Hairs & Fibers

Forensic Science

http://media.popularmechanics.com/images/PMX0706FORENSICSHairSmall.jpg

Presentation developed by T. Trimpe 2006 http://sciencespot.net/

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.

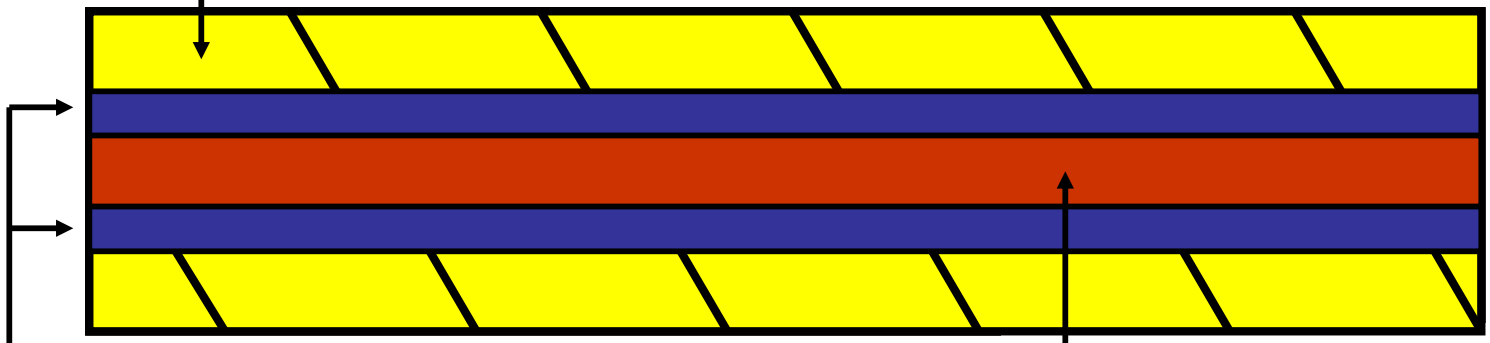
In order to test hair evidence for DNA, the **root** must be present.

Sources: http://library.thinkquest.org/04oct/00206/lesson.htm#t_hair &
http://www.fbi.gov/hq/lab/fsc/backissu/july2000/deedric1.htm#Index%20(Hairs)

Hair Structure

Hair is composed of three principal parts:

Cuticle – outer coating composed of overlapping scales



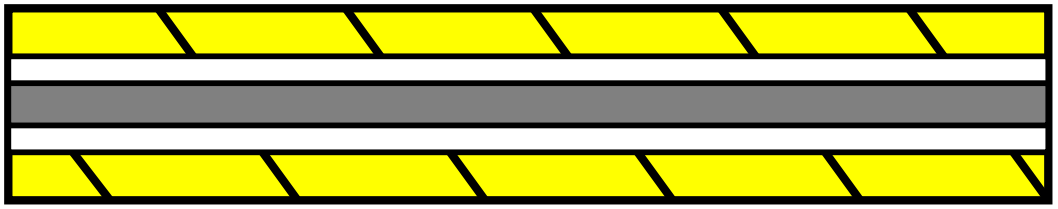
Cortex – protein-rich structure around the medulla that contains pigment

Medulla – central core (may be absent)

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.

http://library.thinkquest.org/04oct/00206/lesson.htm

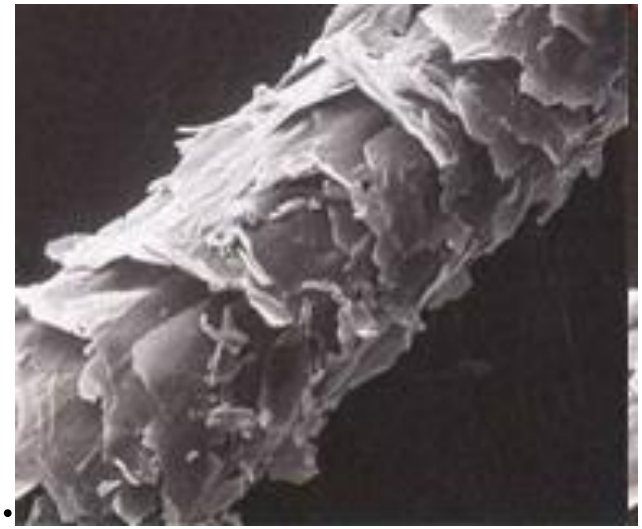
Hair Structure



Cuticle

The cuticle varies in:

