTS – ARCHES

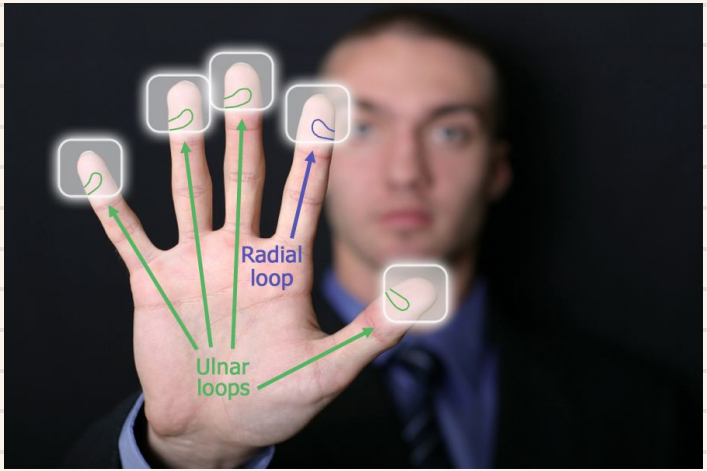
- Arches are the simplest type of fingerprints that are formed by ridges that enter on one side of the print and exit on the other. No deltas are present.



FINGERPRINTS – LOOPS

Loops must have one delta and one or more ridges that enter and leave on the same side. These patterns are named for their positions related to the radial and ulnar bones.

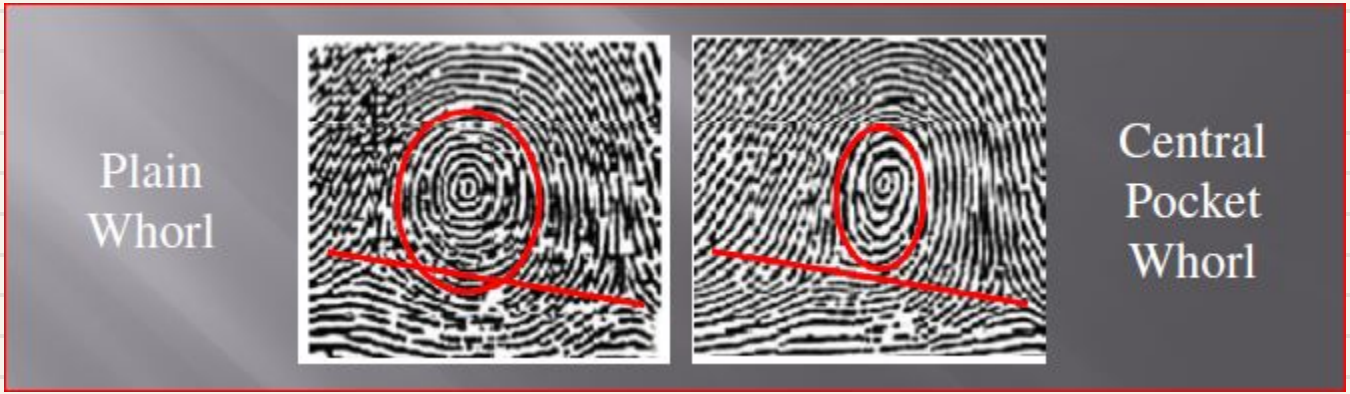




NOTE: *On the left hand, a loop that opens to the left would be an ulnar loop, while one that opens to the right would be a radial loop.*

FINGERPRINTS – WHORLS

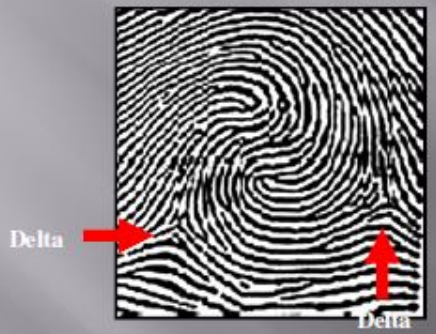
Whorls have at least one ridge that makes (or tends to make) a complete circuit. They also have at least two deltas. If a print has more than two deltas, it is most likely an accidental.



