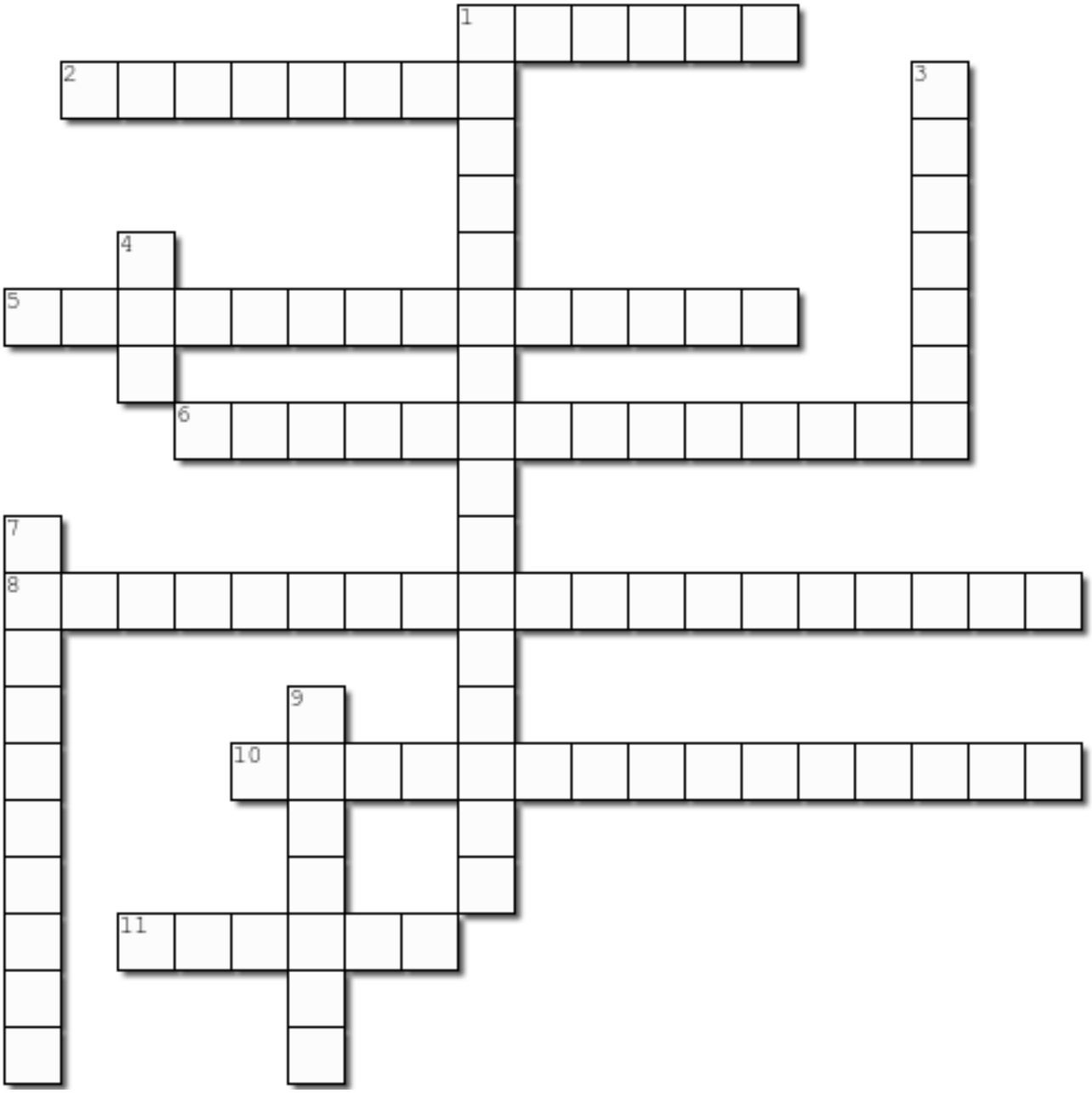
The Study of Hair Vocabulary

Complete the worksheet BEFORE we do we do notes in class



Across

1. The central core of a hair fiber
2. The actively growing root of hair containing DNA and living cells
5. Material that connects an individual or thing to a certain group
6. Small but measurable amounts of physical or biological material found at a crime scene
8. The kind of evidence that identifies a particular person or thing
10. A measurement of how much of a strand is made up of the medulla which can help to identify if the hair is human
11. The region of hair that contains most of the pigment

