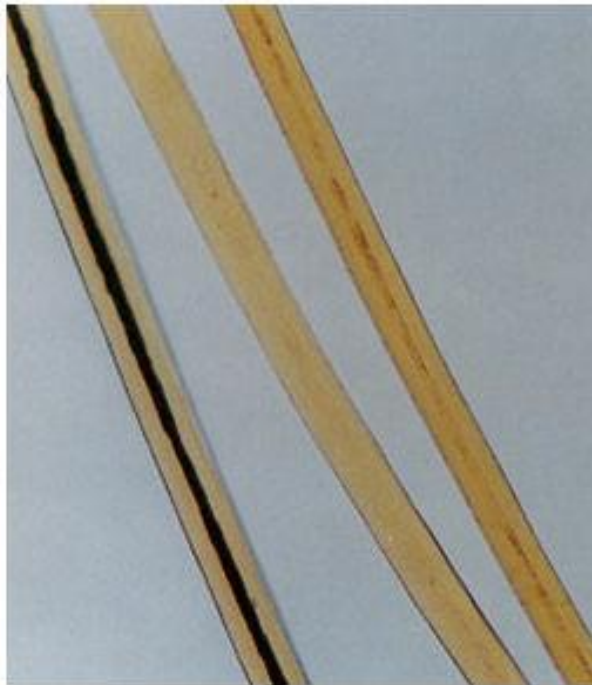


Ch. 3 Notes: Hair as Evidence



Hair as Evidence

Human hair is one of the most frequently found pieces of evidence at the scene of a violent crime. Unfortunately, hair is not the best type of physical evidence for establishing identity. It is not possible to show with any certainty that two hairs came from the same person or animal. However, hair can be used to rule out certain suspects or scenarios. It can also be used to corroborate (support) other physical evidence if it is consistent with the rest of the evidence.



CRIME SCENE DO NOT CROSS

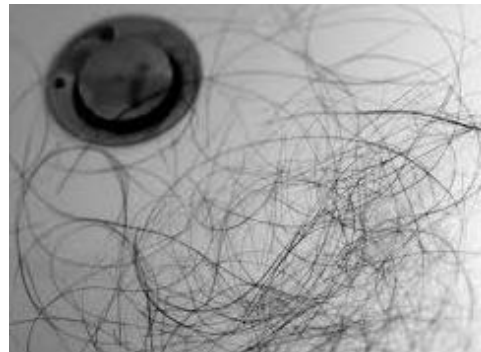
The average human has approximately 250,000 hairs that get replaced in a **3 year** cycle.

- i. About **250** hairs are shed daily; about **100** being from the head.
- ii. **Blondes** tend to have more head hairs than brunettes. **Red heads** have the least.



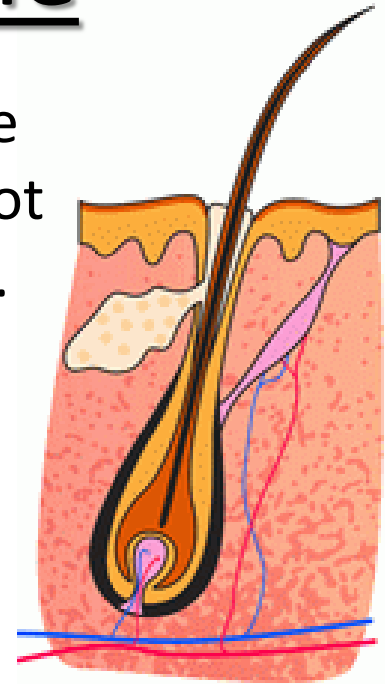
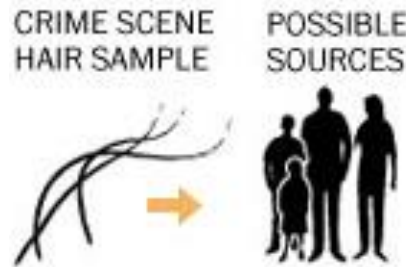
Hair Color Chart

			
C-1 Jet Black	C-2 Dark Brown	C-3 Medium Brown	C-3.2 Light Brown
			
C-3.3 Dark Brown with light brown highlights	C-4 Auburn Brown	C-5 Red Brown with light brown highlights	C-6 Chestnut Red
			
C-7 Light Ash Brown	C-8 Dirty Blonde	C-9 Copper Red	C-10 Copper Blonde
			
C-11 Light Blonde	C-11.1 Lighter Blonde	C-12 Honey Blonde	C-12.1 Light Blonde with white highlights



Hair at a Crime Scene

Hair is considered class evidence. Alone (without follicle cells attached), it cannot be used to identify a specific individual.



Hair can easily be left behind at a crime scene. It can also adhere to clothes, carpets, and many other surfaces and be transferred to other locations. This is called secondary transfer. Secondary transfer is particularly common with animal hair.



Hair analysis may be helpful to determine the following:

- i. Human or animal origin
- ii. The broad racial background of an individual
- iii. Body region from which the hair came
- iv. Manner in which the hair was removed
- v. Chemical tests can provide a history of the use of drugs and other toxins, indicate the presence of heavy metals, and provide an assessment of nutritional deficiencies.
- vi. When the follicle of a hair is present, DNA evidence may be obtained and it can lead to individual identification.



All of these make hair helpful evidence for crime scene analysis.



Collecting Hair as Evidence

- i. Recover all hair present.
- ii. Use the fingers or tweezers to pick up visible strands of hair when possible. Tape lift may be used to help collect hairs if needed. When surfaces are large, they can also be vacuumed.
- iii. Place hair in paper bindles or coin envelopes which should then be folded and sealed in larger envelopes. Label the outer sealed envelope.



Function of Hair

All mammals have hair. Its main purpose is to regulate body temperature— to keep the body warm by insulating it.