Draw a line between the two deltas in the plain and central pocket whorls. If some of the curved ridges touch the line, it is a plain whorl. If none of the center core touches the line, it is a central pocket whorl

FINGERPRINTS – WHORLS

Double Loop Whorl



Double loop whorls are made up of any two loops combined into one print.

Accidental Whorl

Accidental whorls contain two or more patterns (not including the plain arch), or does not clearly fall under any of the other categories.

CAN YOU IDENTIFY THE PATTERN

FINGERPRINTS TYPES

- **Latent fingerprints** are made of the sweat and oil on the skin's surface.
  - Invisible to the naked eye and requires additional processing in order to be seen
  - Processing can include basic powder techniques or the use of chemicals
- **Patent fingerprints** can be made by blood, grease, ink, or dirt.
  - This type of fingerprint is easily visible to the human eye.
- **Plastic fingerprints** are three-dimensional impressions and can be made by pressing your fingers in fresh paint, wax, soap, or tar.
  - Plastic fingerprints are easily seen by the human eye and do not require additional processing for visibility purposes.

WHAT IS IMPRESSION EVIDENCE?

- Impression evidence can be defined as: Objects or materials that have **retained the characteristics of other objects** through **direct contact.**
- Impressions are created when one object is **pressed** against another material with enough force to **leave an impression** of the object.
- Examples: shoe prints, tool marks, tire tracks, bite marks, marks on a fired bullet
- Impressions may be found in or on many different types of materials. The quality of the impression depends on the object making the impression and the surface conditions, such as how hard or soft it is and what type of material it is (soil, mud, dust, concrete, grass, skin, etc.)

SHOE PRINT EVIDENCE

- Investigators can analyze a shoe print to determine its **class**, or the **type** and **brand** of shoe. They will also look for individual characteristics, such as wear patterns and specific damages or defects.
- Databases of shoe prints are available for investigators to help them determine the brand of shoe to provide leads for a case.
- Depending on the quality of the impression, investigators may be able to determine a **person's speed** (walking vs. running) as well as estimate the size of a person based on the impression depth.
- Features to analyze:
  - Tread patterns, size, and depth
  - Wear patterns caused by the way a person walks
- Material defects or damage (nicks, cuts, etc.)
- Other trace materials, such as soil, tar, rocks, and paint that would indicate where a person has been

BREAK! 20 MIN


Science
TREK
CSI:
WHO DID IT?


DNA
How Crimes
are solved
using
Finger Prints

ACTIVITY

- Now that you have learned about how fingerprints can be used in forensic science, let's see how this works in real life!

Instructions

1. Get a dark marker and color each one of your fingers
2. While the ink is still wet, quickly stamp your fingers onto the handout provided
    a. Match up each finger with the corresponding slot
3. Identify your finger type!
4. Compare with your friends!

ACTIVITY

- Let's also see how we can use footprints to identify criminals in forensic science! We'll be using some examples from real life to see how scientists are able to pinpoint suspects