Down

1. Bits of pigment found in the cortex of the hair
3. The tough outer portion of the hair containing scales that can help identify species
4. A method of analysis that determines the composition of elements in a sample
7. A piece of equipment used by forensic scientists to magnify trace evidence for examination
9. Fibrous protein that makes up the majority of the cortex of the hair

The Study of Hair

Learning Objectives:

- ❑ I can describe the structure of hair
- ❑ I can differentiate between types of hair
- ❑ I can explain hairs use in a forensic investigation

Hair as Evidence

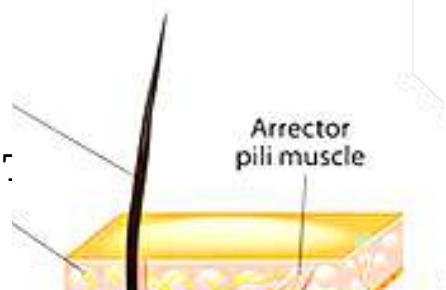
Hair is considered _____ _____ without the follicle

Hair is left behind as _____ _____ at a crime scene and on clothes, carpets and other locations

Hair provides a record of drugs, toxins, heavy metals, and nutritional deficiencies

Function and Structure

Hair on mammals helps to regulate body temperature, decrease friction, and protect against sunlight.



Life Cycle of Hair: Hair proceeds through 3 stages as it develops:

1. During the long _____ stage, hair actively grows. The cells around the follicle rapidly divide and deposit materials in the hair.
2. In the _____ stage, the hair grows and changes.
3. Hair is in the _____ stage when the follicle becomes dormant. During this stage, hairs easily can be lost.

Hair in Investigations

Hair is a major source of trace evidence left behind at crime scenes.

Hair can be collected by _____, gathered using _____, or _____ from a large

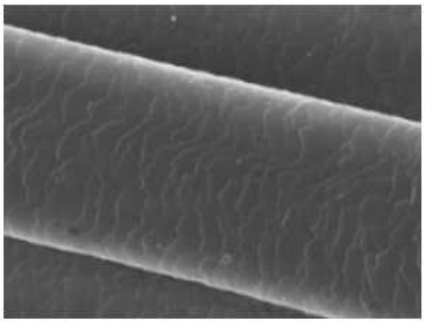
Compound Light Microscope

Stereo (Dissecting) Microscope

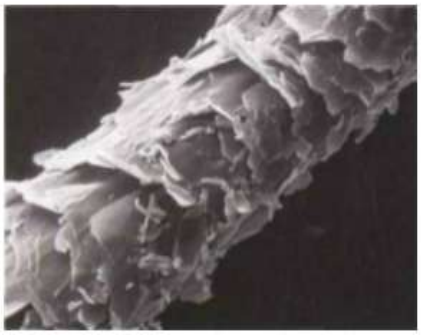
Hair in Investigations

Hair is typically magnified from _____-_____ to observe microscopic characteristics: scales on the cuticle, medullary pattern,