Other functions of hair:

- decrease friction
- to protect against sunlight
- sensory
- camouflage

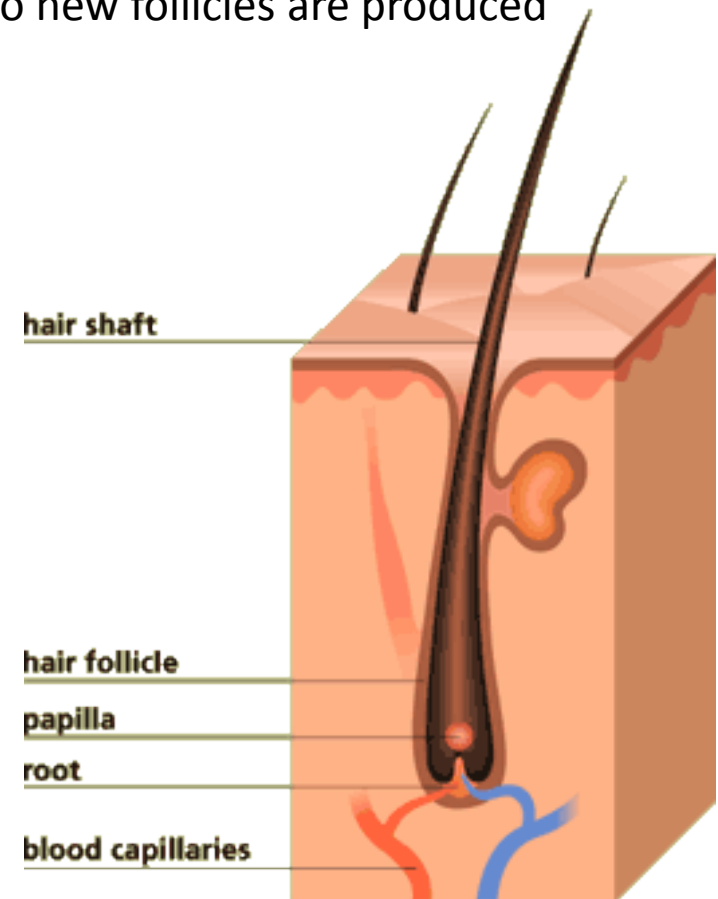


Structure of Hair

A hair consists of two parts: a **follicle** and a **shaft**.

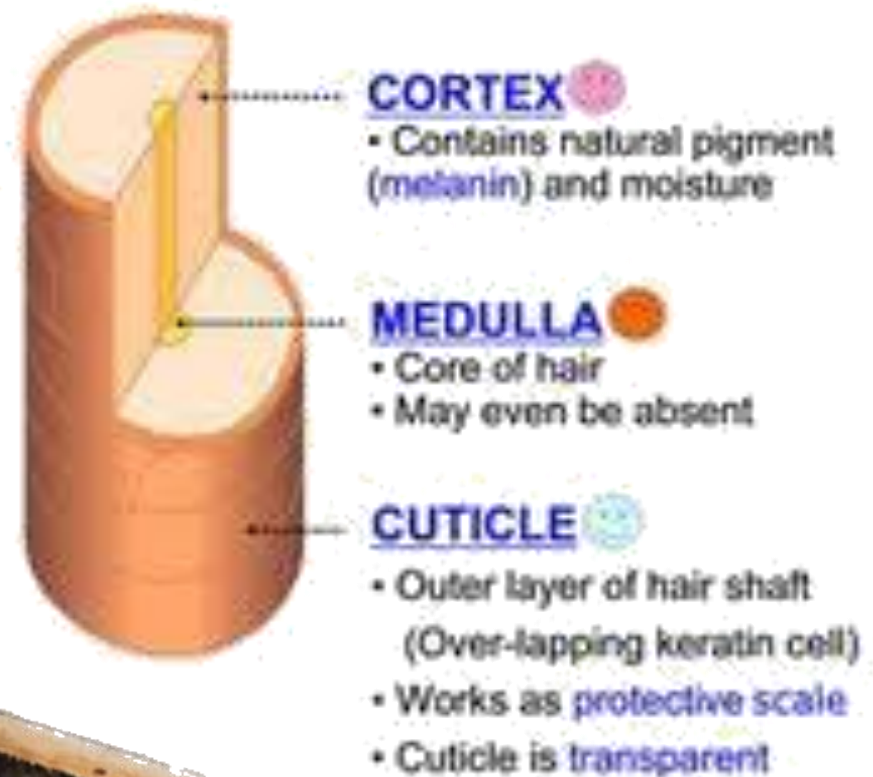
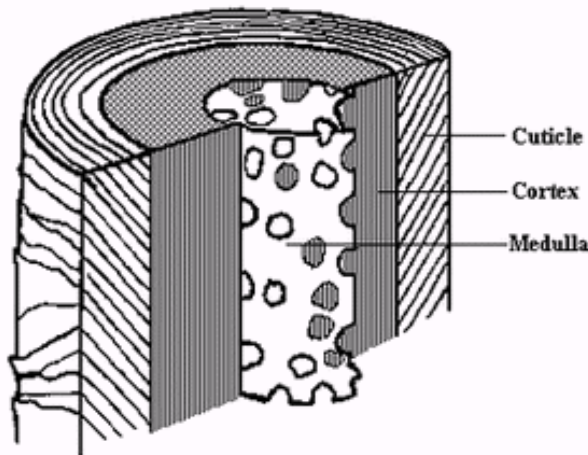
i. Follicle is a **club**-shaped structure in the **skin**

- Hair is produced from the follicle. Humans develop hair follicles during fetal development, and no new follicles are produced after birth.
- At the end of the follicle is the **papilla**, a network of blood vessels that supply **nutrients** to feed the hair and help it **grow**.
- The bulb also contains a sebaceous **gland** to secrete oil, erector **muscles** that cause hair to stand upright, and **nerve** cells to respond to the environment.



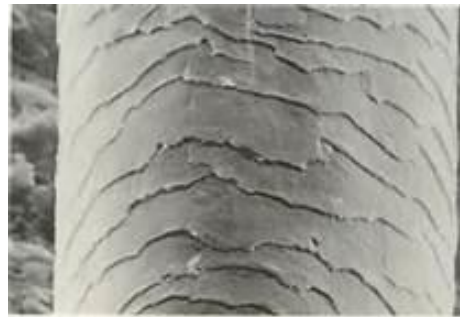
The hair shaft is composed of the protein **keratin**, which is produced in the skin. Keratin makes hair both strong and **flexible**.