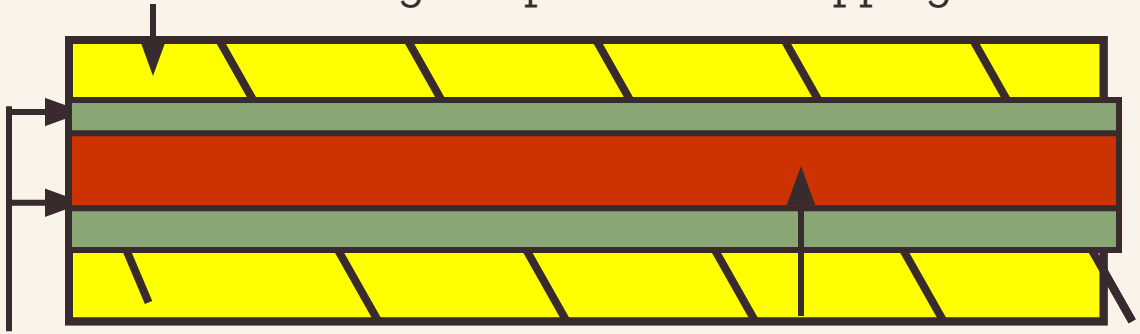
Instructions

1. Place a blank sheet of white paper on the ground
2. Take one foot and step on the paper really hard, making sure to leave an imprint
3. Pick up the paper and see what the imprint looks like
4. Swap papers randomly with a friend, and see if they would be able to identify you by foot!

HAIR STRUCTURE

Hair is composed of three principal parts:

Cuticle – outer coating composed of overlapping scales



Cortex – protein-rich structure around the medulla that contains pigment

Medulla – central core (may be absent)

The structure of hair has been compared to that of a **pencil** with the medulla being the **lead**, the cortex being the **wood** and the cuticle being the **paint** on the outside.

HAIR AS EVIDENCE

- The following information can be learned by examining pieces of hair:
  - Source (human or animal): does the suspect have a pet?
  - Races (sometimes): ovoid bodies
  - Location on source's body: from head, leg arm, etc
  - Forcibly removed?
  - Chemical treatments: bleach, hair dye, etc.
  - If drugs have been ingested (not as popular as urine drug test)

FIBERS

A **fiber** is the smallest unit of a textile material that has a **length** many times greater than its **diameter**. A fiber can be spun with other fibers to form a **yarn** that can be woven or knitted to form a fabric.

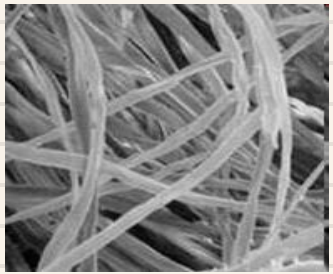
The **type** and length of fiber used, the type of **spinning** method, and the type of **fabric** construction all affect the transfer of fibers and the significance of fiber associations. This becomes very important when there is a possibility of fiber **transfer** between a suspect and a victim during the commission of a crime.

Matching **unique** fibers on the clothing of a victim to fibers on a suspect's clothing can be very helpful to an investigation, whereas the matching of **common** fibers such as white cotton or blue denim fibers would be less helpful.

The discovery of **cross transfers** and multiple fiber transfers between the suspect's clothing and the victim's clothing dramatically **increases** the likelihood that these two individuals had physical contact.

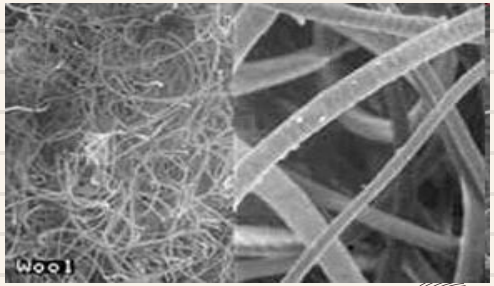
FIBERS

Many different **natural** fibers that come from plants and animals are used in the production of fabric.



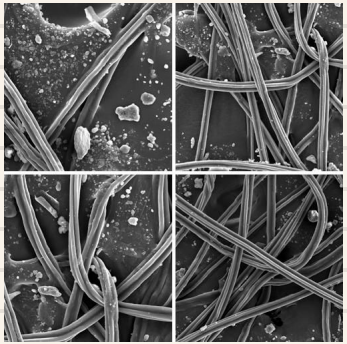
Cotton fibers are the plant fibers most commonly used in textile materials

The animal fiber most frequently used in the production of textile materials is **wool**, and the most common wool fibers originate from sheep.