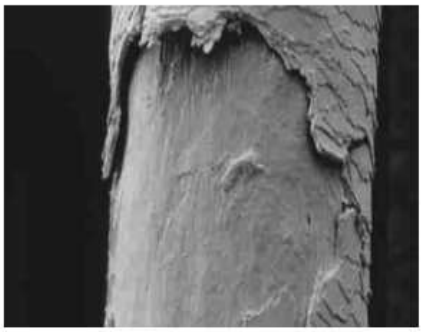
The Cuticle



Healthy Cuticle Layer

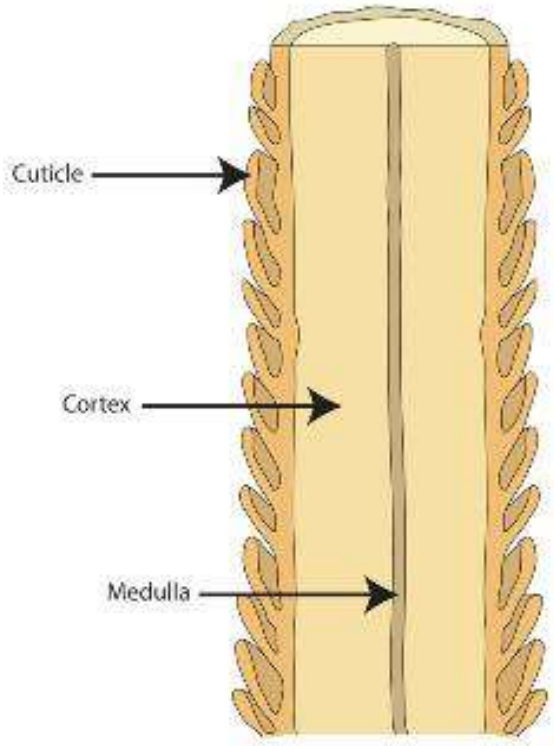


Raised Cuticle Layer



Damaged Cuticle Layer Missing Scales

- The cuticle is a translucent outer layer of the hair shaft consisting of _____ that cover the shaft.
- Cuticular scales always point from the _____ or root end of the hair to the _____ or tip end of the hair.
- The cuticle scales of animals commonly resemble petals (_____) or a stack of crowns (_____).
- The cuticle scales of humans commonly are flattened and narrow (_____).

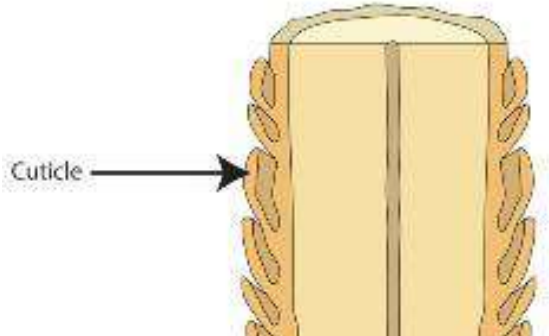


spinous

coronal

imbricate

The Cortex



air

- The Cortex contains most of the _____ granules that give hair its color.
- In _____ pigmentation is denser _____ the _____ and can change abruptly in banded patterns down the shaft.
- In _____ pigmentation is denser _____ the _____ and any change in color indicates treated hair.

Treated Hair

Forensic investigators sometimes can link hair from a location with an individual.

- _____ disturbs the scales on the cuticle and removes pigment

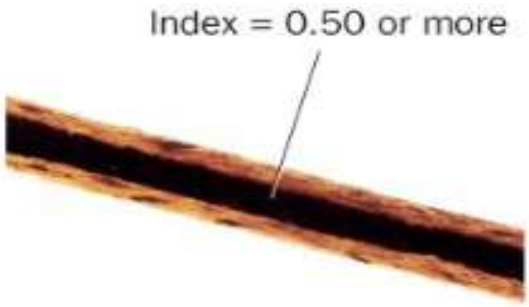
leaving hair brittle and a yellowish color.

- _____ colors the cuticle and the cortex of the hair shaft.

