



# Hairs & Fibers

Forensic Science

# Biology of Hair

Hair is composed of the protein **keratin**, which is also the primary component of finger and toe **nails**.

Hair is produced from a structure called the hair **follicle**. Humans develop hair follicles during **fetal** development, and no new follicles are produced after birth.

Hair color is mostly the result of **pigments**, which are chemical compounds that reflect certain wavelengths of visible light.

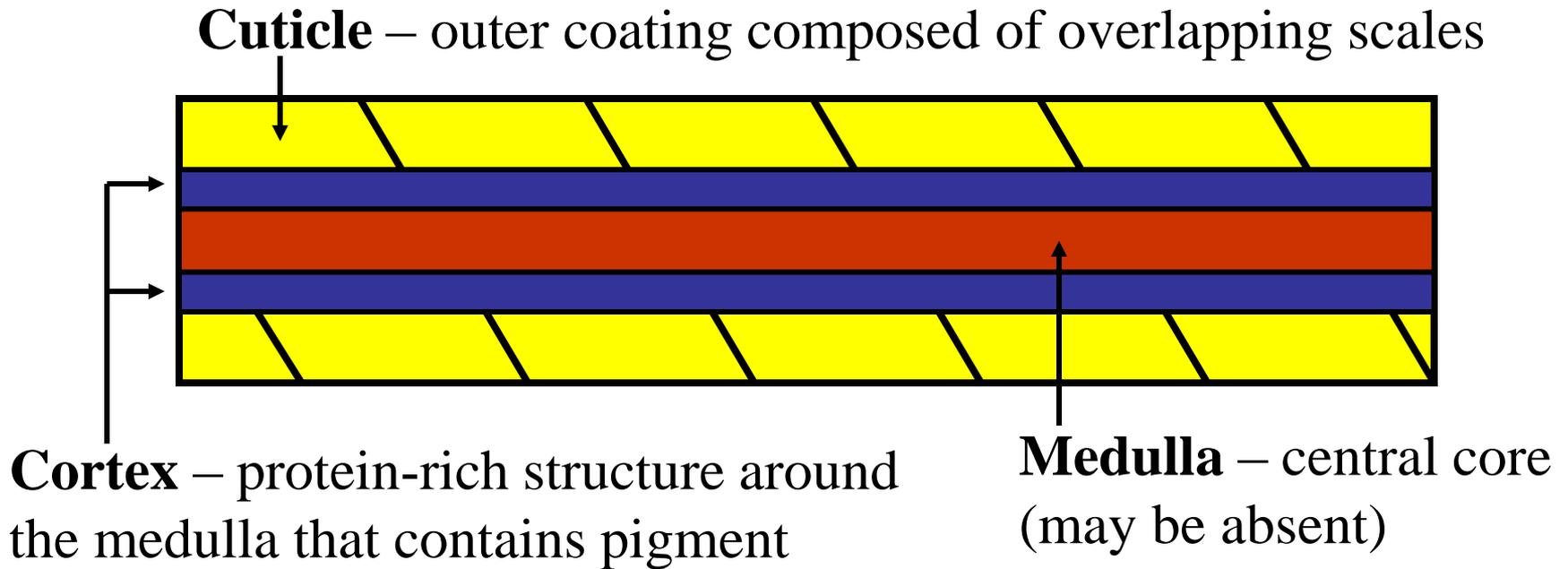
Hair **shape** (round or oval) and **texture** (curly or straight) is influenced heavily by **genes**. The physical appearance of hair can be affected by **nutritional** status and intentional **alteration** (heat curling, perms, straightening, etc.).

The **body area** (head, arm, leg, back, etc.) from which a hair originated can be determined by the sample's length, shape, size, color, and other physical characteristics.

In order to test hair evidence for nuclear DNA, the **root** must be present. The hair may also be tested using mitochondrial DNA whether or not the root is present.