PLANT FIBER CHARACTERISTICS

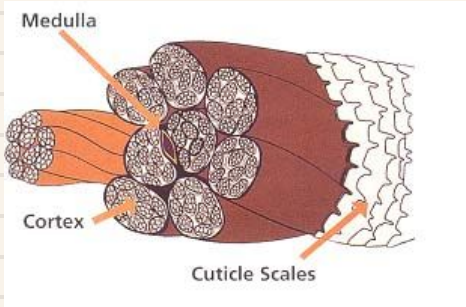
- Plant fibers come from plants, such as hemp, flax, bamboo and cotton.
- Modern paper comes from wood pulp
- Will not dissolve in bleach

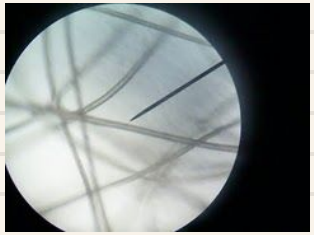


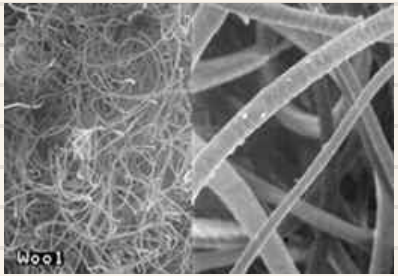
ANIMAL FIBER CHARACTERISTICS

- Animal fibers are human hair, silk and animal fur, such as wool

- Have structures
  - Medulla
  - Cortex
  - Cuticle
  - DNA

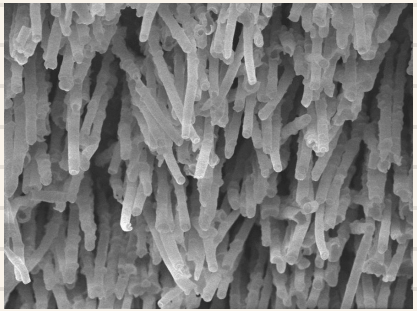






SYNTHETIC FIBERS

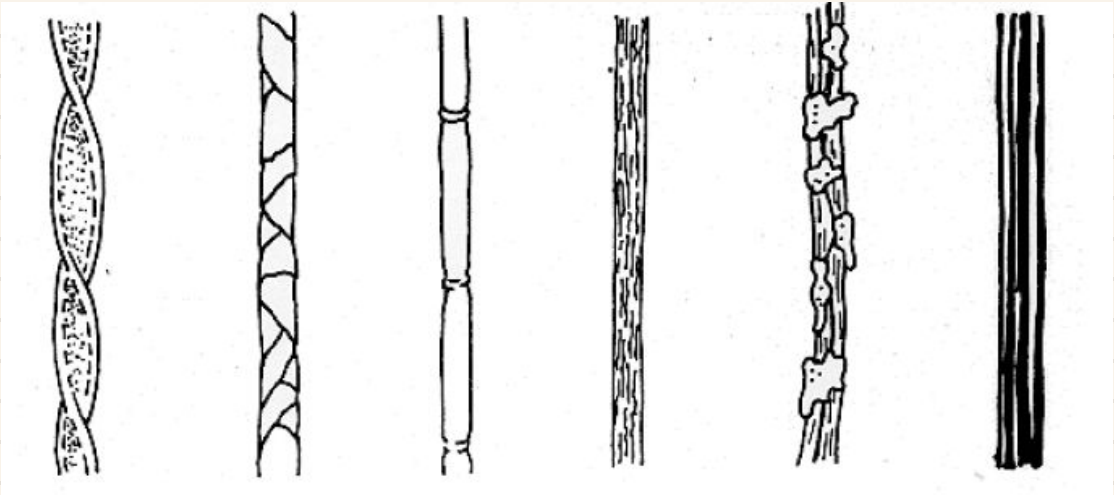
- Made from man-made or natural materials
- Some examples: Nylon, Lycra, spandex, polyester, fiberglass, carbon fibers
- Often in clothing or carpets



FIBER CHARACTERISTICS

- Fibers are either Animal, Vegetable or Synthetic (man-made)
- Identify using magnifying glass or microscope
- Further testing with **Burn Test**
  - Synthetic fibers will melt much faster than animal or vegetable fibers
  - Hair and wool have a strong smell when burned
- Animal fibers dissolve in bleach
- Real-world testing is more sophisticated – clothing is often a mixture of man-made and natural fibers.

