

A vertical, narrow strip of a hair cross-section, showing a central dark core (medulla) surrounded by a lighter, textured cortex. The strip is positioned on the left side of the slide.

Chapter 5: Hair

“For three days after death, hair and fingernails continue to grow but phone calls taper off.”

—Johnny Carson
Comedian and television host



‡ <http://kids.niehs.nih.gov/illusion/illusions.htm>

Hair Analysis

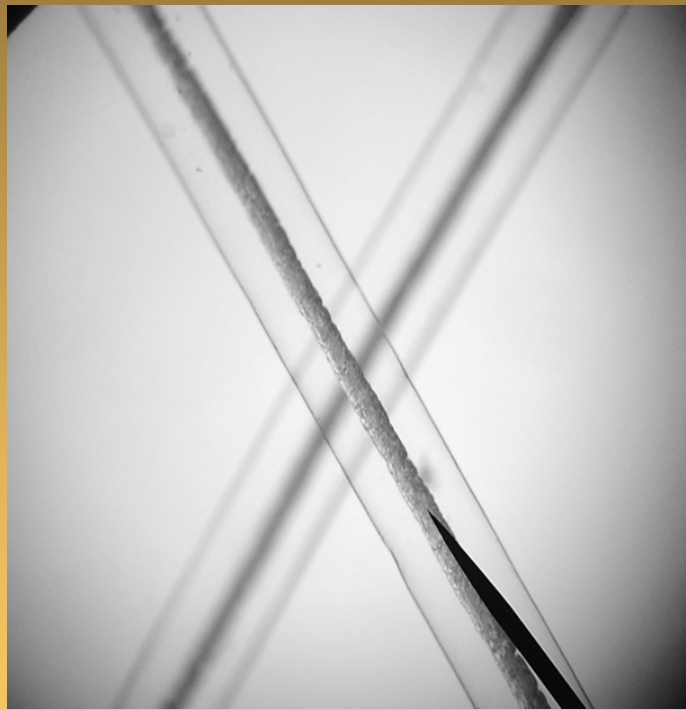
Students will learn:

- hair is class evidence
- hair can be used to back up circumstantial evidence
- hair absorbs and adsorbs substances both from within the body and from the external environment



Hair Analysis

Students will be able to:



- Describe the structure of a hair
- Explain the difference between human and animal hair
- Explain which characteristics of hair are important for forensic analysis
- Assess the probative value of hair samples

A vertical, close-up photograph of a hair cross-section, showing the internal structure of the cortex and medulla. The hair is brown and has a slightly irregular, textured appearance. The background is a light, neutral color.