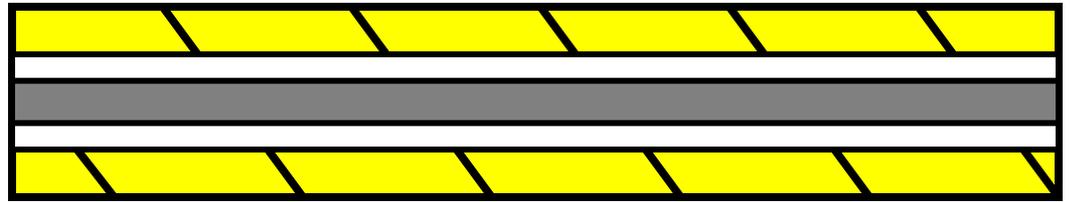
# Hair Structure

**Hair is composed of three principal parts:**



The structure of hair has been compared to that of a **pencil** with the medulla being the **lead**, the cortex being the **wood** and the cuticle being the **paint** on the outside.

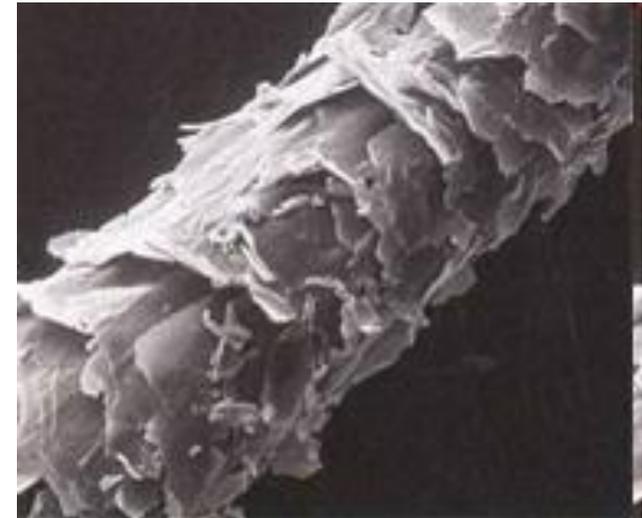
# Hair Structure



## Cuticle

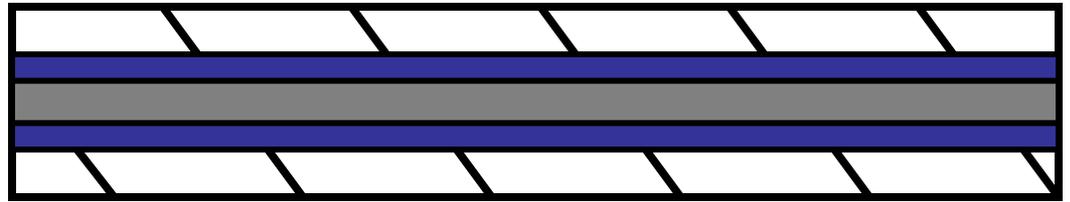
The cuticle varies in:

- Its **scales**,
  - How many there are per centimeter,
  - How much they overlap,
  - Their overall shape, and
  - How much they protrude from the surface
- Its **thickness**, and
- Whether or not it contains **pigment**.



Characteristics of the cuticle may be important in distinguishing between hairs of different **species** but are often not useful in distinguishing between different **people**.

# Hair Structure



## Cortex

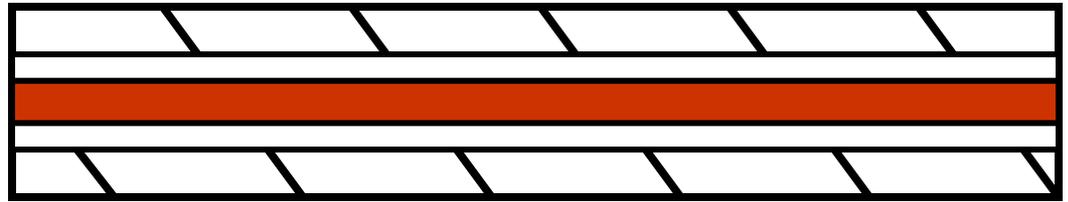
The cortex varies in:

- **Thickness**
- **Texture**
- **Color**



- Distribution of the cortex is perhaps the most important component in determining from which individual a **human** hair may have come.
- Microscopic examination can also reveal the condition and shape of the **root** and **tip**.