The hair shaft is made up of **three layers**:

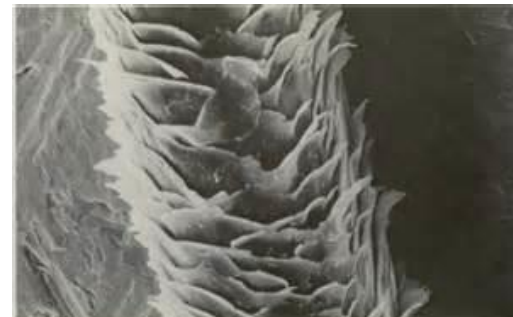


Cuticle

- Transparent outer layer of the hair; protects the hair.
- Made of scales that overlap one another and point toward the tip end



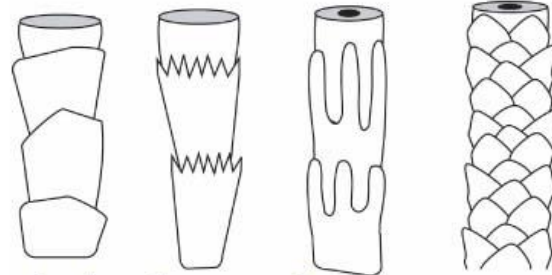
Healthy



Damaged

Different types of mammals have different cuticle scale patterns.

Coronal Scales



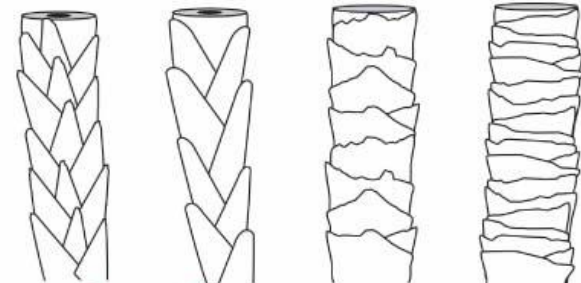
Simple

Serrate

Dentate

Ovate

Imbricate Scales



Acuminate

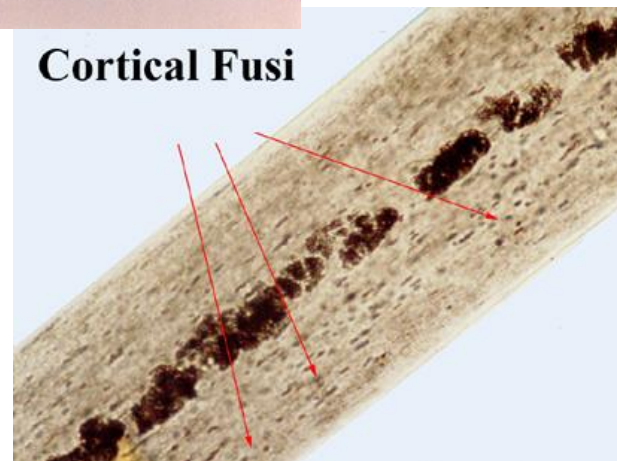
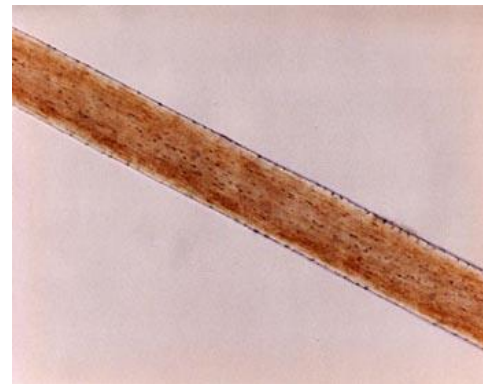
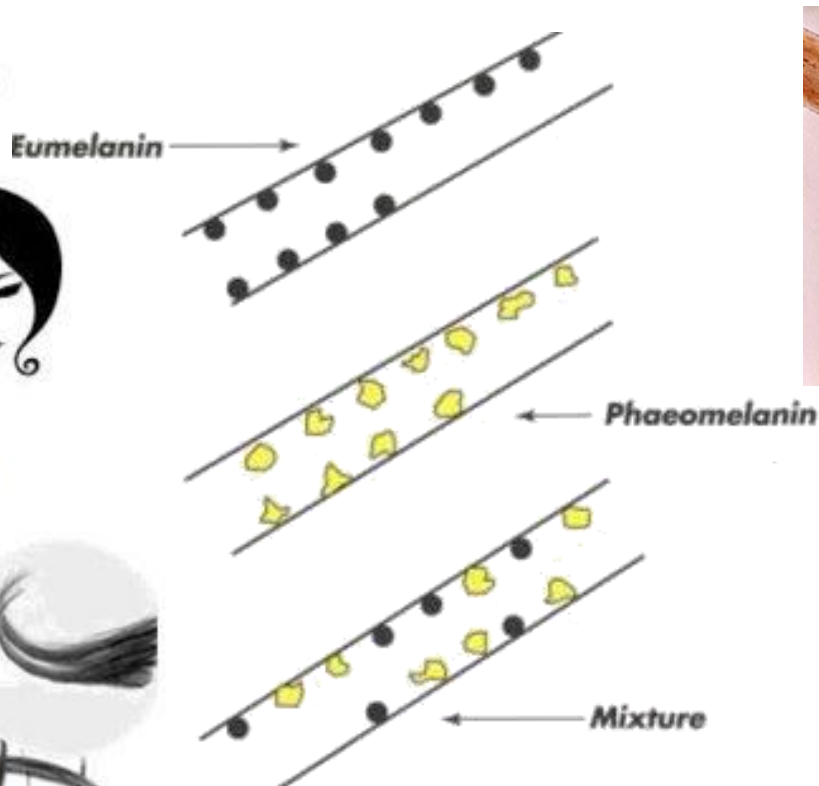
Elongate

