Chapter 5 Hair
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
Skin Structure

- Skin surface
- Hair shaft
- Sebaceous gland
- Meissner's corpuscle (touch receptor)
- Dermal papilla
- Free nerve ending (pain receptor)
- Epidermis
- Dermis
- Subcutaneous layer
- Sweat gland
- Artery
- Vein
- Nerve
- Hair follicle
- Arrector pili muscle
- Adipose tissue (fat)
**Hair Shaft**

*Composed of:*

- **Cuticle**—outside covering, made of overlapping scales

- **Cortex**—inner layer made of keratin and embedded 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 among species of animals and are named based on their appearance.

*The three basic patterns are:*

- **Coronal**
- **Spinous**
- **Imbricate**
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 it is 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 fusii**—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)
Hair Growth

**Terminology**

- **Anagen**—hair is actively growing; lasts up to 5 years
- **Catagen**—hair is not growing; a resting phase
- **Telogen**—follicle is getting ready to push the hair out; lasts two to six months

Grows about 0.4 mm per day, or 1 cm per month; approximately one-half inch per month
The Root

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

• The body area from which a hair originated can be determined by general morphology. Length, shape, size, color, stiffness, curliness, and microscopic appearance all contribute to the determination of body area.
Head Hairs

Typically longer than other hairs.

Uniform diameter

Often have cut tip

Razor cut Hair

A Split Hair

A hair with a cut tip
Pubic hair

- Pubic hairs are generally coarse and wiry in appearance. They exhibit considerable diameter variation or buckling and often have a continuous to discontinuous medulla.
Facial and Limb Hair

- Facial hairs are more commonly called beard hairs or mustache hairs. These hairs are coarse in appearance and can have a triangular cross section. Heavy shouldering or troughs in the hair are observed under magnification.

- Hairs from the legs and arms constitute limb hairs. These hairs are shorter in length, arc-like in shape, and often abraded or tapered at the tips. The pigment in limb hair is generally granular in appearance, and the medulla is trace to discontinuous.
DNA from Hair

The root contains nuclear DNA. If the hair has been forcibly removed, some follicular tissue containing DNA may be attached.

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 more costly than using nuclear DNA.

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 evidence of poisoning

Collections must be taken from different locations on the body to get an accurate timeline.
Hair Toxicology, continued

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 killed him.