# Hair Structure



## Medulla

The medulla may vary in:

- **Thickness**
  - **Continuity** - one continuous structure or broken into pieces
  - **Opacity** - how much light is able to pass through it
- 
- It may also be **absent** in some species.

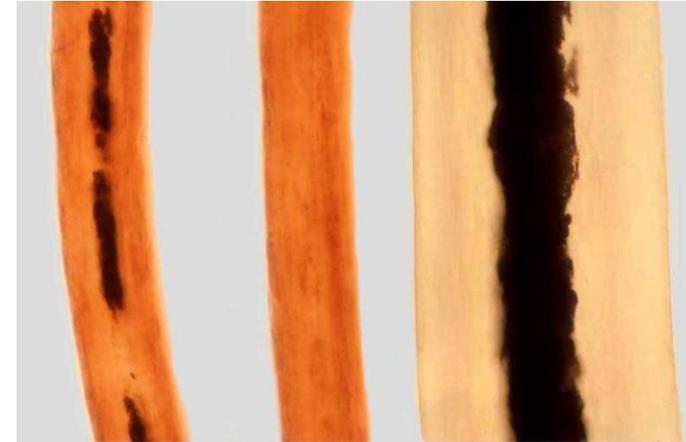


Figure 3. Light micrographs of three human hairs. The left example illustrates dark hair with a typical fragmentary medulla. The middle hair is blond and has no medulla. The right coarser hair is white with a continuous medulla.



Like the cuticle, the medulla can be important for distinguishing between hairs of different **species**, but often does not lend much important information to the differentiation between hairs from different **people**.

# Fiber Evidence

A **fiber** is the smallest unit of a textile material that has a **length** many times greater than its **diameter**. A fiber can be spun with other fibers to form a **yarn** that can be woven or knitted to form a fabric.

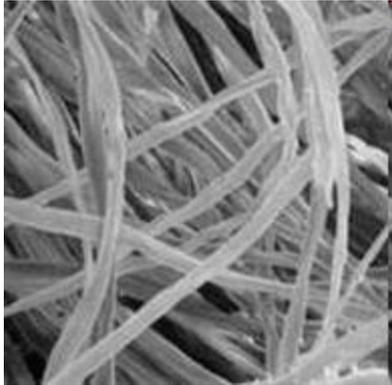
The **type** and length of fiber used, the type of **spinning** method, and the type of **fabric** construction all affect the transfer of fibers and the significance of fiber associations. This becomes very important when there is a possibility of fiber **transfer** between a suspect and a victim during the commission of a crime.

Matching **unique** fibers on the clothing of a victim to fibers on a suspect's clothing can be very helpful to an investigation, whereas the matching of **common** fibers such as white cotton or blue denim fibers would be less helpful.

The discovery of **cross transfers** and multiple fiber transfers between the suspect's clothing and the victim's clothing dramatically **increases** the likelihood that these two individuals had physical contact.

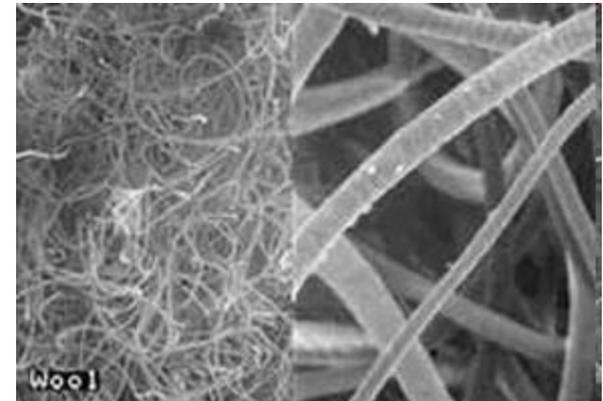
# Natural Fibers

Many different **natural** fibers that come from plants and animals are used in the production of fabric.