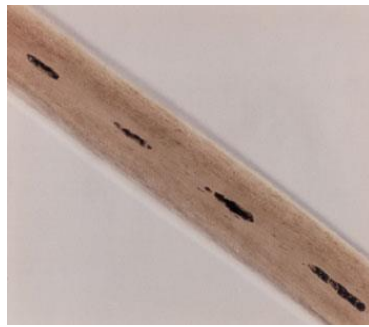
Crenate

Flattened

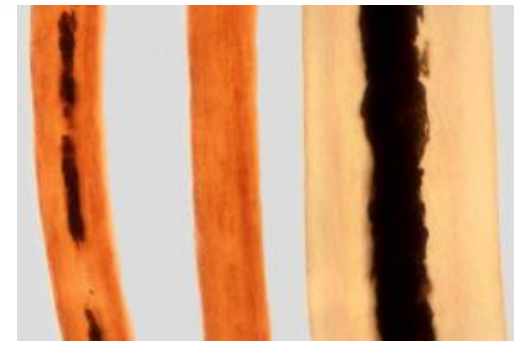
Cortex

- Middle layer; largest part of the hair shaft, contains pigment granules
- There are two main pigments found in human hair:
 - ❖ Eumelanin- gives color to brown or black hair
 - ❖ Pheomelanin- produces the color in blonde or red hair



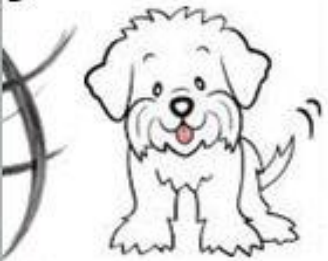


Medulla



- Central core of the hair. It can be a hollow tube, or filled with cells.
- Forensic investigators classify hair into five different groups depending on the appearance of the medulla.

Medulla Pattern	Description	Diagram
Continuous	One unbroken line of color	
Interrupted (Intermittent)	Pigmented line broken at regular intervals	
Fragmented or Segmented	Pigmented line unevenly spaced	
Solid	Pigmented area filling both the medulla and the cortex	
None	No separate pigmentation in the medulla	

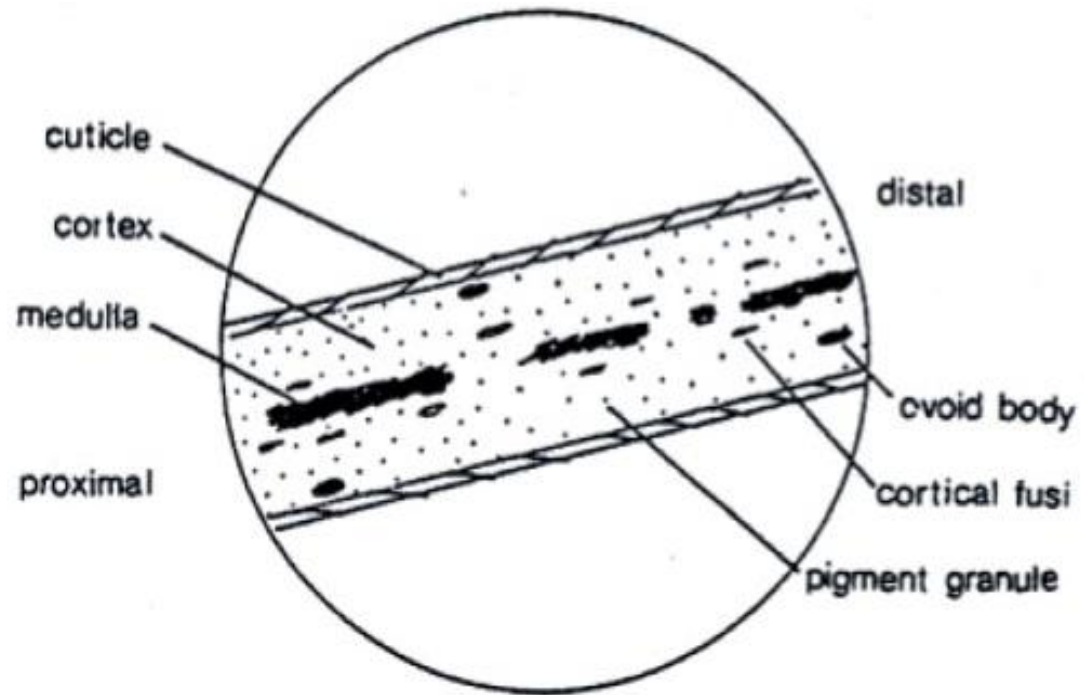


Analogy for the
structure
of the hair shaft:

Cuticle
Cortex
Medulla



Good example
of a microscope
drawing of hair:



Differences in Hair

- a. Hair can vary in shape, length, diameter, texture, and color.
- b. The **cross section** of the hair may be circular, triangular, irregular, or flattened, influencing the curl of the hair.
- c. The **texture** of hair can be coarse as it is in whiskers or fine as it is in younger children.

