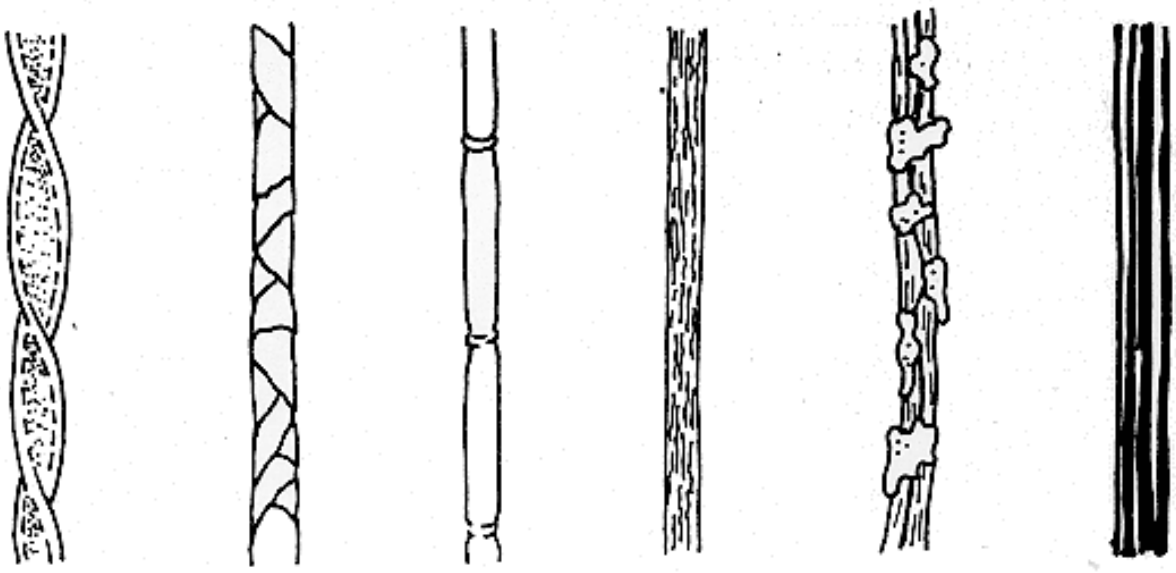
Name: _____ Per: _____ Date: _____

Unit 5: Hair Analysis



By the end of this unit, you will be able to:

- ✓ Identify the various parts of a hair
- ✓ Describe variations in the structure of the medulla, cortex, and cuticle
- ✓ Distinguish between human and non-human hair
- ✓ Determine of two samples of hair are from the same person
- ✓ Explain how hair can be used in a forensic investigation
- ✓ Calculate the medullary index for a hair.

Unit Vocabulary

- Cuticle:
  _____
- Cortex:
  _____
- Medulla:
  _____
- Keratin:
  _____
- Cortical fusi:
  _____
- Micrometer (μm)
  _____
- Anagen phase:
  _____
- Catagen phase:
  _____
- Telogen phase:
  _____
- Melanin:
  _____

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Introduction

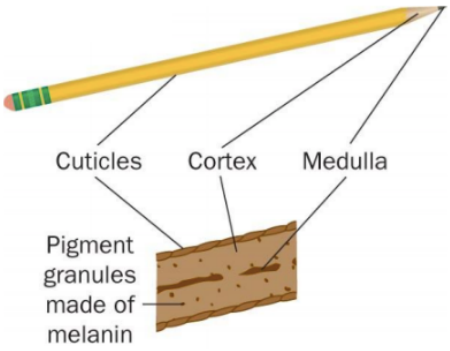
- Careful _____ of hair can provide important clues in an investigation.
- Hair is considered _____ unless the follicle cells are attached.
- If the _____ is attached it can be considered _____ evidence because _____ evidence may be obtained.

Function of Hair

- Hair has _____ for mammals, including humans, who have hair.
    - Regulates _____
        - Hair stands upright when cold to trap warm air underneath
    - _____ against sunlight

Structure of Hair

- All hair has the same _____ structure
- The internal structure of a hair can be compared to that of a graphite _____
- A follicle embedded in the skin produced the hair shaft, which is made of _____
- Three layers
    - The inner _____
    - The _____
    - The outer _____



Types of Cuticle and Cortex

- Cuticle:
    - The _____
    - Over-lapping _____ that protect the inner layers
    - Can have _____ depending upon the species of the mammal
    - Scales point from the scalp to the end, which helps determine _____ and older hair
- Cortex:
    - _____
    - Contains most of the pigment
    - Distribution of _____ varies
    - Usually denser nearer the cuticle

Types of 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	

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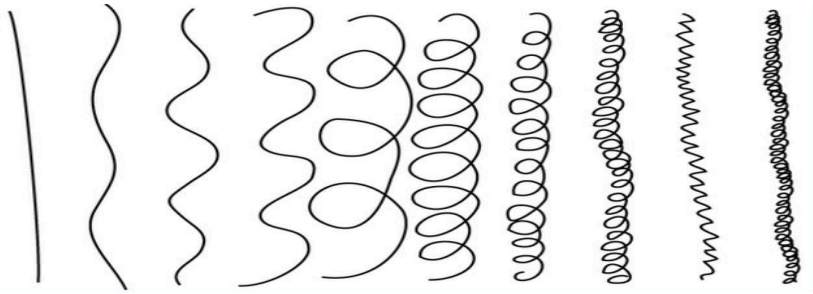
Types of Hair



- Hair can vary in:
  - _____
  - Length
  - Diameter
  - Texture
  - _____
- A _____ _____ can be circular, _____, irregular, or flattened
- The shape influences the curl of the hair
- Texture: coarse or fine

Hair from Different Parts of the Body

- Human hair varies on the body
  - Head Hair
  - Eyebrows and Eyelashes
  - _____ and _____ Hair
  - Underarm Hair
  - _____ _____ (Auxiliary Hair)
  - Pubic Hair

The Life Cycle of Hair

- Hair proceeds through 3 stages as it develops:
- Anagen stage: (80-90% of hair)
  - _____ _____ _____
  - cells around the follicle rapidly divide and deposit materials in the hair
- Catagen stage: (2% of hair)
  - hair grows and changes (perhaps turning gray)
- Telogen stage: (10 – 18% of hair)
  - _____ _____ _____; hairs are easily lost

Treated Hair

- When a person chemically treats his or her hair, traces of the _____ used _____.
- Also creates subtle changes that can be detected only by using a _____.
- Bleaching
  - disturbs the scales on the cuticle
  - removes pigment
  - leaves hair brittle and yellowish
- Dyeing colors the _____ and the _____

Racial Differences

- Broad _____ categorization can be made by identifying certain _____ of hair.
- These characteristics may NOT be applicable to _____ individuals in these groups.
- Therefore, _____ hairs CANNOT be assigned to any of these groups

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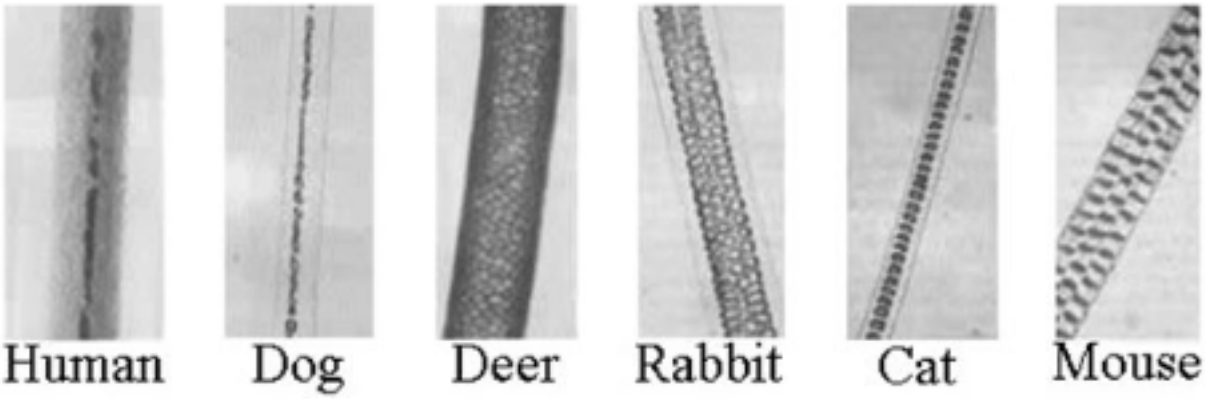
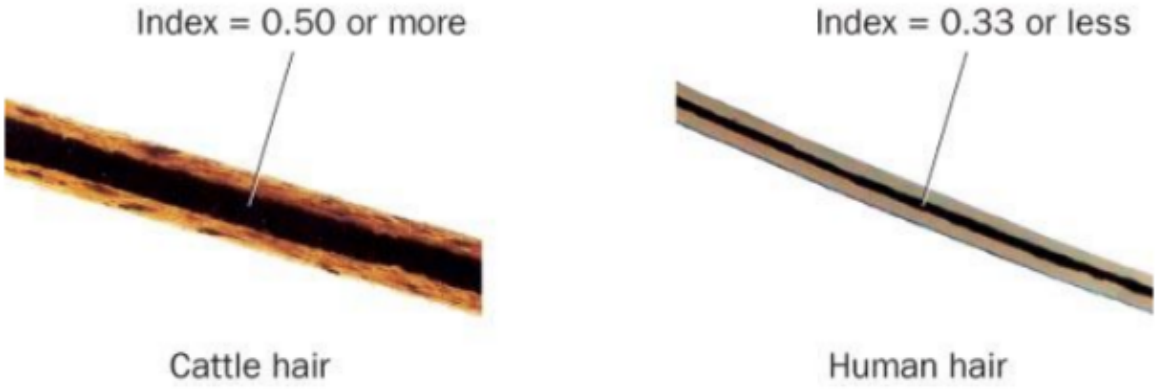
Animal Hair and Human Hair

- Pigmentation:
  - animal hair is denser toward the _____
  - human hair tends to be denser toward the _____
- Banded Color Patterns:
  - _____ in animals
  - not in humans
- Medulla: much thicker in animals



Medulla Index - Animals vs. Humans



- See separate handout for practice calculating the medulla index.

Animal Hair and Human Hair

- Animals: cuticle scales resemble _____ (spinous) or a stack of _____ (coronal)
- Humans: commonly flattened and narrow (_____)

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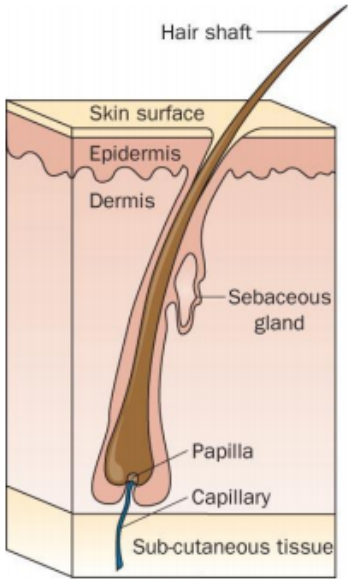
Using Hair in an Investigation

- Investigators often make observations about the macroscopic and microscopic features of a hair
- Microscopy
  - _____ (especially comparison microscopes) are important tools to the forensic investigation of hair.
  - Different kinds of microscopes provide different kinds of _____.

Testing for Substances in the Hair Shaft

- Some _____ and _____ which an individual has _____ leave traces in the hair.
- Chemical _____ determine presence of various substances
- Examining a hair shaft
  - Investigators can calculate the _____ during which a person was taking drugs or ingesting other toxins.
- Neutron Activation Analysis (NAA)
  - Determines the concentrations of 9 different _____
  - Probability of two individuals having the same concentration is about one in a million

Testing the Hair Follicle



- Microscopic assessment
  - _____
- Blood test
  - Determine blood type
- DNA analysis
  - Identification with a high degree of _____

Root

- The _____ and other surrounding cells in the hair follicle provide the tools necessary to produce hair and continue its _____.
- When pulled from the head, some _____ _____ surrounding the hair's shaft near the root may be found. This is called a _____ _____.
- By using DNA analysis on the follicular tag, the hair may be individualized.

Comparing Strands

- The comparison microscope is an indispensable tool for comparing the _____ (appearance/shape)_____ of hair.
- The criminalist is particularly interested in _____ the color, length, and diameter.
- Microscopic examination will reveal features that can distinguish _____ hair from the hair of _____.

- Scale structure, medullary index, and medullary shape are particularly important in animal hair identification.
- Other important features for comparing human hair are:
  - the presence or _____ of a medulla.
  - the distribution, shape, and color intensity of the pigment granules present in the cortex.
- The most common request is to determine whether or not hair _____ at the crime scene _____ to hair removed from the _____.
- However, microscopic hair examinations tend to be _____ and highly dependent on the skills and integrity of the analyst.

Hair and DNA

- Recent major breakthroughs in DNA profiling have extended this technology to the _____ of human hair.
- The probability of detecting _____ in hair roots is more likely for hair being examined in its _____ or early growth phase as opposed to its catagen (middle) or telogen (final) phases.
- The follicular tag has proven to be a rich source of _____ _____associated with hair.

Hair and Mitochondrial DNA

- _____ DNA can be extracted from the hair _____.
- Mitochondrial DNA is found in cellular material located outside of the nucleus and it is transmitted only from the _____ to child.
- As a rule, all positive microscopic hair comparisons must be _____ _____ _____ analysis.

Collection and Preservation

- As a general rule, forensic hair comparisons involve either head hair or pubic hair.
- The collection of _____ full-length hairs from all areas of the _____ will normally ensure a representative sampling of head hair.
- A minimum collection of _____ full-length _____ hairs should cover the range of characteristics present in pubic hair.
- Hair samples are also collected from the victim of _____ deaths during an _____.

Microscopic Assessmentp