Introduction

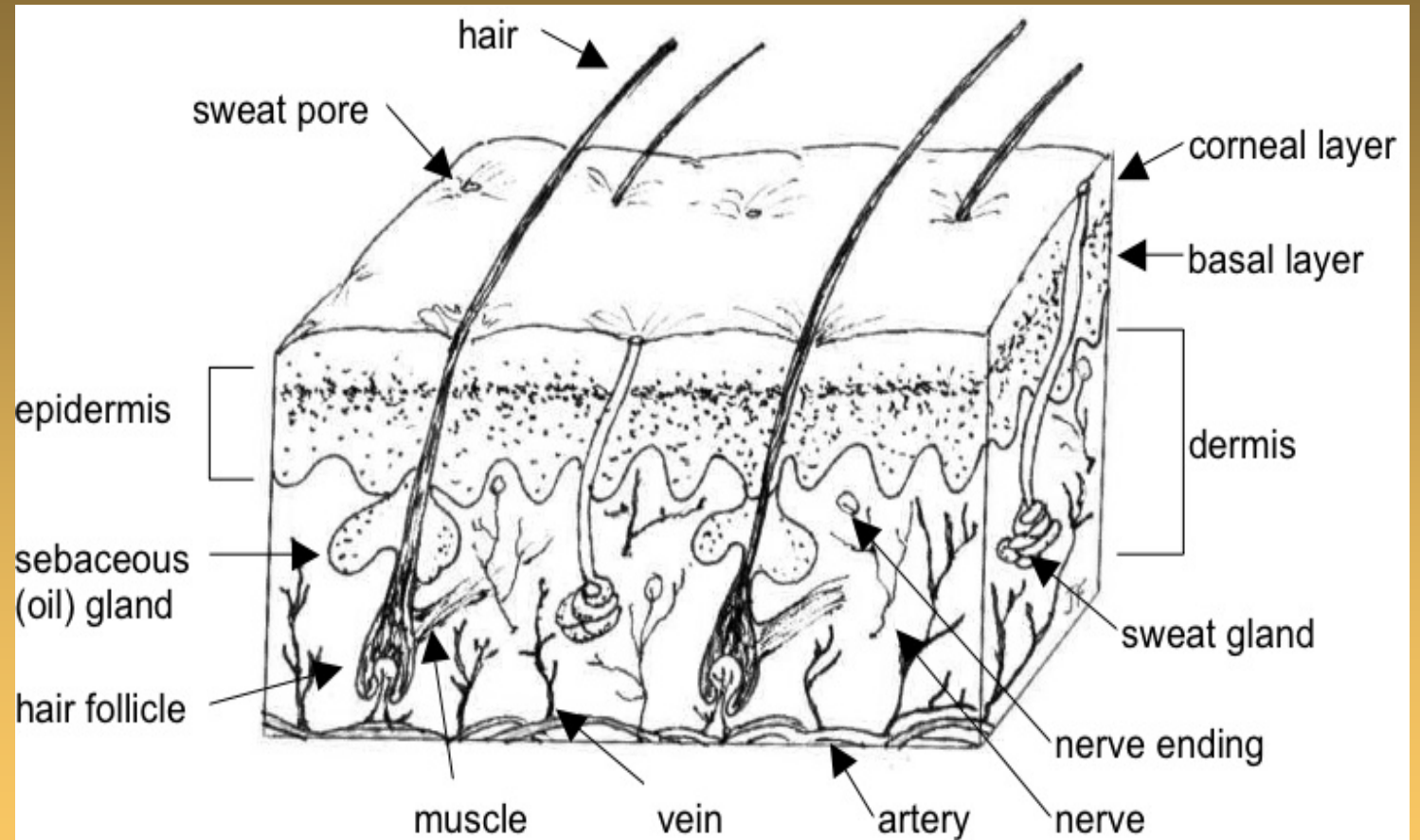
- Human hair is one of the most frequently found pieces of evidence at the scene of a violent crime. It can provide a link between the criminal and the crime.
- From hair one can determine:
 - If the source is human or animal
 - Race (sometimes)
 - Origin of the location on the source's body
 - Whether the hair was forcibly removed
 - If the hair has been treated with chemicals
 - If drugs have been ingested

A vertical, close-up photograph of a hair cross-section, showing a central dark core (medulla) surrounded by a lighter, textured outer layer (cortex).

Hair

- ‡ Hair is considered class evidence for the most part.
- ‡ Hair is often a valuable tool for forensic scientists. Hair is more resistant to decay than most other body tissues and fluids and thus remains intact much longer than other types of evidence. This durability makes hair one of the most frequently found pieces of evidence at crime scenes.