Hair Follicle Cross Sections



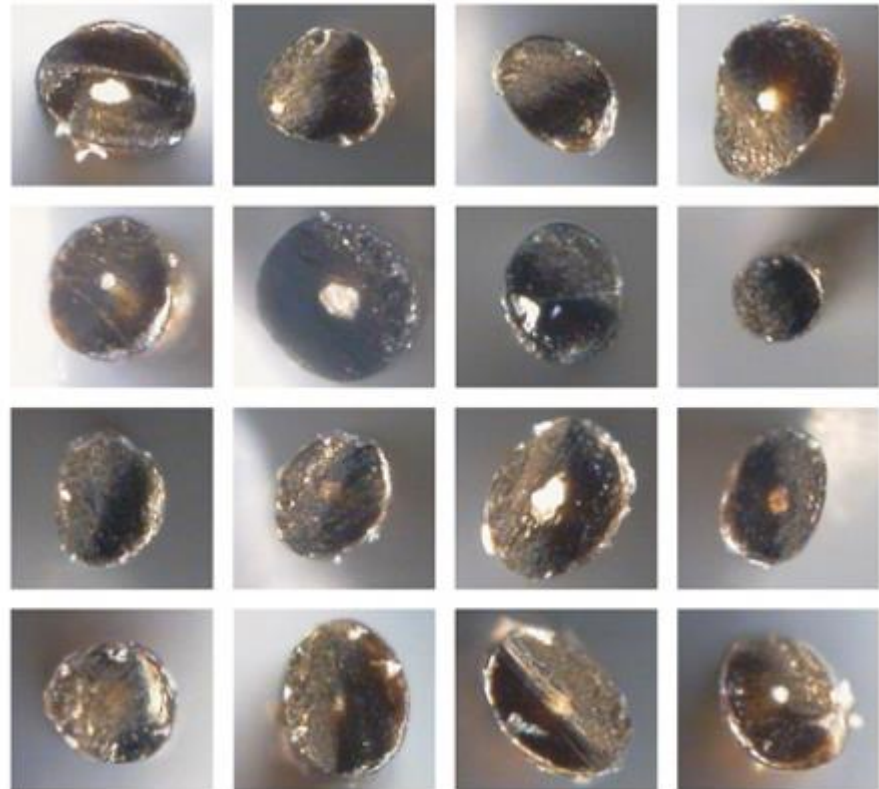
Curly or coily hair cross section



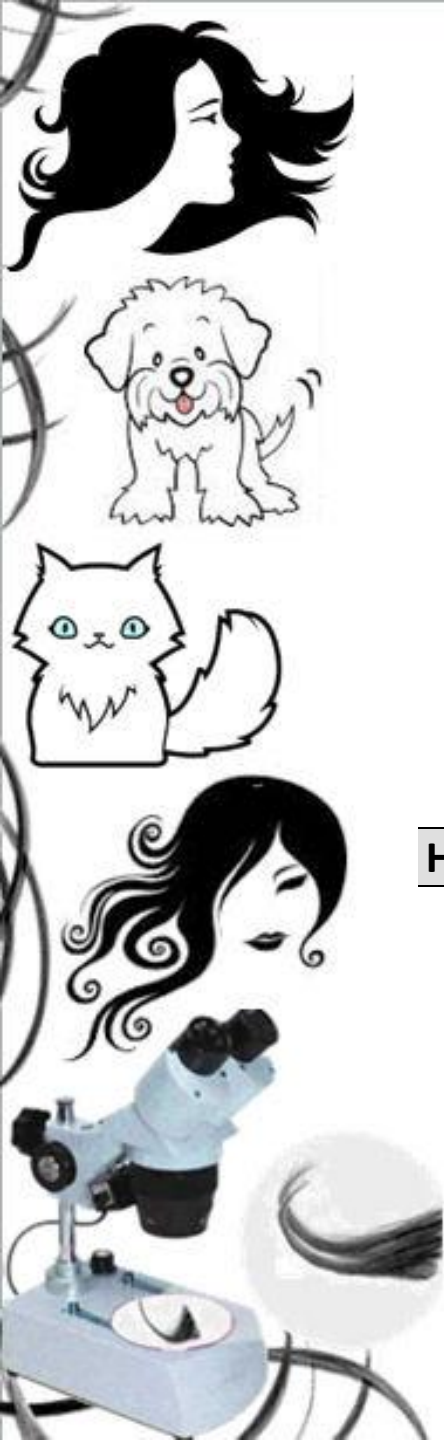
Wavy hair cross section



Straight hair cross section



Differences in hair can be used for identification (association) or **exclusion** in forensic investigations.



ASSOCIATION

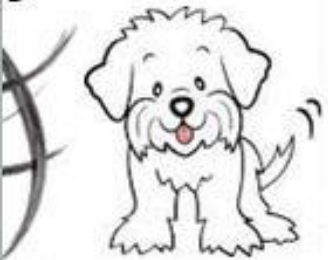
Hairs "could have a common origin"



EXCLUSION

Hairs "do not have a common origin"

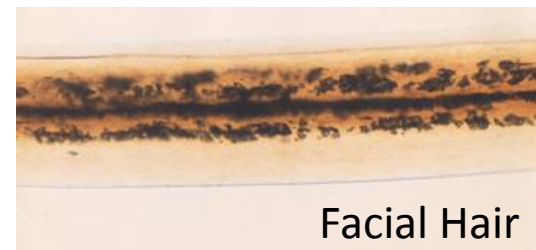




Hair from Different Parts of the Body

Six types of hair on the human body:

- Head hair
- Eyebrows and eyelashes
- Beard and mustache hair
- Underarm hair
- Auxiliary or body hair
- Pubic hair