Forensic scientists can estimate when hair was last treated given a standard growth rate of _____ _____ _____ _____

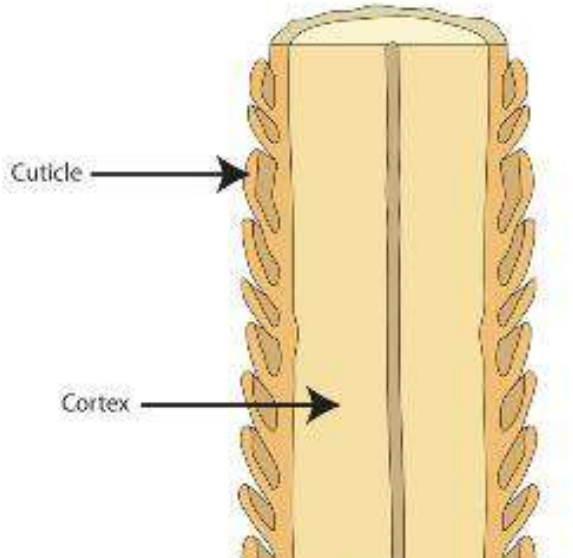
The Medulla

$$\text{Medullary Index} = \frac{\text{medulla's width}}{\text{entire hair's width}}$$



Cattle hair

Human hair



Hair

- The thickness of the medulla, or _____ _____,

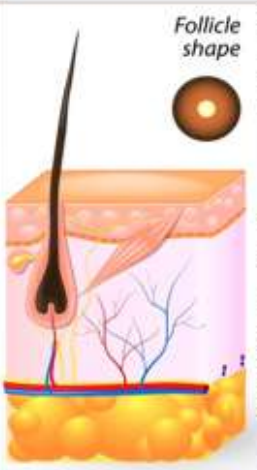
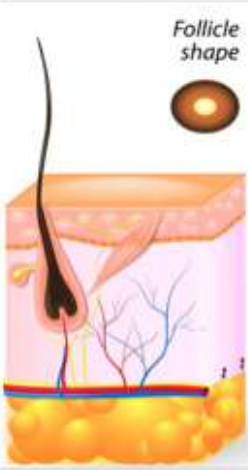
can be used to _____ _____ the hair is _____.

- The medulla can be hollow or filled, absent, fragmented, continuous, doubled, pigmented, or un- pigmented.
- _____ _____ can help to _____ what _____ the hair is from

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	

Racial Differences

Hair examiners have identified certain characteristics to generally be associated with broad racial groups, though they don't fit each individual.

Asian	Caucasian	African
 Generally straight hair Round cross section with a large diameter	 Generally wavy to straight hair Oval or round cross section with a moderate diameter	 Generally curly to coiled hair Flattened cross section and with moderate to small diameter

Testing for Substances

- _____, _____, and the presence of many _____ can be detected by chemical analysis of the hair.
- A time line of exposure can also be determined given the standard growth rate of _____ _____ _____ _____.
- Neutron activation analysis (_____) is used to identify the concentration of multiple elements in a strand of hair. The probability of the hairs of two individuals having the same concentration of nine elements is one in one million.

Testing the Hair Follicle

If hair is pulled out by the roo it may leave behind a follicular tag. If this occurs blood and tissue attached to

the follicle may be analyzed
for _____ evidence.

The Study of Fibers and Textiles

Complete the worksheet BEFORE we do we do notes in class

R L K G E C A J J M K O X P E
E C H I X V J O F R O P L H D
D L K X C C O R E M O N O M A
E D V Q R D I B S C H P O D R
H Y W P Y S I T O T Z Q Z E P
Y N X C S F C Q E X C I L R V
B T K O T O F E D H B E C E P
A N J L A Z X R F F T X R X D
N O T K L B X R U F I N U I C
A Q V S L D G R G B S E Y A D
T O S N I X R E M Y L O P S Z
U X J M N C M F I R J G G Q D
R Y F E E G R K V K P E J F M
A A T G L Y K T E X T I L E L
L A W N R A Y R A D N O C E S

1. Regularly shaped fibers composed of polymers stacked side by side _____
2. Type of transfer from victim to suspect or vice versa _____
3. Smallest unit of a textile _____
4. Small molecule that may bond to other monomers to create a polymer _____

