

TRAINING LAB – HAIR AS EVIDENCE: PART 1 – HUMAN HAIR

NAME _____

Background: You lose about 50 to 100 hairs a day from the approximately 100,000 total hairs present on your head. Don't worry, however, because there are always new hairs growing to take the place of those falling out (unless you are going bald)! As you move around from place to place throughout the day you leave behind a trail of hairs that can help tell where you have been. This means that a suspect could be identified by losing, and leaving behind, a hair or two while at a crime scene. What does a detective look for when identifying a hair sample? Keep reading and you will become an expert in this Hairy Training Lab!

1. You will be trained to observe the different characteristics of human hair.
2. You will be trained to identify a suspect based on a hair sample.

Hair As Evidence Reference Information:

- *a hair found at a crime scene is NOT like a fingerprint. Recall that a fingerprint is INDIVIDUAL EVIDENCE because it is unique to one person. A hair found at a crime scene is considered CLASS EVIDENCE because several people may have hair that looks similar to the evidence hair – a hair's appearance is NOT unique to one person.
- *in fact, one person may have several different looking hairs growing on their head. For this reason it is recommended that up to 30 hairs from a suspect be observed when trying to match a suspect's hair to a crime scene hair.
- *although hair is considered Class Evidence it is still important evidence. Hair evidence can help to establish that a suspect is guilty when used with other types of Class Evidence or Individual Evidence.
- *human hair is usually used as evidence in two ways:
 1. the suspect's hair is found at the crime scene OR the suspect's hair is found on the victim's clothes or belongings.
 2. the victim's hair is found on the suspect's clothes or belongings.
- *if a hair is found with the root attached it becomes special evidence. The root contains living cells that can be used for DNA Fingerprinting – an example of Individual Evidence.
- *hair can also be used to determine if a person has used drugs within the past several months (drug chemicals become embedded in the hair's structure).
- * IN GENERAL – humans of European ancestry often have oval or round hair shafts
humans of Asian ancestry often have larger, round hair shafts
humans of African ancestry often have flattened hair shafts

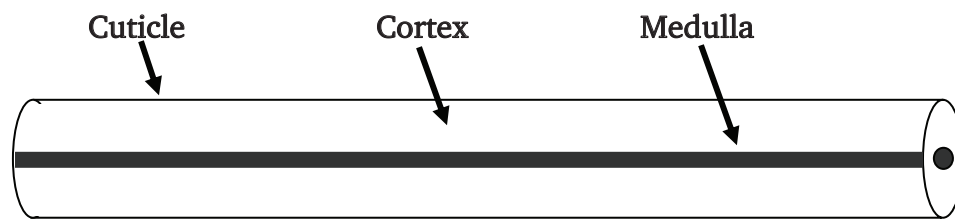
Procedures:

Part 1 – General Hair Observations

1. Grab a microscope, microscope slide, cover slip, forceps, and scissors.
2. Carefully cut (or pull) a single hair from the top of your head and make a wet mount of the hair. Use your supervisor's hair (or a friend's) if your hair is too short to sample.
3. Find your hair on low power first, then move on up to medium and high power. You should complete the following hair observations using high power.

4. The hair shaft you see is made of layers of dead, dried-up cells filled with **KERATIN PROTEIN**, which makes the hair flexible and strong. In addition, hair is composed of **THREE DISTINCT LAYERS**. See if you can locate these three layers (described below) in your hair (NOTE: the Medulla layer may not be visible in all hairs). You may need to focus in and out using the fine focus knob and adjust the light to see each layer clearly.

- A. **CUTICLE** – A thin layer of dead cells covering the outside of your hair. These cells overlap each other like shingles on a roof and protect your hair from damage. You should be able to focus on the outlines of these cells.
- B. **CORTEX** – A layer of dead cells that make up the majority of human hair. The cortex contains pigment granules or bodies filled with brown **MELANIN PROTEIN** that gives a hair its color. Darker hair typically contains more pigment granules filled with more Melanin Protein.
- C. **MEDULLA** – A layer of dead cells and air spaces that runs down the middle/center of the hair. The medulla might appear as an obvious dark line (the medulla is filled with air spaces) or the medulla might seem to be missing (the medulla is pigmented the same color as the surrounding cortex).



Part 2 – Observing The Specific Characteristics Of Human Hair

ESTIMATED DIAMETER OF HAIR

1. Make sure you are observing your hair using High Power.
2. Ask your supervisor for the **Field of View Diameter for High Power** for the microscope you are using and write this number in the space below. The Field Of View Diameter is the actual distance across the circle of light you see when you look through the microscope (or how much of the microscope slide you can see).