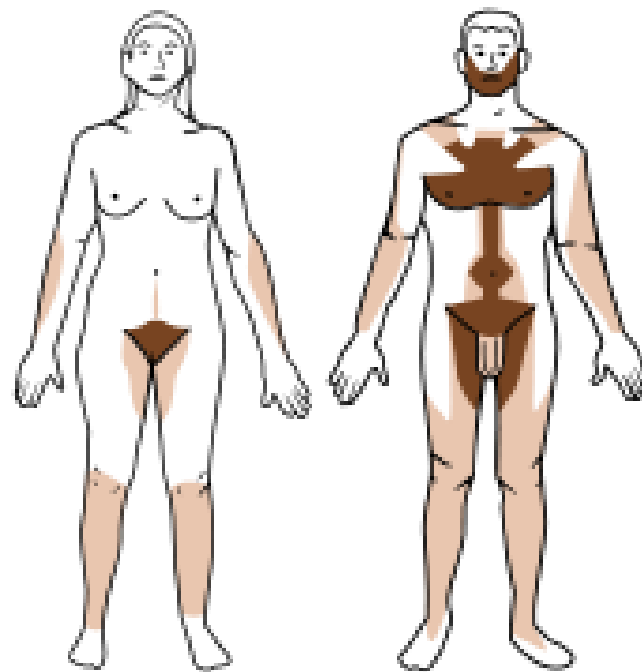
Facial Hair



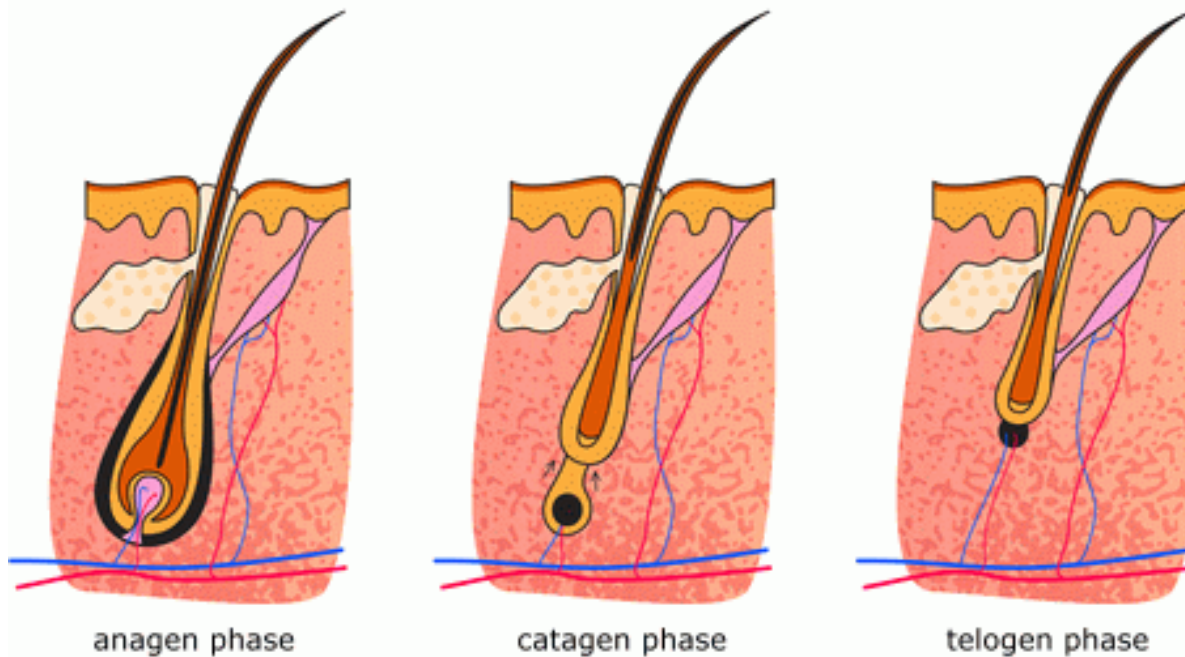
Pubic Hair

Each hair type has its own shape and characteristics.

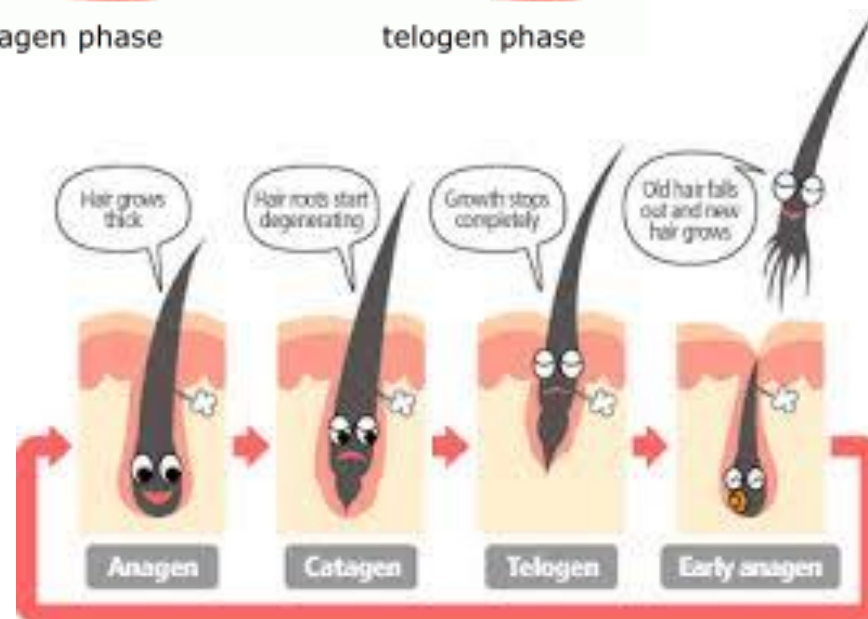
Hair from head and pubic region are the most common hairs found at crime scenes



The Life Cycle of Hair







A= Period of active growth
C= Transitional or regressive stage
T= Final resting stage

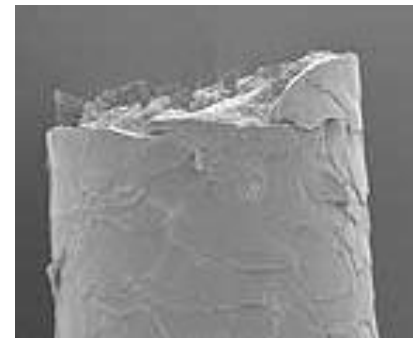


Distal Tips

- The appearance of the tip of the hair shaft is an important **comparative** characteristic.
- If sufficient sample is available, it may be possible to identify the type of treatment and estimate the length of time since the last cutting.

Uncut	Scissors (freshly cut)	Razor	Clippers
			
Tip is tapered, round, split, or frayed.	Tip is partially compressed.	Tip has a long tail on one side of the cut.	Reveals broken and partially cut shafts.

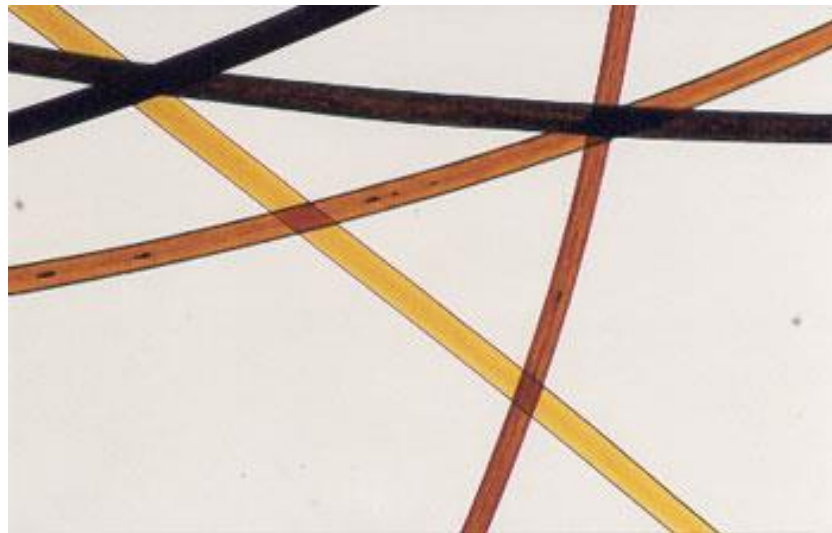
Tips usually take on a rounded form in 2-3 **weeks**.