← **Cotton** fibers are the plant fibers most commonly used in textile materials

→ The animal fiber most frequently used in the production of textile materials is **wool**, and the most common wool fibers originate from sheep.

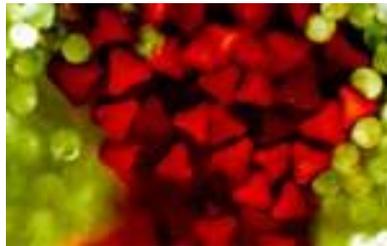


# Synthetic Fibers

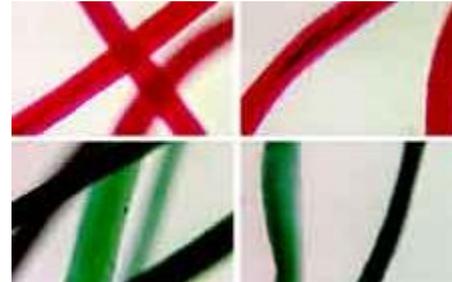


More than half of all fibers used in the production of textile materials are synthetic or **man-made**.

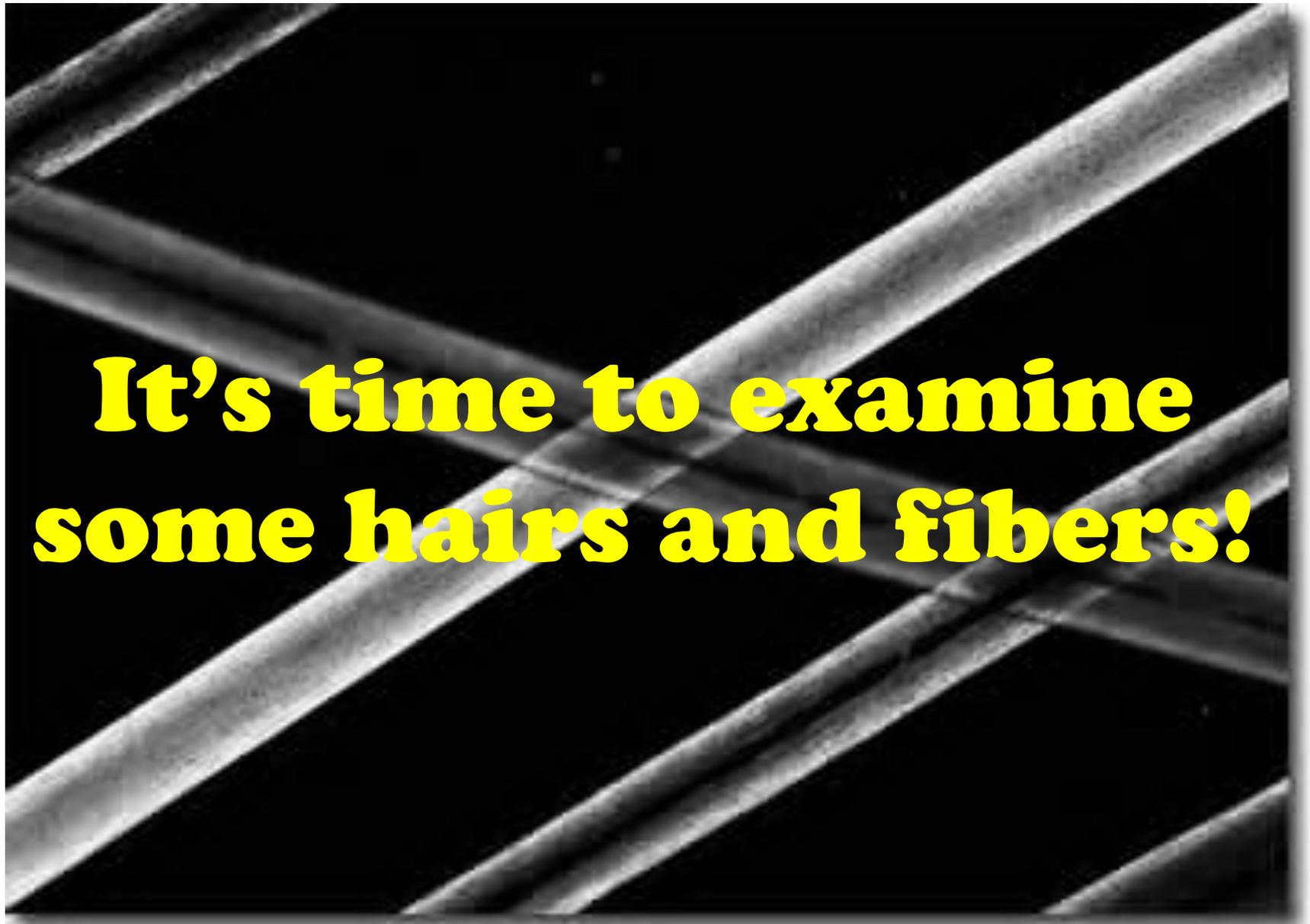
Nylon, rayon, and polyester are all examples of **synthetic** fibers.