Skin Structure





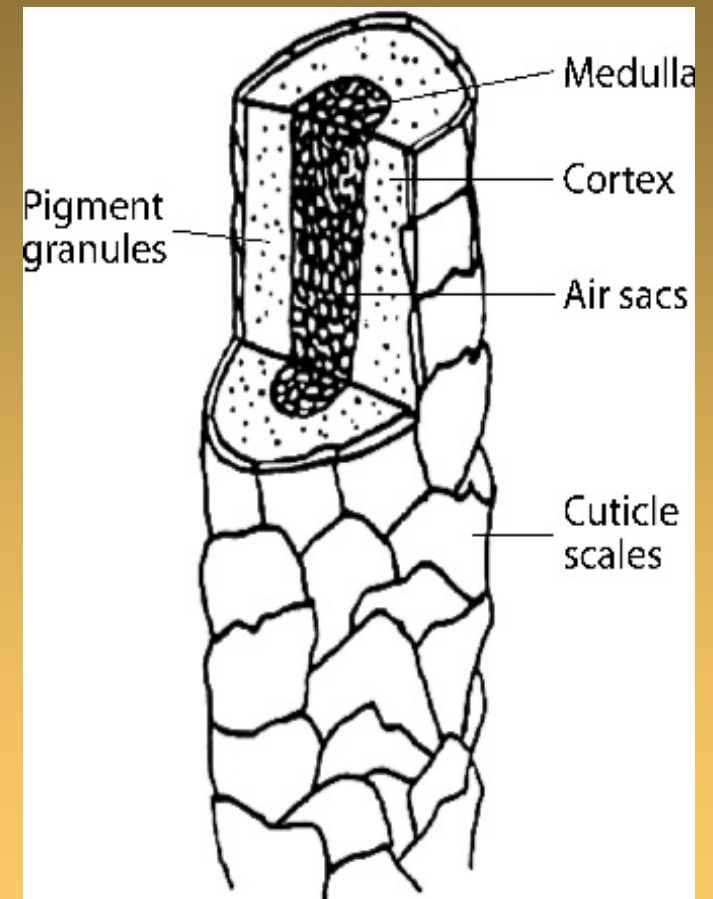
Morphology of Hair

- ± Hair is made up of mostly complex cross linked protein polymers (long chains)
- ± Hair grows from the hair follicle in the under layer of skin (dermis)

Hair Shaft

Composed of:

- **Cuticle**—outside covering, made of overlapping scales
- **Cortex**—inner layer made of keratin and imbedded with pigment; also contains air sacs called cortical fusi
- **Medulla**—inside layer running down the center of the cortex

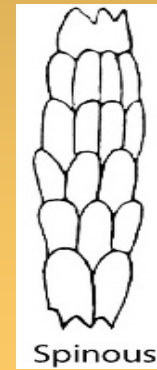
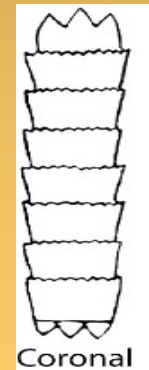


The Cuticle

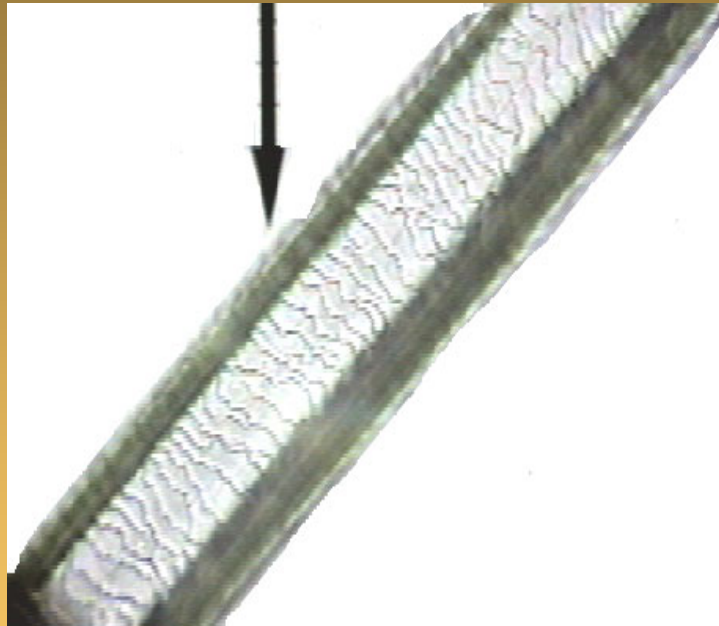
The cuticle is the outermost layer of hair which is covered with scales. The scales point toward the tip of the hair. Scales differ between species of animals and are named based on their appearance.