Field Of View Diameter For High Power =

micrometers

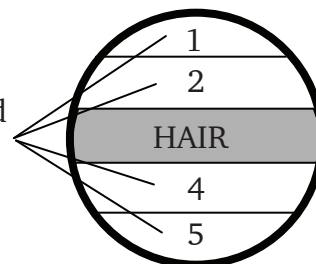
3. Look through the microscope at your hair and estimate how many of your hairs could be placed side by side to fit exactly across the Field of View circle and fill it up (you can use fractions, like 4.5, if needed).

Write your estimate in the space below.

Number of Hairs I
Think Would Fit Across

=

Estimated
Hairs



4. Complete the following calculation to determine the Estimated Diameter of your hair:

$$\text{Estimated Diameter of Hair} = \frac{\text{Field of View Diameter}}{\text{Estimated Number of Hairs}}$$

EXAMPLE: Field of View Diameter for High Power = 530 micrometers
I estimate that 5 of my hairs will fit across the field of view

$$\text{Estimated Diameter of Hair} = \frac{530 \text{ micrometers}}{5 \text{ Hairs}}$$

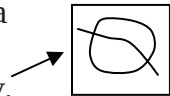
Estimated Diameter of Hair = 106 micrometers

5. Record your hair's Estimated Diameter in Table 1.

CUTICLE DESCRIPTION

1. What is the **CUTICLE SCALE PATTERN**? Observe the pattern of overlapping cuticle cells on the surface of your hair using High Power (adjust focus and light for best view!). If the Cuticle Scale Pattern is hard to see, try this method:

- First paint a very thin layer of clear fingernail polish in the center area of a cover slip (NOT a microscope slide).
- Lay most (but not all) of a hair in the wet polish and let the polish dry.
- Grab the free end of hair with forceps and lift the hair out of the dried polish.
You can discard the hair. You will be looking at the hair's imprint left in the polish.
- Place the cover slip (with the hair removed) polished side DOWN on a dry microscope slide (do not use a drop of water). Place the slide and cover slip on a microscope stage and observe the hair's Cuticle Scale Patten imprint left behind in the dried polish.

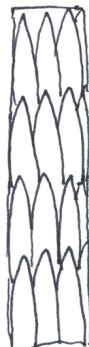


2. Pick one of the Cuticle Scale Patterns below that best describes your hair's cuticle.



random
overlapping
scales – often
flattened

Imbricate



longer, pointed
scales that
overlap

Spinous



ring-like scales
– often look
like cups one
inside the
other

Coronal

3. Record the Cuticle Scale Pattern of your hair in Table 1.

CORTEX DESCRIPTION

1. What is the **GENERAL COLOR OF THE CORTEX** when viewed through the microscope:
White or Clear, Light Yellow, Medium Yellow, Light Brown, Medium Brown, Dark Brown, Black, Red, etc..
2. What is the **PIGMENT GRANULE DISTRIBUTION**? Choose from:
Smooth Cortex – pigment granules are not obvious
Granular Cortex – obvious pigment granules give the cortex a granular appearance
Spotty Cortex – larger dark bodies are scattered among the smaller pigment granules
3. Record the Cortex Color and Cortex Pigment Granule Distribution in Table 1.

MEDULLA DESCRIPTION

1. What is the **MEDULLA PATTERN**? Scan along the length of the hair on your slide looking for the presence of a medulla, which is usually darker in color than the cortex. Pick one of the Medulla Patterns below that best describes your hair's medulla.



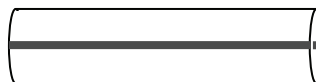
2. Record the Medulla Pattern in Table 1.
3. What is the **MEDULLARY INDEX**? Medullary Index describes the thickness of the medulla layer that is present. Observe your hair on high power and choose the Medullary Index below that best describes your hair's medulla.

Medulla is not present.



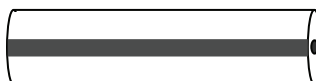
Medullary Index = 0

Is the medulla about 1/8 the thickness of the hair?



Medullary Index = 0.125

Is the medulla about 1/4 the thickness of the hair?



Medullary Index = 0.25

Is the medulla about 1/2 the thickness of the hair?



Medullary Index = 0.5

Is the medulla about 3/4 the thickness of the hair?



Medullary Index = 0.75

Is the medulla almost the entire thickness of the hair?