Cross-section of a man-made fiber



Fibers under a microscope



**It's time to examine  
some hairs and fibers!**

# Hair & Fiber Identification Lab

## Directions:

Your team will need to use a microscope to document all the hairs and fibers in your set.

Write the name of the hair or fiber on the line and then draw what you see under medium or high power. Be sure to indicate the power of magnification!

Add a description that highlights the unique characteristics of each hair and fiber sample.

Pay attention to details to help you identify samples during the Hair & Fiber Challenge activity.

Hair and Fiber Samples Name \_\_\_\_\_

Part 1: Use a microscope to examine the HAIR samples provided by your teacher. Sketch the view under MEDIUM POWER and write a DESCRIPTION that would help you identify the sample, such as unique marks or other details.

Power = ___ X Description:	Power = ___ X Description:	Power = ___ X Description:
Power = ___ X Description:	Power = ___ X Description:	Power = ___ X Description:
Power = ___ X Description:	Power = ___ X Description:	Power = ___ X Description:

Part 2: Use a microscope to examine the FIBER samples provided by your teacher. Sketch the view under MEDIUM POWER and write a DESCRIPTION that would help you identify the sample, such as unique marks or other details.

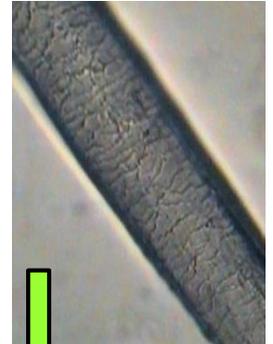
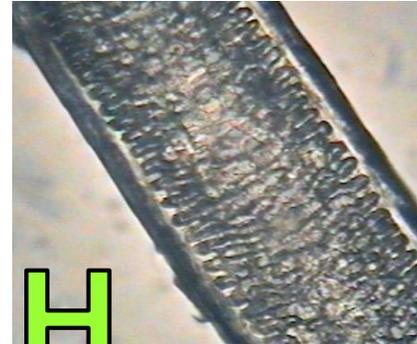
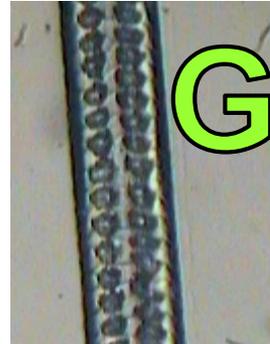
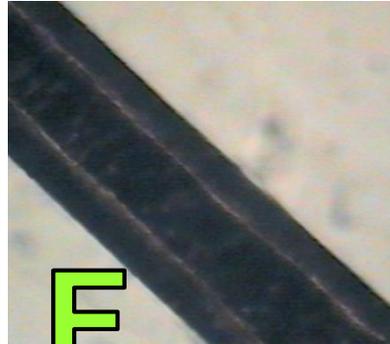
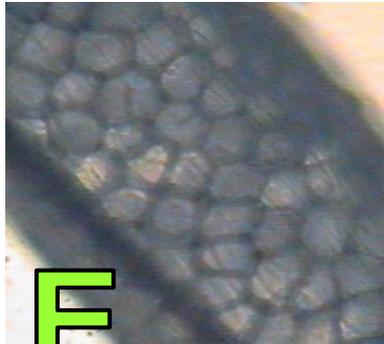
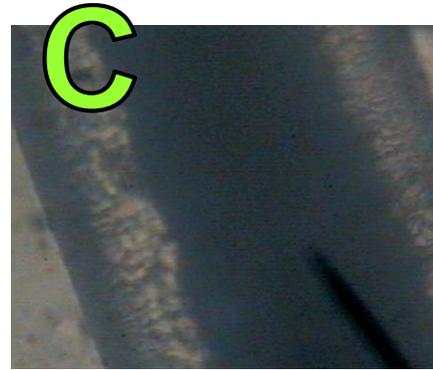
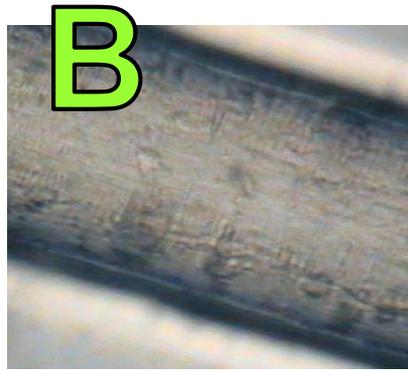
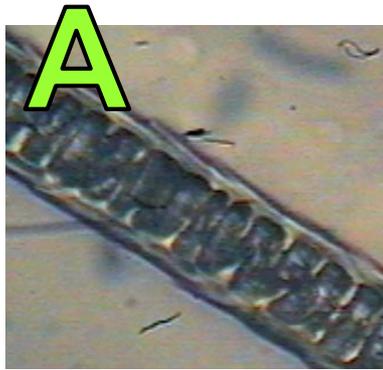
Power = ___ X Description:	Power = ___ X Description:	Power = ___ X Description:
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Part 3: Try to identify the HAIRS & FIBERS on the practice slides. Write your guesses in the space below.

#1 _____	#7 _____
#2 _____	#8 _____
#3 _____	#9 _____
#4 _____	#10 _____
#5 _____	#11 _____ d
#6 _____	#12 _____ d

T. Tringale 2006 <http://sciencepot.net/>

# Can you identify the animal hairs shown?

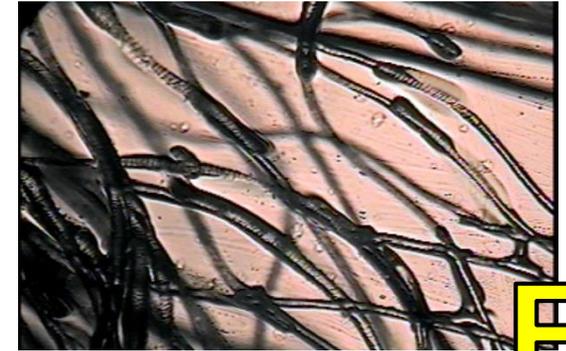
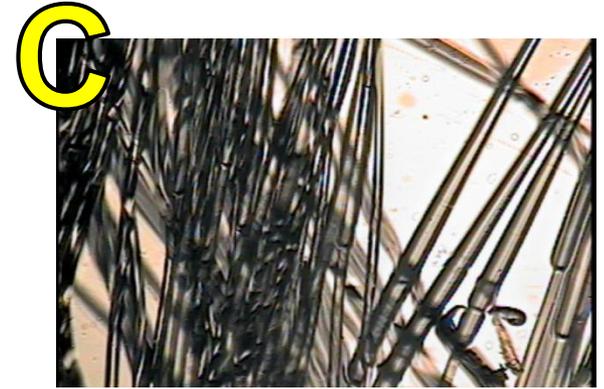
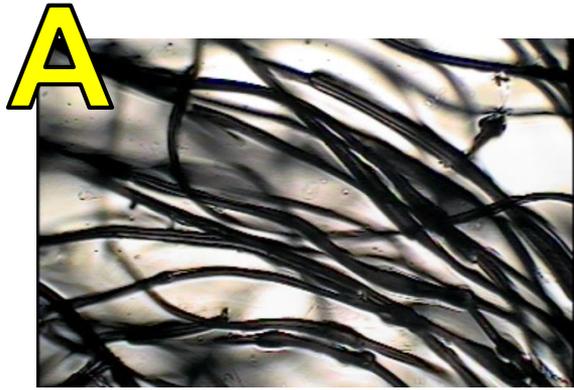