The three basic patterns are:

- Coronal
- Spinous
- Imbricate



Human Scales



In order to visualize the scales:

- paint clear fingernail polish on a glass slide
- when the polish begins to dry, place a hair on the polish
- when almost dry, lift off the hair and observe the scale imprints

What pattern is seen in this slide?



The Cortex

The cortex gives the hair its shape.

It has two major characteristics:

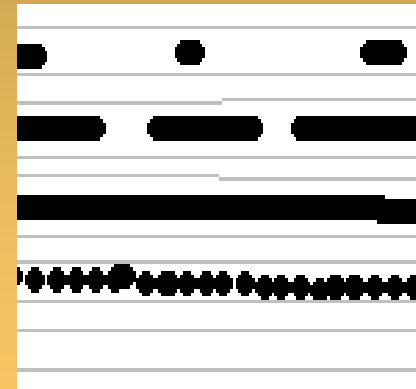
- **Melanin**—pigment granules that give hair its color
- **Cortical fusi**—air spaces, usually found near the root but may be found throughout the hair shaft

The Medulla

The medulla is the hair core that is not always visible. The medulla comes in different types and patterns.

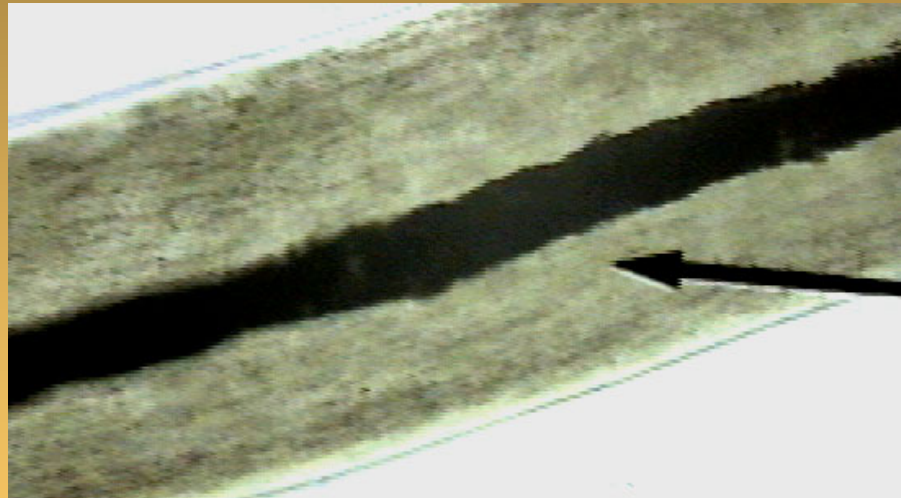
Types:

- Intermittent or interrupted
- Fragmented
- Continuous
- Stacked
- Absent—not present



Human Medulla

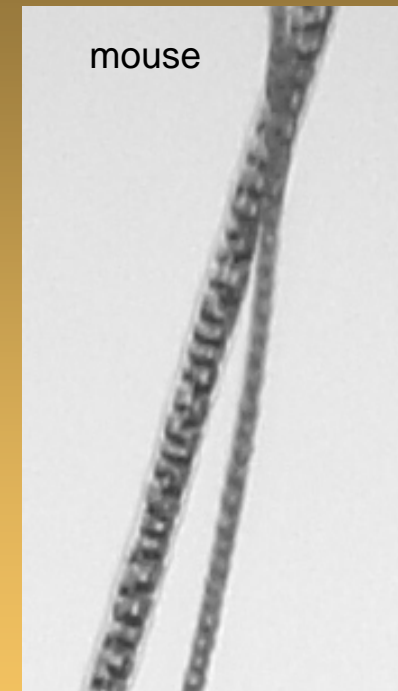
Human medulla may be continuous, fragmented or absent.



Medullary Index

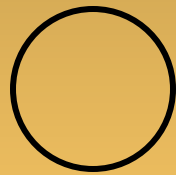
Determined by measuring the diameter of the medulla and dividing it by the diameter of the hair.

- Medullary Index for human hair is generally less than $1/3$.
- For animal hair, it is usually greater than $1/2$.