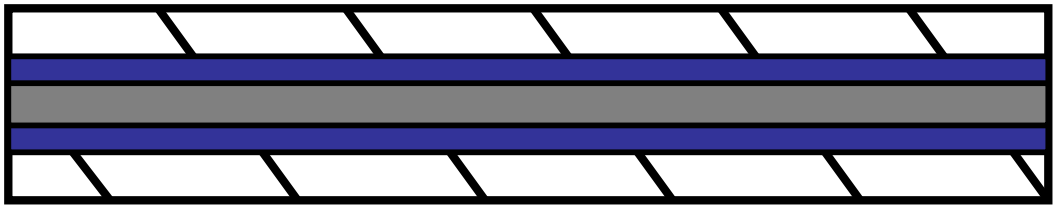
- Its **scales**,
  - How many there are per centimeter,
  - How much they overlap,
  - Their overall shape, and
  - How much they protrude from the surface
- Its **thickness**, and
- Whether or not it contains **pigment**.



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

Info: http://library.thinkquest.org/04oct/00206/lesson.htm#t_hair
Image: http://www.hairdressersus.com/micro/Image5b.jpg

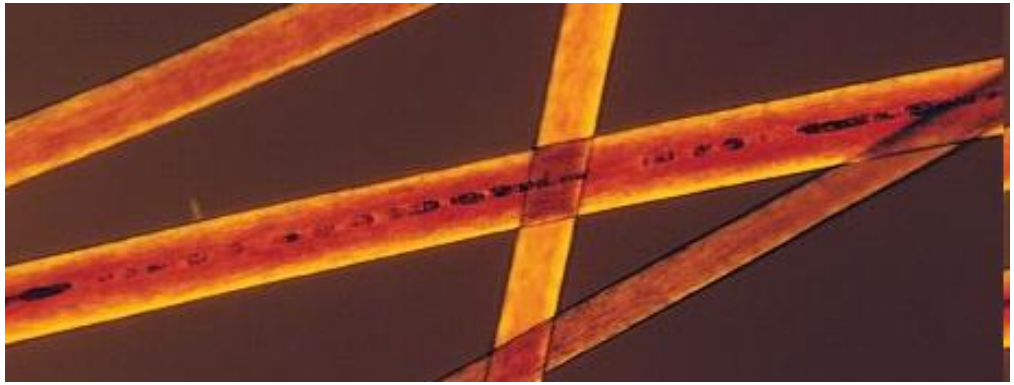
Hair Structure



Cortex

The cortex varies in:

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



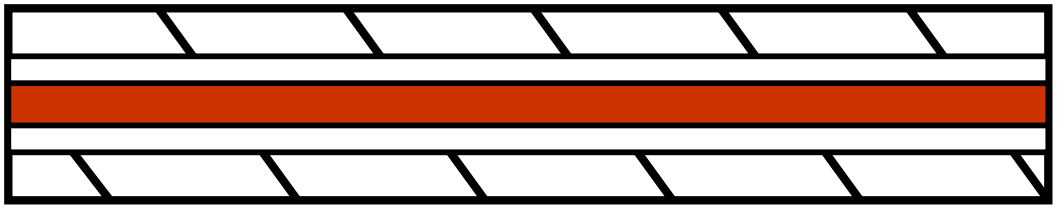
• Distribution of the cortex is perhaps the <u>most important component in determining from which individual a **human** hair may have come</u>.

• Microscopic examination can also reveal the condition and shape of the **root** and **tip**.