Medullary Index = 0.9

4. Record the Medullary Index in Table 1.
 5. What is the **MEDULLA COLOR**? Describe the color or darkness of your hair's medulla:
Black, Dark Brown, Light Brown, Gray, White or Clear, Absent.
 6. Record the Medulla Color in Table 1.
- REMOVE A SECOND HAIR, THIS TIME FROM THE BACK OF YOUR HEAD, AND REPEAT ALL THE OBSERVATIONS IN PART 2.** Record your observations in Table 1.

Part 3 – The Car Thief

NEWTON COUNTY SHERIFF DEPARTMENT

“Protect and Serve”

To ABC Technologies Forensic Lab:

Our county has recently had an outbreak of auto thefts. Each theft has been similar – a car is stolen from a parking lot and is found abandoned several days later, however, the car is usually heavily damaged and all electronic equipment (radios, GPS units, DVD players, etc.) has been removed. We have been following several leads and have gathered enough information to narrow our suspect list down to four people. We have also recovered a few hairs found on the driver’s side headrest from two of the stolen vehicles. These hairs do not appear to belong to the vehicle owners. Could your lab analyze these evidence hair samples to see if they could have come from one of our suspects? A positive hair match would serve as class evidence in this case, however, it is the final bit of evidence we would need to build a strong case against the suspect and make an arrest.

We appreciate your assistance in helping solve this crime,

Sheriff Harry M. Duhla

1. Analyze the evidence and suspect hairs Sheriff Harry M. Duhla sent to our lab. Record all observations in Table 2.
2. Write a conclusion paragraph to Sheriff Harry M. Duhla (in the space provided in Table 2) that summarizes your findings. This paragraph should include the following:
 - A. Do any of the suspects match the evidence hairs, and if so, which suspect matches?
 - B. Describe the hair characteristics you observed in Evidence Hair #1 that matched and helped you identify the suspect you singled out. Repeat to describe the hair characteristics of Evidence Hair #2 that matched your suspect’s hair.

Table 1 – Observations and measurements of my hair taken from two locations.

	Estimated Diameter of Hair (micrometers)	Cuticle Scale Pattern	Cortex Color	Cortex Pigment Granule Distribution	Medulla Pattern	Medullary Index	Medulla Color
Hair - Top of Head							
Hair - Back of Head							

Table 2 – Analysis of evidence and suspect hairs from Newton County auto thefts.

	Estimated Diameter of Hair (micrometers)	Cuticle Scale Pattern	Cortex Color	Cortex Pigment Granule Distribution	Medulla Pattern	Medullary Index	Medulla Color
Evidence Hair #1 (from Mercedes)							
Evidence Hair #2 (from Corvette)							
Suspect A Hair							
Suspect B Hair							
Suspect C Hair							
Suspect D Hair							
Conclusion:							

QUESTIONS – HAIR AS EVIDENCE: PART 1 – HUMAN HAIR

NAME _____

1. Why is the microscopic observation of hair found at a crime scene considered an example of Class Evidence and not Individual Evidence?
2. What part of the hair would be best to recover from a crime scene if you wanted to use it as Individual Evidence?
3. Why do you think the part of hair you named in Question #2 can be used as Individual Evidence?
4. You observed two hairs from your head – one from the top and one from the back. Hairs from the same person are usually similar, however, the hairs are usually not identical and show some variation. Below is a list of the hair observations you completed on your hairs. Mark which observations were about the same and which were different for your two hairs.

	SAME	DIFFERENT
Estimated Diameter (micrometers)		
Cuticle Scale Pattern		
Cortex Color		
Cortex Pigment Granule Distribution		
Medulla Pattern		
Medullary Index		
Medulla Color		

5. You find a hair at a crime scene and want to match it to a suspect. Why is it important to observe several (typically 15-30) hairs from your suspect's head?

6. Human hair is composed of three layers of dead cells. Name these three layers from the INSIDE OUT.

inner most layer _____

middle layer _____

outer most layer _____

7. Which layer appears to always be the largest and takes up most of the space of a human hair?

8. ALL human hairs contain cuticle cells arranged in the same Cuticle Scale Pattern. Name this Cuticle Scale Pattern (the other Cuticle Scale Patterns are found only in different animal hairs).

9. A murder was committed (the victim had multiple stab wounds) and a suspect has been identified. You are responsible for gathering evidence associated with this crime. You visit the suspect and remove hairs from his clothing as evidence. Why?

10. You are teaching a group of Forensic Science students how to analyze evidence collected from a crime scene. One student collects a hair and asks, "What information can you learn from this evidence". You look closely at the hair with a magnifying glass and say, "I may be generalizing, however, this hair most likely came from a Caucasian - someone of European ancestry". The students are astonished when they find out you are correct. Describe what single characteristic you saw in the magnified hair that helped you conclude it was probably from a Caucasian.