Treated Hair

- When a person chemically treats his or her hair, traces of the chemicals used remain. Some of these changes are subtle and can be detected only by using a microscope.
- Bleaching hair removes pigment granules and gives hair a yellowish tint. It also makes hair brittle and can disturb the scales on the cuticle.

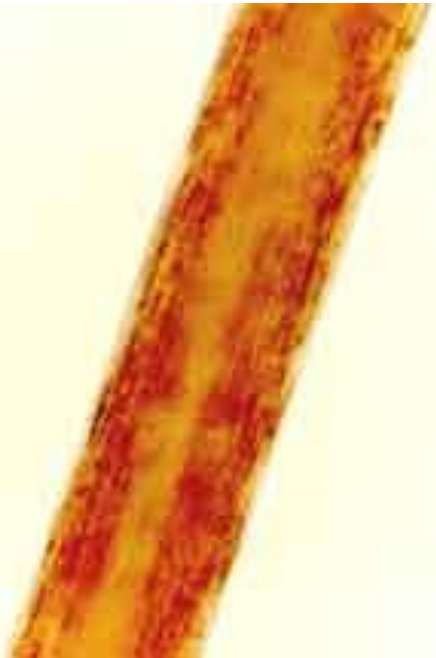
Dyeing hair changes the color of the hair shaft. An experienced forensic examiner can immediately recognize the color as unnatural. In addition, the cuticle and cortex both take on the color of the dye.



Racial Differences

A human hair can be associated with a particular racial group based on established models for each group. Forensic examiners differentiate between hairs of **Caucasoid (European ancestry)**, **Mongoloid (Asian ancestry)**, and **Negroid (African ancestry)** origin, all of which exhibit microscopic characteristics that distinguish one racial group from another. Head hairs are generally considered best for determining race, although hairs from other body areas can be useful.

Caucasian or European hair



Negroid or African hair

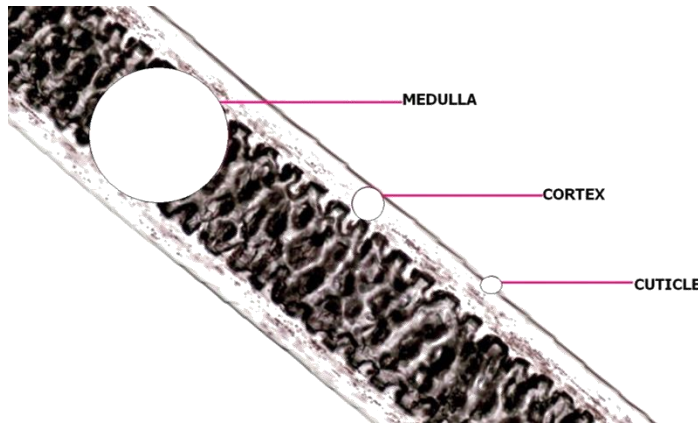


**Mongoloid
or Asian
hair**



Animal Hair and Human Hair

One of the more reliable ways to distinguish between a human and other animal hair is to calculate the medullary index of the hair.



Diameter of the medulla divided by the diameter of the entire hair is known as the medullary index.

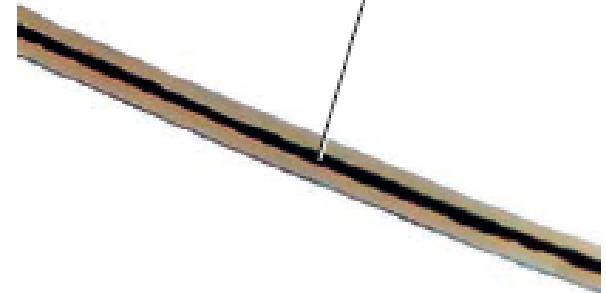
- If the medullary index is 0.5 or greater, the hair came from an animal.
- If the medullary index is 0.33 or less, the hair is from a human.

Index = 0.50 or more



Cattle hair

Index = 0.33 or less

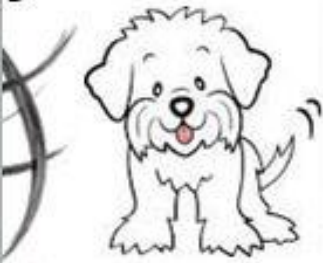




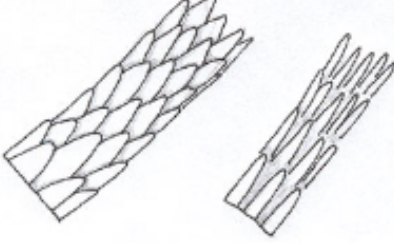
Human hair





Cuticle scales differ between species of animals;
three basic scale structures include:



coronal (crown-like)	Imbricate (flattened)	Spinous (petal-like)
		
<ul style="list-style-type: none">• Found in hairs of very fine diameter and resemble a stack of paper cups• Coronal scales are commonly found in the hairs of small rodents and bats but rarely in human hairs	<ul style="list-style-type: none">• Overlapping scales with narrow margins• They are commonly found in human hairs and many animal hairs	<ul style="list-style-type: none">• Triangular in shape and protrude from the hair shaft• Found on the fur hairs of mink, seals, cats, and some other animals.• They are never found in human hairs



Animal hairs also show a wide variety of medulla patterns:



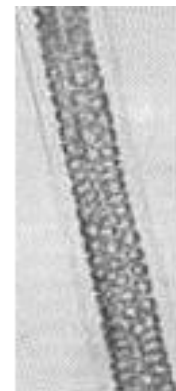
Human



Dog



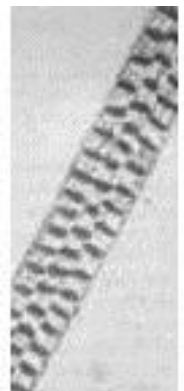
Deer



Rabbit



Cat



Mouse

Hair viewed for forensic investigations is studied both **macroscopically** and **microscopically**

Different kinds of microscopes provide different kinds of evidence.