5. A fiber made from plant, animal, or mineral sources _____
6. A substance composed of long chains of repeating units _____
7. A fiber made from man-made sources such as plastic _____
8. Transfer of evidence from a source to a person and then to another person _____
9. A flexible flat material made by interlacing yarns (or threads) _____
10. Fibers that have been spun together _____

The Study of Fibers and Textiles

Learning Objectives:

- ❑ I can describe weave patterns of various textiles
- ❑ I can use forensic science to identify and describe common natural and synthetic fibers

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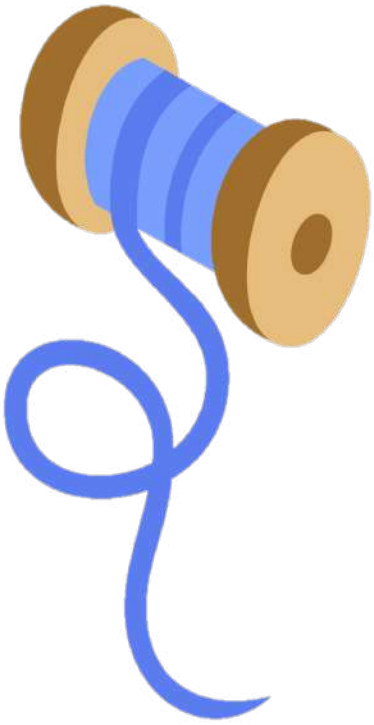
Fibers and Textiles as Evidence

- Fibers can be identified by type and composition, determined by _____, _____ _____, and _____ _____
- Textiles can be identified by _____ _____, _____ _____, or two ply _____ _____

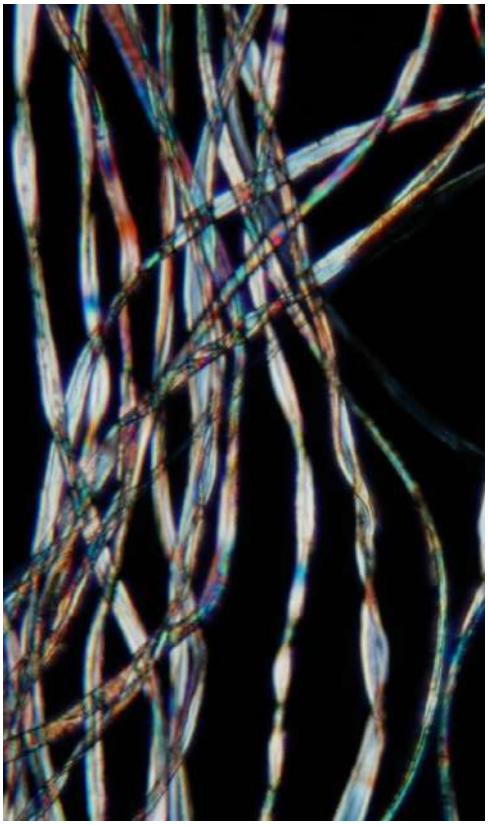
- Fiber identification provides _____ _____ only and should not be used to convict someone.
- Collecting fibers within _____ _____ is critical.