Info: http://library.thinkquest.org/04oct/00206/lesson.htm#t_hair

Image:

Hair Structure



Medulla

The medulla may vary in:

- **Thickness**
- **Continuity** - one continuous structu
  or broken into pieces
- **Opacity** - how much light is able to
  pass through it

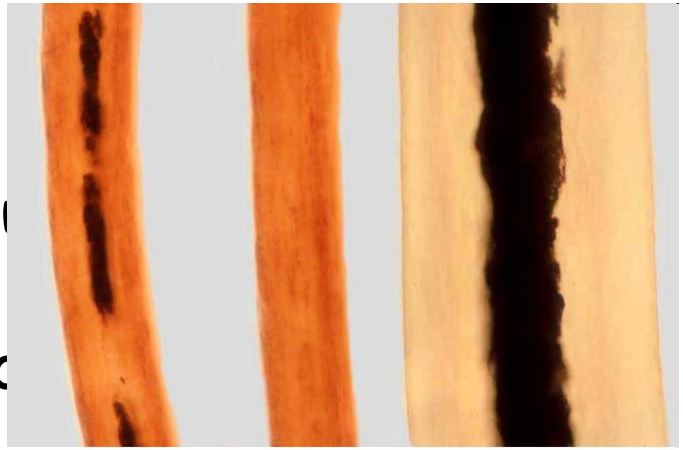


Figure 3. Light micrographs of three human hairs. The left example illustrates dark hair with a typical fragmentary medulla. The middle hair is blond and has no medulla. The right coarser hair is white with a continuous medulla.

- It may also be **absent** in some species.

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**.

http://library.thinkquest.org/04oct/00206/lesson.htm#t_hair

http://www.bfro.net/images/whatis/figures/Fig.%203%20with%20caption.jpg

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.

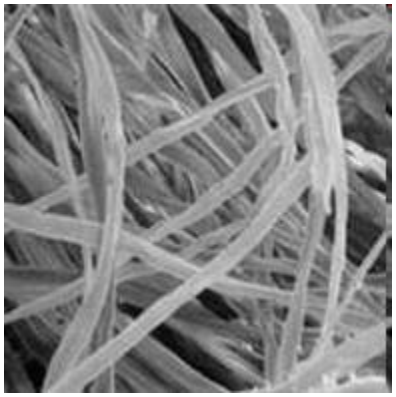
Matching **unique** fibers on the clothing of a victim to fibers on a suspect's clothing can be very helpful to an investigation, whereas the matching of **common** fibers such as white cotton or blue denim fibers would be less helpful.

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.

http://www.fbi.gov/hq/lab/fsc/backissu/july2000/deedric3.htm#Fiber%20Evidence

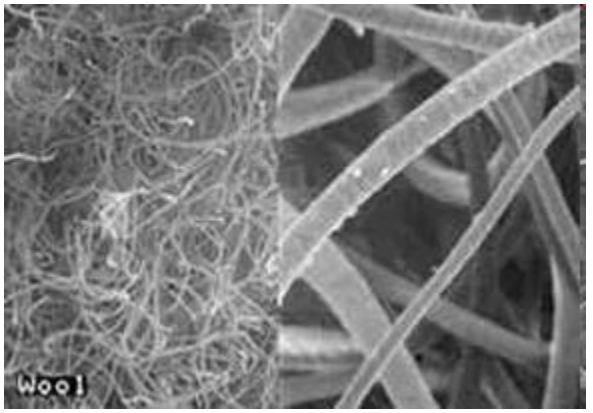
Natural Fibers

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.

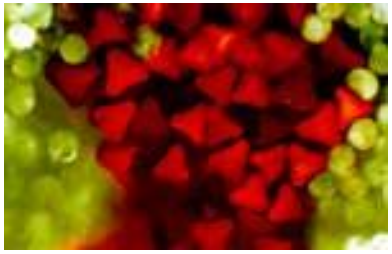


http://www.fireflydiapers.com/articles/diaperarticle_naturalfibersabsorb.htm

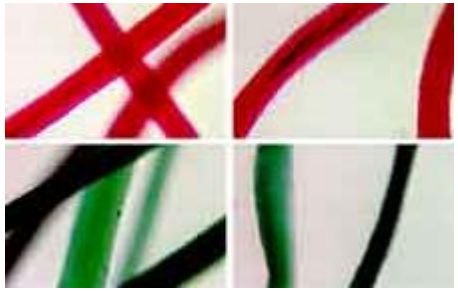
Synthetic Fibers

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

Images: http://www.trashforteaching.org/phpstore/product_images/YarnWS.JPG
http://www.fbi.gov/hq/lab/fsc/backissu/july2000/deedric3.htm#Fiber%20Evidence
http://www.jivepuppi.com/images/fiber_evidence.jpg

Now Work on Your Data Tables

http://micro.magnet.fsu.edu/primer/techniques/polarized/gallery/images/humansmall.jpg

Stop Here

Hair and Fiber Analysis
Lab Activity

- Pre-Lab – due Today!