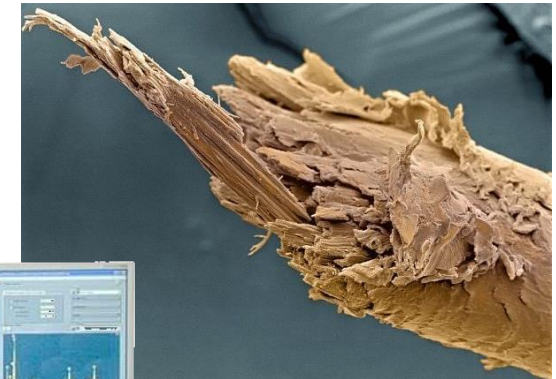
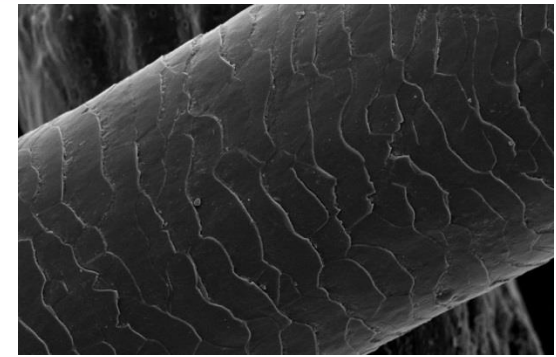
Comparison microscopes are especially important tools to the forensic investigation of hair.



A **fluorescence** microscope is equipped with filters to detect fluoresced light, indicating the presence of a dye or other treatment.



Electron microscopes provide incredible detail of the surface or interior of the sample, magnifying the object 50,000 times or more.

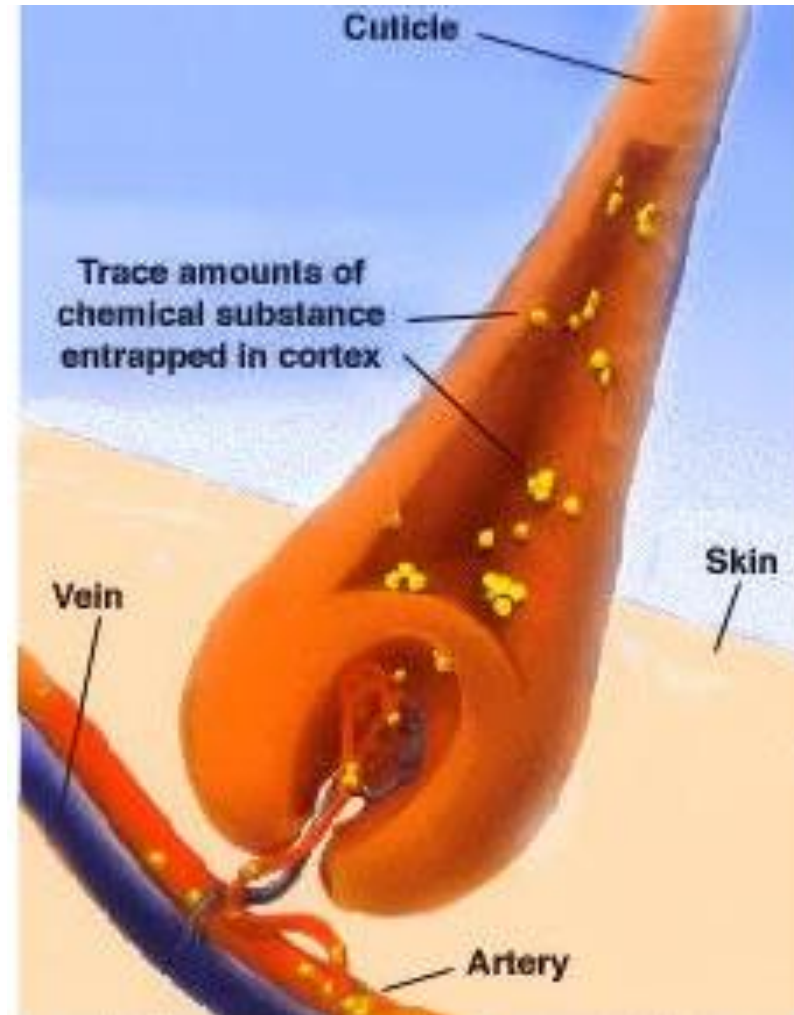


Testing for Substances in the Hair Shaft

Because hair grows out of the skin, chemicals that the skin absorbs and some toxins and drugs which an individual ingests can leave traces in the hair.

In order to test hair, it must first be dissolved in an organic solvent that breaks down the keratin and releases any substances that have been incorporated into the hair.

A forensic chemist can then perform chemical tests for the presence of various substances to provide evidence of poisoning or drug use.

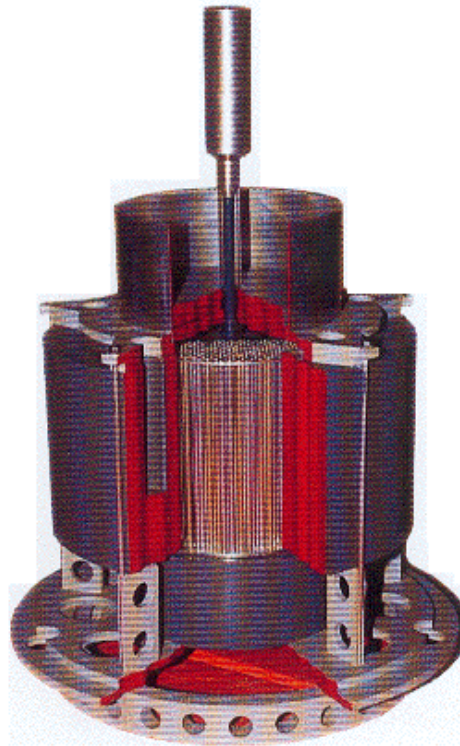




Neutron Activation Analysis (NAA)

A useful technique that can identify up to 14 different elements in a single two-centimeter-long strand of human hair.

The probability of the hairs of two individuals having the same concentration of these different elements is about one in a million.



Testing the Hair Follicle

If hair is forcibly removed from a victim or suspect, the entire hair follicle (called a **follicular tag**) may be present. If so, **blood** and **tissue** attached to the follicle may be analyzed for blood type and **DNA**.



Naturally shed hairs, such as a head hair dislodged through combing, display undamaged, club-shaped roots.



A hair forcibly removed from the scalp will exhibit stretching and damage to the root area.



Forcibly removed hairs may have tissue attached.