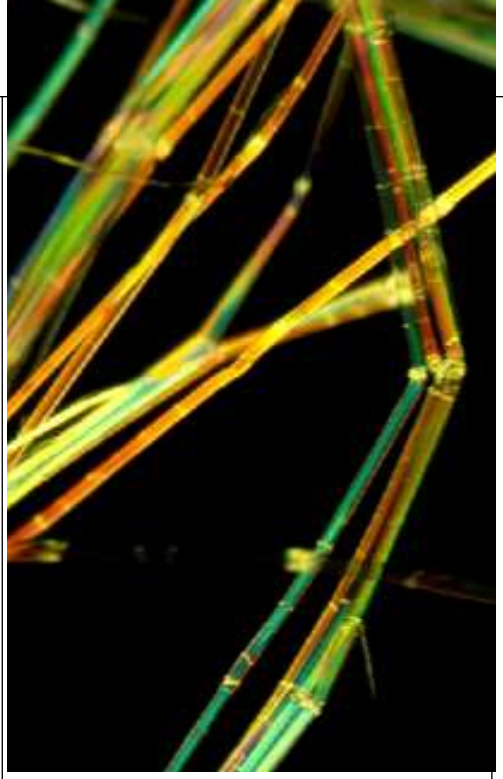
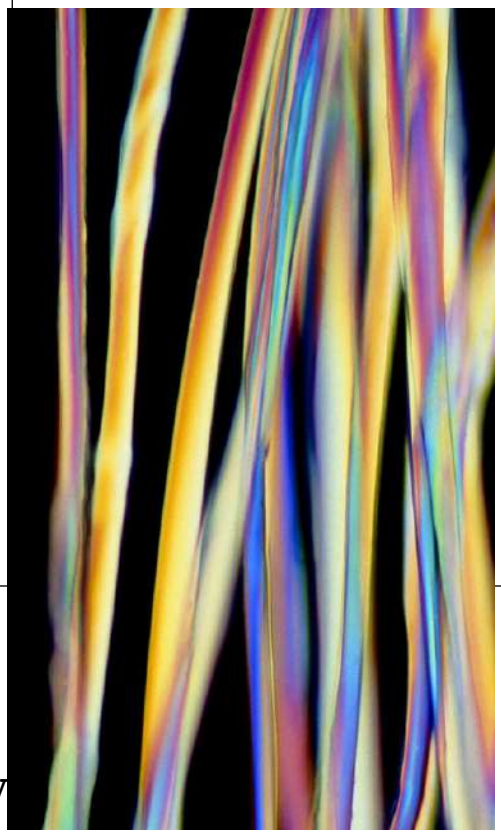