Hair Shape

Can be straight, curly or kinky depending on the cross-section, which may be round, oval or crescent-shaped



Round
(Straight)



Oval
(Curly)



Crescent moon
(Kinky)

Undulation

‡ Slight waviness

‡ Undulated



‡ Twisted





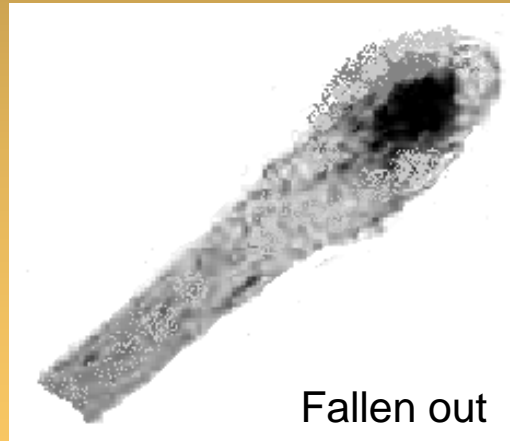
Hair Growth

- **Terminology**

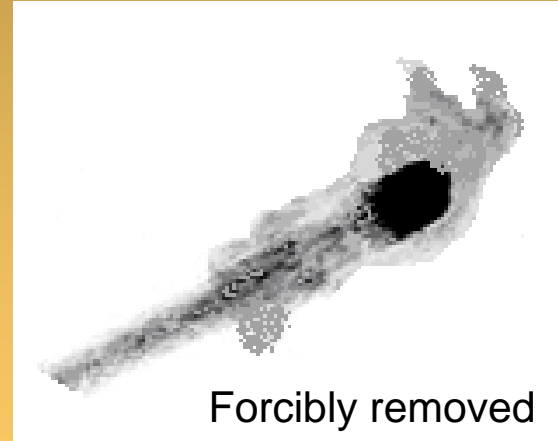
- **Anagen**—hair that is actively growing; lasting up to 5 years
 - **Catagen**—hair is not growing; a resting phase
 - **Telogen**—hair that is dying and ready to fall out; lasting two to six months
- Grows about 0.5 mm per day or 1 centimeter per month; approximately one half inch per month

The Root

Human roots **look** different based on whether they have been forcibly removed or if they are telogen hairs and have fallen out. Animal roots will vary, but in general have a spear shape.



Fallen out



Forcibly removed

Hair Comparison

- Color
- Length
- Diameter
- Distribution, shape and color intensity of pigment granules
 - Dyed hair has color in cuticle and cortex
 - Bleaching removes pigment and gives a yellow tint
- Scale types
- Presence or absence of medulla
- Medullary type
- Medullary pattern
- Medullary index

A vertical, close-up photograph of a hair cross-section. The hair shaft is dark brown and shows a central medulla surrounded by a cortex. The root is visible at the top, showing the papilla and surrounding follicular tissue.

DNA from Hair

- The root contains nuclear DNA. If the hair has been forcibly removed, some follicular tissue may be attached containing DNA.
- The hair shaft contains abundant mitochondrial DNA, inherited only from the mother. It can be typed by comparing relatives if no DNA from the body is available. This process is more difficult and costly than using nuclear DNA.

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Collection of Hair

- Questioned hairs must be accompanied by an adequate number of control samples.
 - from victim
 - from possible suspects
 - from others who may have deposited hair at the scene
- Control Sample
 - 50 full-length hairs from all areas of scalp
 - 24 full-length pubic hairs



Hair Toxicology

- Advantages:
 - Easy to collect and store
 - Is externally available
 - Can provide information on the individual's history of drug use or of poisoning.
- Collections must be taken from different locations on the body to get an accurate timeline.

Hair Toxicology



- Napoleon died in exile in 1821. By analyzing his hair, some investigators suggest he was poisoned by the deliberate administration of arsenic; others suggest that it was vapors from the dyes in the wallpaper that did him in.



More about Hair

For additional information about hair and other trace evidence, check out Court TV's Crime Library at:

www.crimelibrary.com/criminal_mind/forensics/trace/1.html