SHAPES OF FIBERS



Cotton Wool Linen Nylon Silk Rayon

THANK YOU FOR LISTENING!

PRE-ACTIVITY

You have been recruited by the San Diego Police Department as a trainee to solve a mystery!

Yesterday, on a dark and stormy night in San Diego, 23-year old Mr. Jones was mysteriously found dead in his apartment! Reported to have been living alone at the time of the incident, there were no witnesses of the murder, leaving the police stumped. Luckily for you, although there were no witnesses, the chief of police has narrowed the case down to three major suspects for you to choose from! There are many hidden clues around the room for you to help the police identify the murderer!

It's up to you to solve Mr. Jones' murder! Can you apply what you learned to bring the case to a close?

Hint: look for fingerprints, hair, and footprints

The Suspects:

Mrs. Lee
Hair: Purple, curly
Fingerprint type: loop
Shoe:

The Suspects:

Ms. Whitney
Hair: Magenta, curly
Fingerprint type: loop
Shoe:

The Suspects:

Mr. Evans
Hair: Teal, straight
Fingerprint type: whorl
Shoe:

TIME TO USE YOUR TRAINEE SKILLS TO SOLVE...

THE LEGEND

Over 100 years ago, a young girl named **Eliza Wren** vanished in the foggy woods near Hollow Creek, last seen near the crumbling one-room schoolhouse. Some say her ghost still lingers, calling out for help. Every 10 years, another child disappears in the same spot.

Just days ago, **Max Delgado**, a superstitious researcher at the local laboratory, went to explore the ruins for lab evidence. He never came home.

All that remains: a broken lantern, a medium-sized shoe print in the mud, and a few strange hairs caught on an old wooden desk.

But something feels... off.

YOUR MISSION

As the team of newly appointed sheriffs, your job is to…

- Investigate physical evidence using real forensic techniques
- Analyze suspects
- Solve the riddle of Eliza's legend
- Uncover what really happened to Max—and why the legend keeps returning

INVESTIGATION STATIONS OVERVIEW

You will rotate through **3 investigation stations**:

1. **Fingerprint Analysis** – “The Lantern Clue”
2. **Shoe Print Casting** – “Footprints in the Fog”
3. **Hair & Fabric Analysis** – “The Rusted Desk”

STATION 1 – FINGERPRINT ANALYSIS

Clue: A **fresh fingerprint** was found on the broken lantern.
You need to compare it to:

- **Max's fingerprints**
- **Eliza's fingerprints** (from an old diary page)
- **3 modern suspects**:
    - The **Teacher**
    - The **Groundskeeper**
    - The **Local Historian**

Key Forensic Focus: **Fingerprint Types** – Loop, Arch, Whorl
Materials: Ink pads, fingerprint charts, clear tape

STATION 2 – SHOE PRINT CASTING

Clue: A **mysterious shoe print** was found in the mud.

- **One shoe print is backward**: Did Max run away, or was he chased?
- **Compare the shoe print** with the shoe print cards provided.

Key Forensic Focus: **Shoe Print Analysis**

- Look for **unique patterns** in the prints, such as tread design, size, and direction of wear.
- Analyze any **backward impressions** or signs that could indicate someone was running or trying to hide.

Materials: Paper shoe outlines, shoes with unique tread patterns, chalk for prints

HAIR AND FIBER ANALYSIS

Clue: Hairs and fibers were found on the old wooden desk.

- **Curly black thread** (linked to the Teacher's scarf)
- **Short brown synthetic fiber** (linked to the Historian's gloves)
- **Long gray-white hair** (doesn't match anyone!)

Key Forensic Focus: **Hair and Fiber Comparison**
Hair and fiber evidence can often be linked to individuals based on their unique characteristics. In this case, the hair found does not match any of the suspects, making it particularly suspicious. Fiber types and colors can often help trace them back to clothing or objects.

Materials: Yarn, string, pet hair, fabric strips, magnifying glasses

The **long gray-white hair** found on the desk is a strange clue. At first, it seems unrelated to the suspects or Max. However, upon closer inspection, it matches a strand of hair from **Max's labcoat.**

UNLOCKING THE MYSTERY

You have gathered your evidence! Now it’s time to solve the legend puzzle...

Clue: A riddle was found in Eliza’s old diary. It’s your job to decode it:

“I never leave, though I’m often gone,

I’ve seen things that others would never know,

I’m high up, always watching,

And I hold the truth of what you seek below.”

THE FINAL TWIST

Twist 1: A **modern fingerprint** on the lantern doesn't match any of the suspects or Max. This fingerprint was recently added to the scene, suggesting that someone else was involved in placing the evidence.

Twist 2: A secret note from the Teacher reveals:

- "Eliza knew something. So did I. Every 10 years, the legend protects the one who caused it."
- The Teacher suggests that someone close to the mystery has been benefiting from the legend's eerie power to distract attention from their own guilt.

Max's Involvement:

- Max was found **safe** but **refuses to speak** about his experience in the bell tower. His hands are **stained with dust**—an odd sign that he had been near the tower recently.
- Max's **backpack** was found near the tower, and it contains **a page titled "The Girl Who Never Left."**
- **The Hair Evidence**: The long gray-white hair found on the desk **doesn't match any of the suspects** or Eliza. It's not until Max is investigated that we realize the hair is actually **Max's**—he must have brushed against an old piece of furniture in the tower while hiding or moving things around.

AND THE CULPRIT IS...

MAX!

Max Delgado is a **young researcher** around **19 or 20 years old**, working at the **local science lab**. He's always been **obsessed with the old ghost stories** of Hollow Creek. Some say he's even a little superstitious.

He wanted to **prove the legend was real**—so people would believe him.

CHASING THE CULPRIT

❗ What Was Max’s Intent?

Max didn’t mean to scare anyone.
He **faked his own disappearance** so people would think **Eliza’s ghost was real**.

Why?
Because he wanted to be **famous** for discovering something spooky and mysterious.
He planned to **hide out**, then come back and say,

> “I saw Eliza’s ghost! She’s real!”

But his plan didn’t go well…

CHASING THE CULPRIT

🧩 What Happened at the Scene?

- Max brought a **lantern** and his **backpack** full of research notes.
- He explored the schoolhouse, **touched things**, and **left behind clues** (like fingerprints and gray hairs).
- When the lantern broke, he panicked.
- He ran out the door so fast, he **left a backward footprint** in the mud.
- He was in a hurry, so some hairs from his coat got snagged on a desk.

Then…
He **hid in an old tool shed nearby**, waiting for someone to “rescue” him so his story would sound exciting.

CHASING THE CULPRIT

🧠 How the evidence adds up

1. **Fingerprint on the Lantern** → Matches Max
   ✅ He was there.

2. **Shoe Print in the Mud** → Matches Max's boot
   ✅ One is backwards, like he turned and ran quickly.

3. **Gray Hair on the Desk** → Not Eliza, not an adult suspect
   ✅ It matches Max (he has some gray hair even though he's young).

4. **Strange Note in the Backpack** → "She said I'd disappear if I told."
   ✅ It's not a real ghost message—it's something **Max made up** to sound spooky.

CATCHING MAX!

🎭 Final Twist

Max is found nearby the next day.
He admits:

> “I just wanted to make people believe the legend. I thought it’d be fun... but I got too scared.”

He wasn’t taken. He was hiding. He left all the clues without realizing how obvious it would be.