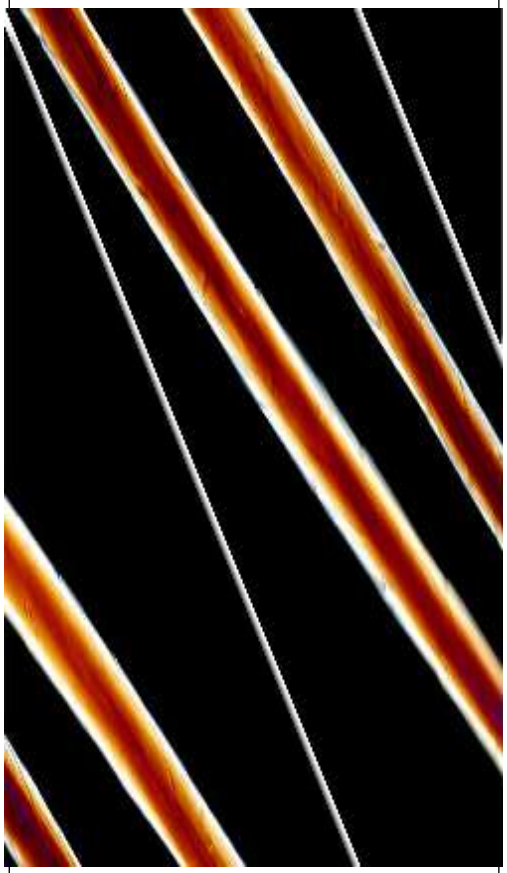
Sampling and Testing

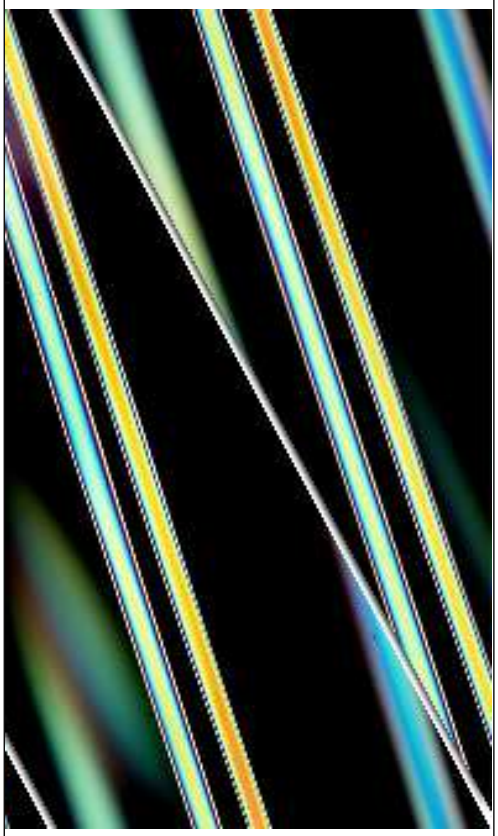
- Shedding from an article of clothing or a textile is the most common form of fiber transfer.
- _____ _____ can be viewed with an _____ _____with or without a polarizer.
- _____ _____ may require _____ _____ can reveal _____ _____ since their physical structure is indistinct.
- If a large quantity of fibers is found, some can be subjected to destructive tests such as burning them in a _____ (see analysis key above) or _____ them in various liquids.

Comparison of Fibers

Cotton		
Natural plant fiber with a flattened hose appearance Composed of chains of glucose forming cellulose polymers Up to 2 inches long, tapers to a blunt point and may have a frayed root Smells like burnt hair when burned Used in many types of textiles for clothing		Sample:
Flax		
Natural plant fiber with a bamboo appearance Composed of chains of glucose		Sample:

forming cellulose polymers Crystalline structure with nodes visible in an “X” every inch or so Often occur bundled with several fibers Used in bed linens and table cloths		
Silk		
Natural animal fiber from the cocoon of caterpillars Composed of a protein which scatters light similar to a prism and gives glossy appearance		Sample

Fibers do not taper but may have small variations in diameter No internal structure Used in clothing and bedding		
Wool		
Natural animal fiber from sheep hair Composed of a protein chain called keratin Surface scales may be visible Hollow or partially hollow core Fibers up to 3 inches long tapering to a fine point		Sample

Used in clothing and blankets		
Synthetic		
Include rayon, nylon, acrylics, and polyester Some made with cellulose, others made with petroleum Uniform diameter throughout the fiber Surface treatments appear as spots or stains Used in clothing, bedding, towels, carpets		Sample:

Fiber Analysis

Step 1

Fibers should be first examined using _____.

Physical features length, color, diameter, luster, cross section, damage, and debris should be noted

Similar fibers may be compared further using a comparison microscope

Step 2

If enough fibers are found some may be _____to aid in identification

Odor of burning hair – Animal source

Odor of burning paper – Plant source

Step 3

Fibers may also be _____ _____to narrow down the source

Dissolves in strong acid – plant, silk, or manufactured.

Dissolves in strong base – wool

Step 4

Analysis of _____can be done.

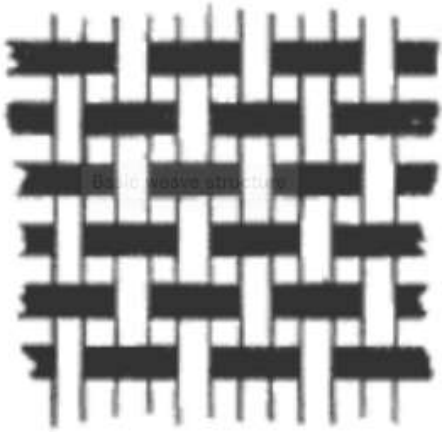
Using Microspectrophotometry (MSP) light absorbed by or reflected from a sample is separated into its component wavelengths, and intensity at each wavelength plotted.