## Think About It ...

- (1) In which samples are we viewing the cuticle? How do they compare?
- (2) In which samples are we viewing the medulla? How do they compare?
- (3) What characteristics can be used to identify hair samples?



# Can you identify the types of fibers shown?



## Think About It ...

- (1) Which samples are natural fibers?
- (2) Which samples are synthetic fibers?
- (3) What characteristics can be used to identify fiber samples?



A black and white micrograph showing several human hair fibers. The fibers are oriented in various directions, creating a complex pattern of light and dark bands. The text "Answer Keys" is overlaid in a large, bold, yellow font in the center of the image.

# Answer Keys

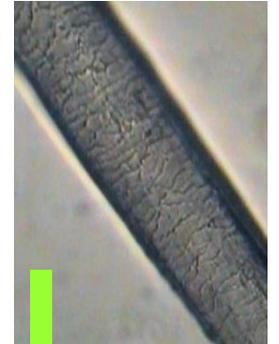
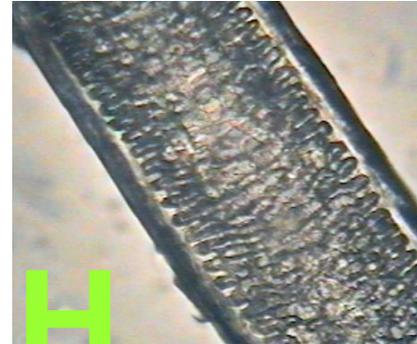
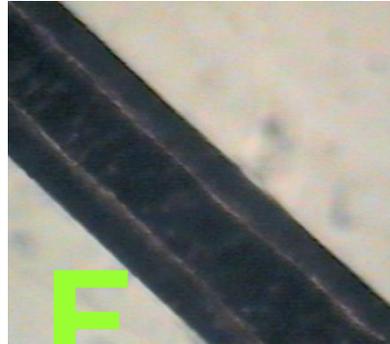
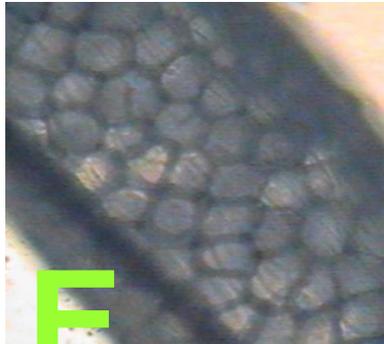
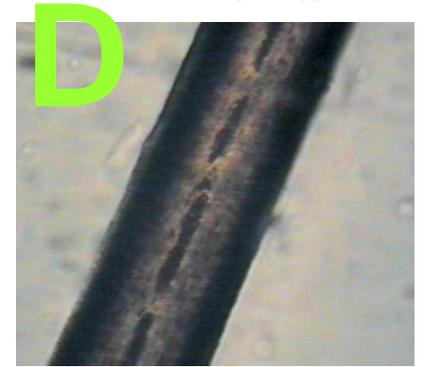
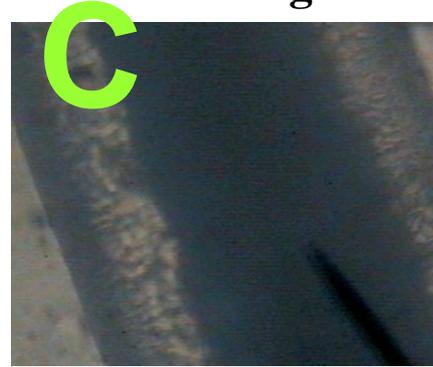
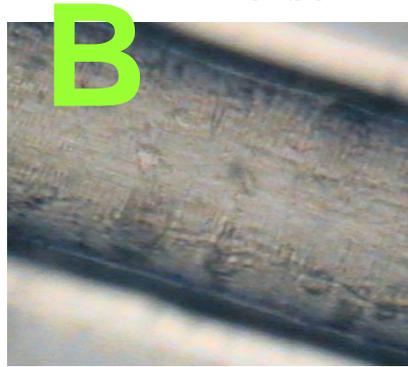
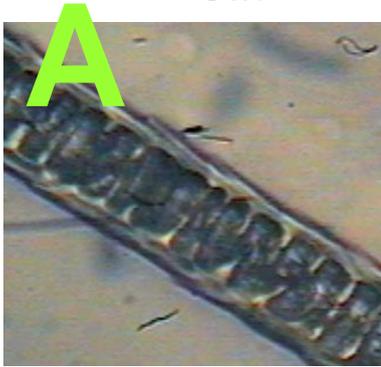
# Types of Animal Hairs - Key

Cat

Horse

Pig

Human



Deer

Dog

Rabbit

Rat

Human

# Types of Fibers - Key

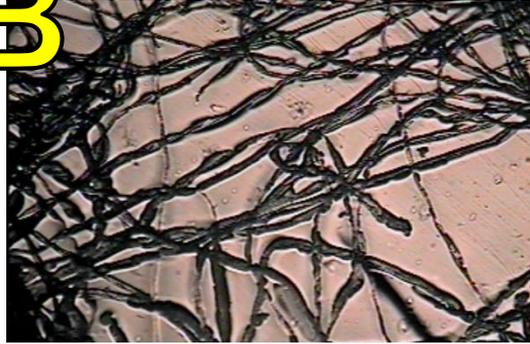
**A**

Acrylic Yarn



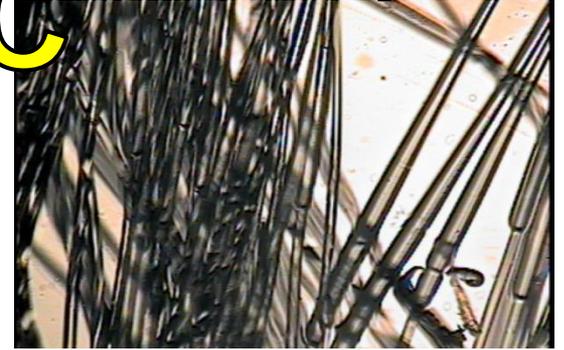
**B**

Cotton Yarn



**C**

Nylon Rope



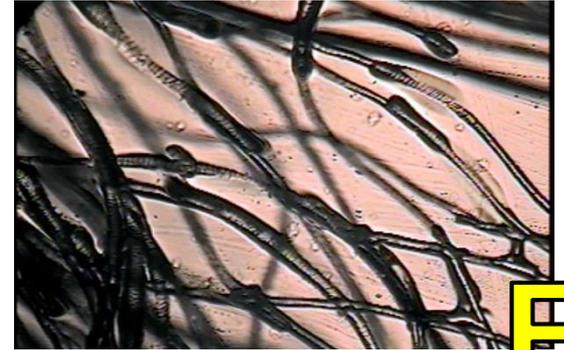
**D**

Polyester Yarn



**E**

Rayon Rope



**F**

Wool Yarn