1. Read and Highlight important information pages S1-S7
2. Work on Pre-lab questions on page S8 bring them up when you are done

Lab work will begin on Next Class

Hair & Fiber Identification Lab

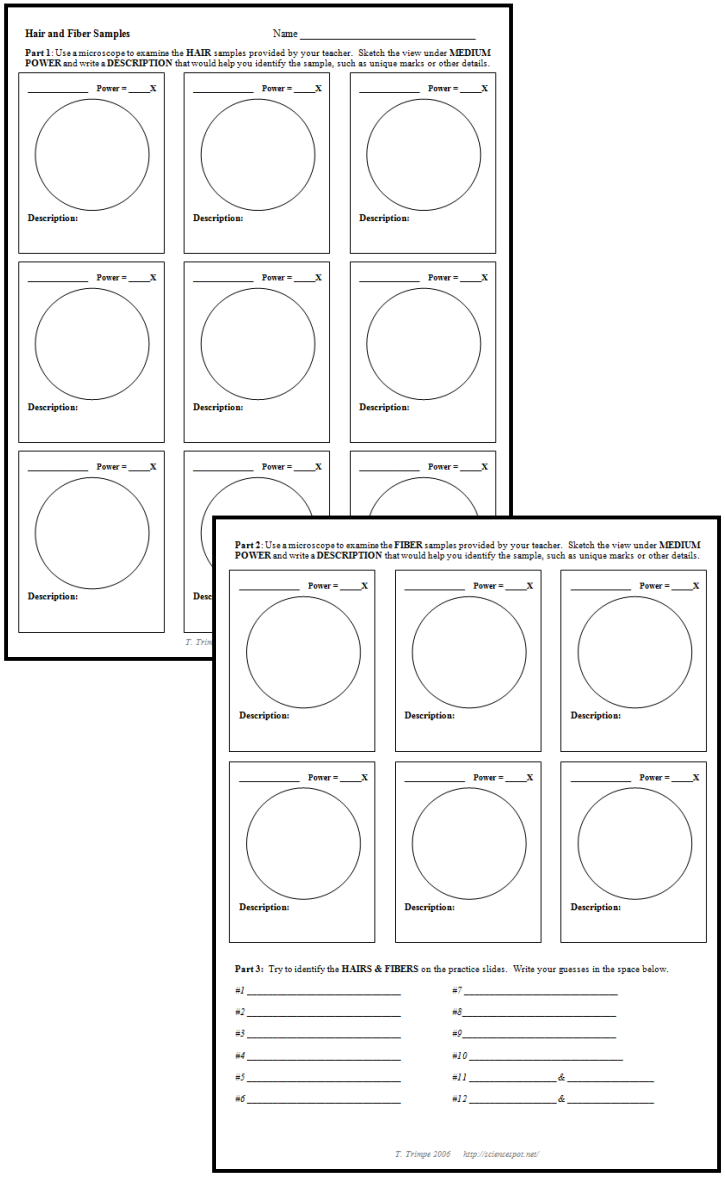
Directions:

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

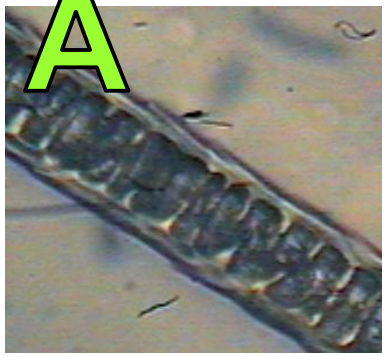
Write the name of the hair or fiber on the line and then draw what you see under medium or high power. Be sure to indicate the power of magnification!

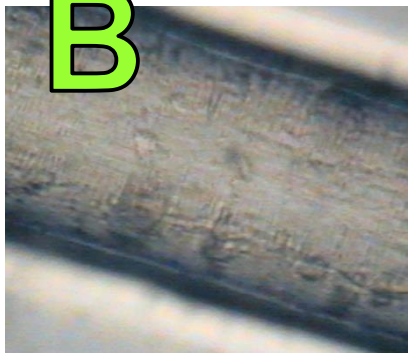
Add a description that highlights the unique characteristics of each hair and fiber sample.

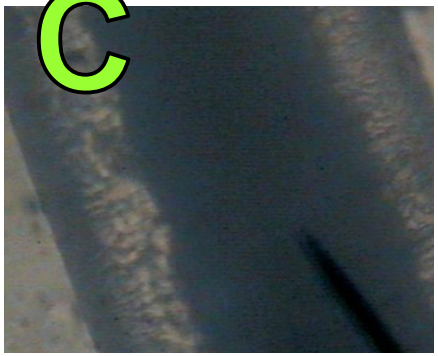
Pay attention to details to help you identify samples during the Hair & Fiber Challenge activity.

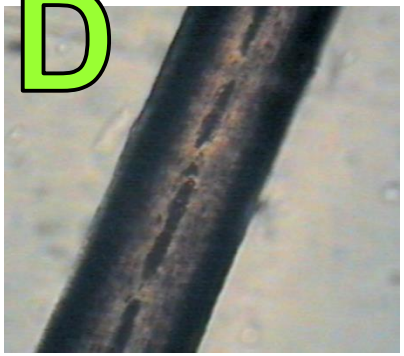


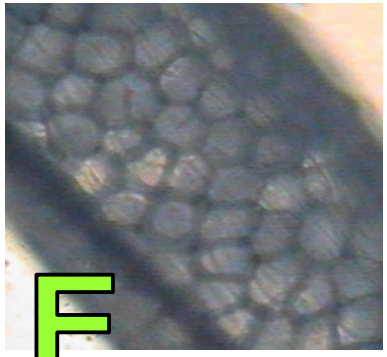
Can you identify the animal hairs shown?

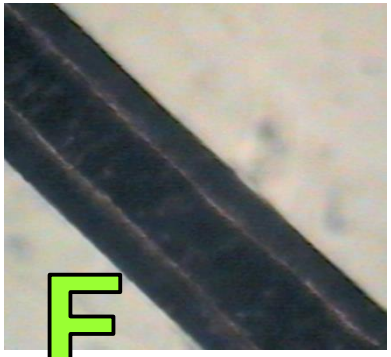


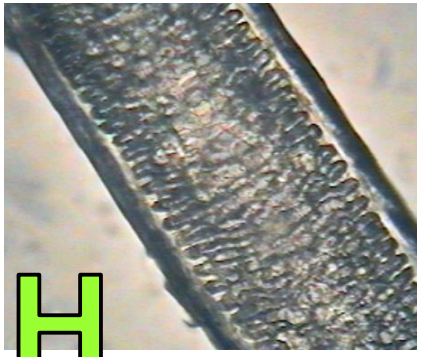


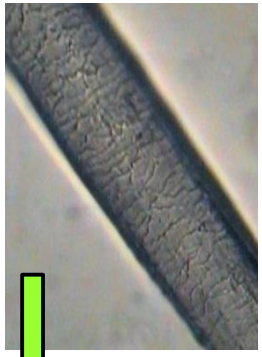












Think About It …

(1) In which samples are we viewing the cuticle? How do they compare?

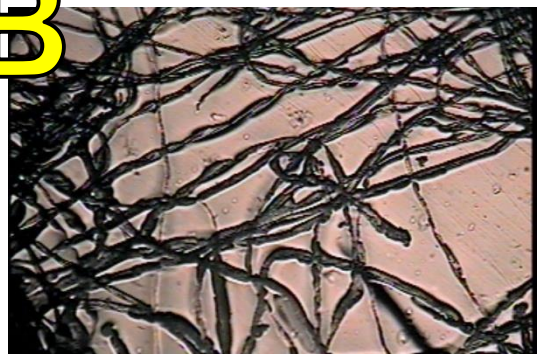
(2) In which samples are we viewing the medulla? How do they compare?

(3) What characteristics can be used to identify hair samples?

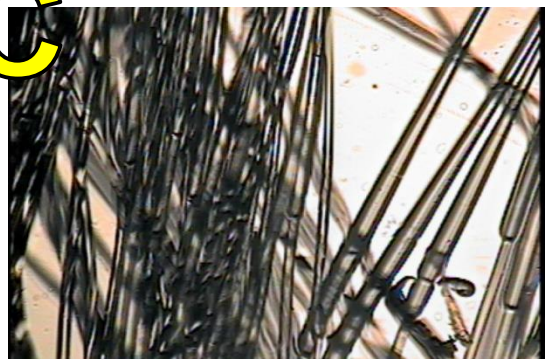
Can you identify the types of fibers shown?

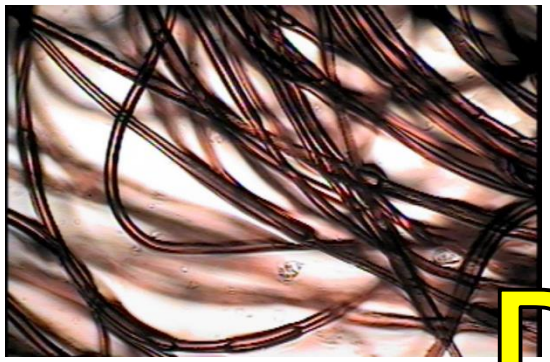
A

B



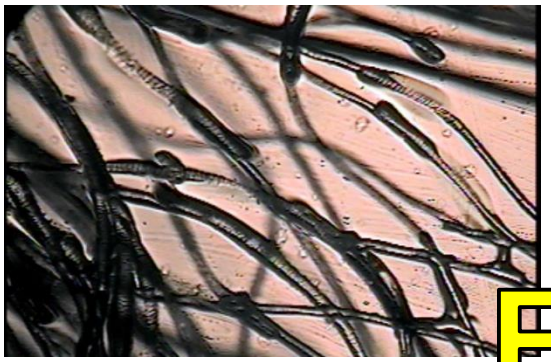
C





D

E



F

Think About It …

(1) Which samples are natural fibers?

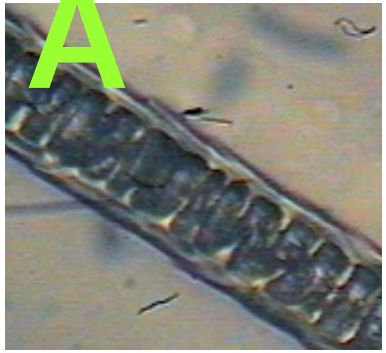
(2) Which samples are synthetic fibers?

(3) What characteristics can be used to identify fiber samples?

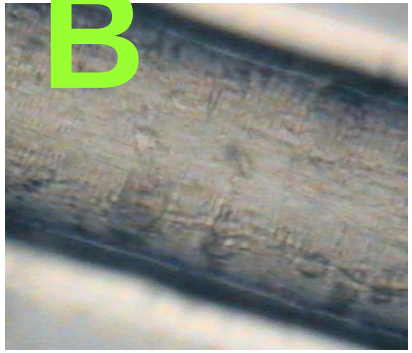
http://micro.magnet.fsu.edu/primer/techniques/polarized/gallery/images/humansmall.jpg

Types of Animal Hairs - Key

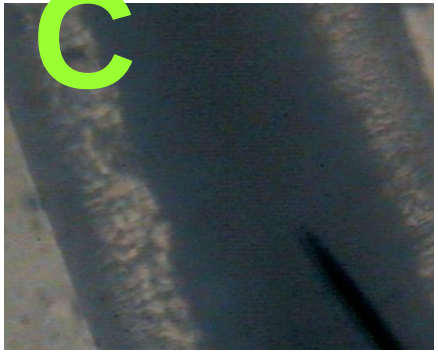
Cat



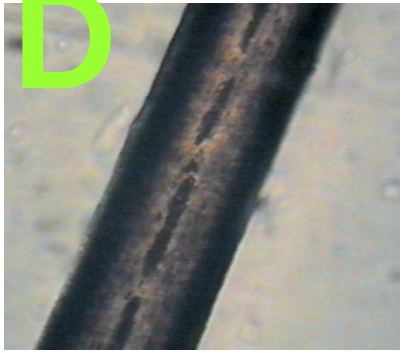
Horse

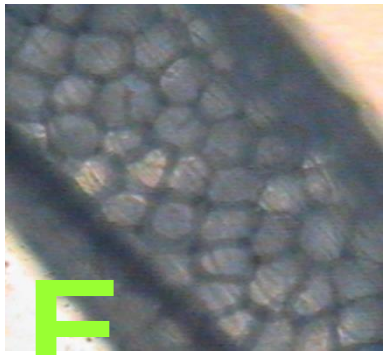


Pig

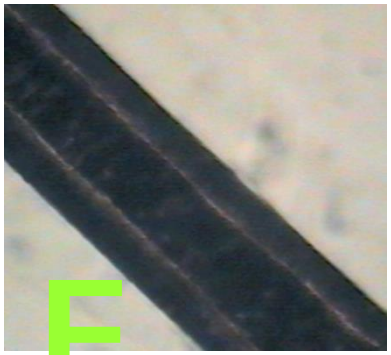


Human



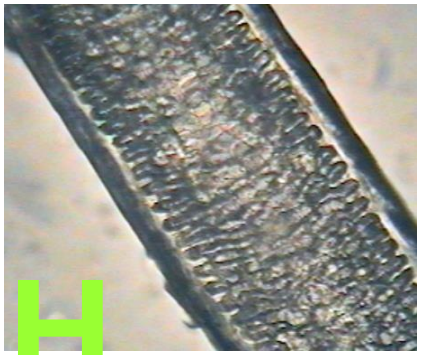


Deer

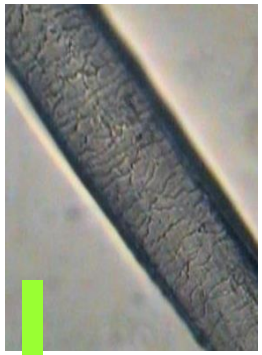


Dog

Rabbit



Rat



Human

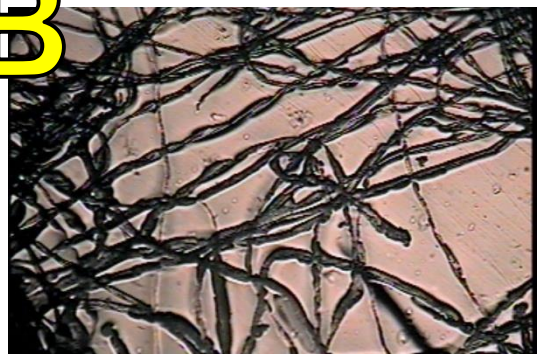
Types of Fibers - Key

A

Acrylic Yarn

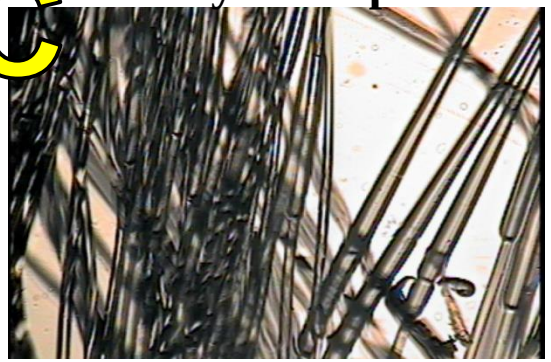
B

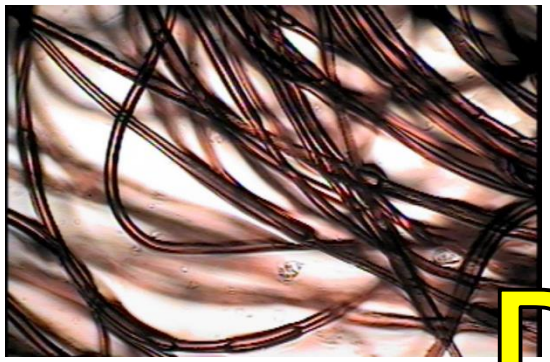
Cotton Yarn



C

Nylon Rope



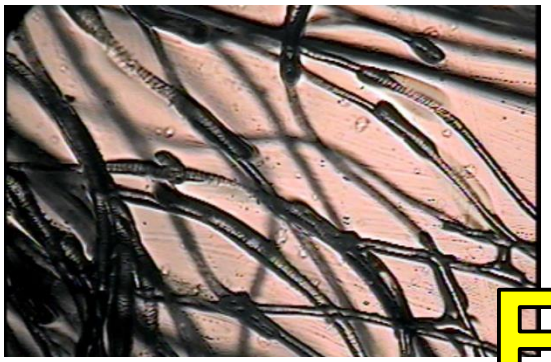


D

Polyester Yarn

E

Rayon Rope



F

Wool Yarn