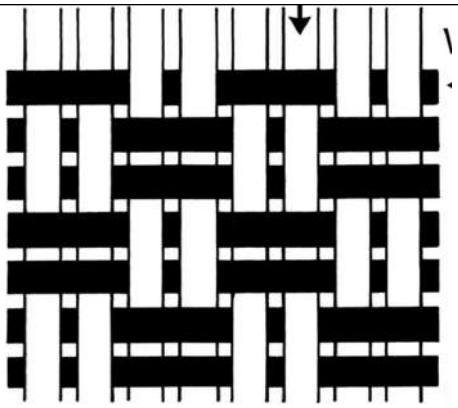
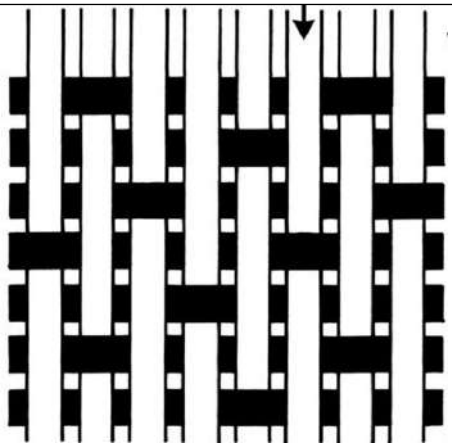
Using Thin-layer chromatography (TLC) Dye components are separated by their migration pattern as the dye flows through a medium.

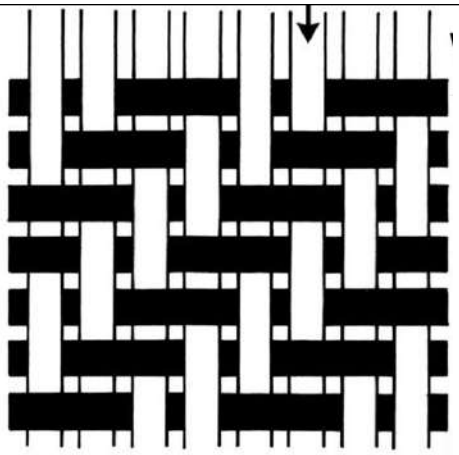
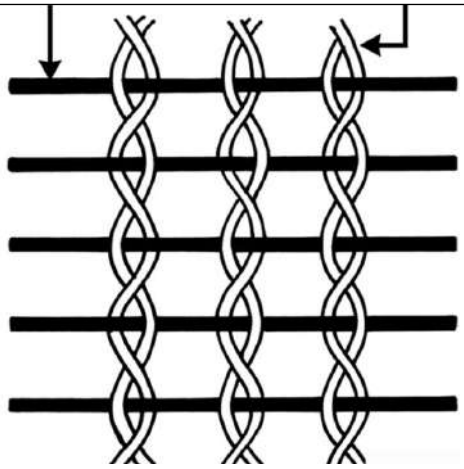
Step 5

The _____ _____ _____ the _____itself can be analyzed through further testing

The Gas chromatography (GCMS) instrument is made up of two parts. The gas chromatography (GC) portion separates the chemical mixture into pulses of pure chemicals and the mass spectrometer (MS) identifies and quantifies the chemicals.

Weave Patterns		
Plain		
Alternating warp and weft Firm and wears well Low tear strength Tends to wrinkle		Sample
Basket		

Alternating pattern of two weft threads crossing two warp threads An open or porous weave Does not wrinkle Not very durable Tends to distort as yarns shift Shrinks when washed		Sample:
Satin		
A weft crosses over three or more warp threads Not durable Tends to snag and break during wear Shiny surface High light reflectance Little friction with other garments		Sample:
Twill		

Weft is woven over three or more warps and then under one. The next row the pattern is shifted by one thread. Very strong Dense and compact Different faces Diagonal design on surface Soft and pliable		Sample:
Leno		
This uses two warp threads and a single weft thread. The two adjacent warp threads cross over each other the weft is woven between the two warp threads Open weave Easily distorted with wear and washing Stretches in one direction only		Sample: