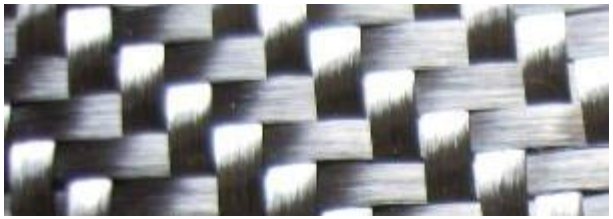
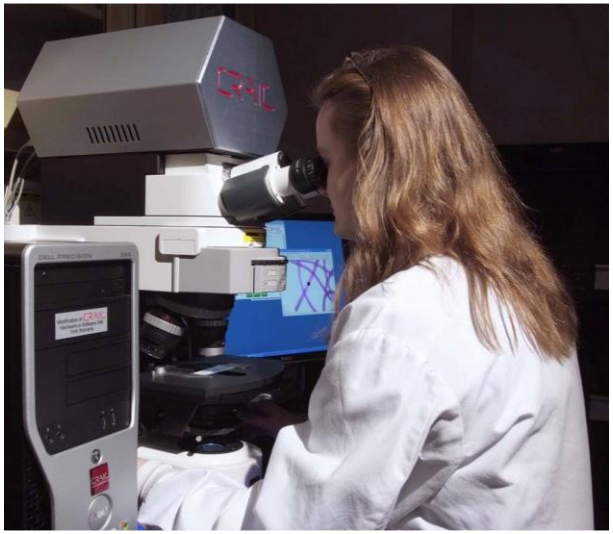
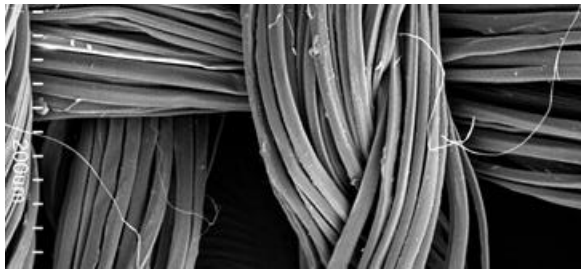
CHAPTER 4 NOTES

FIBER EVIDENCE





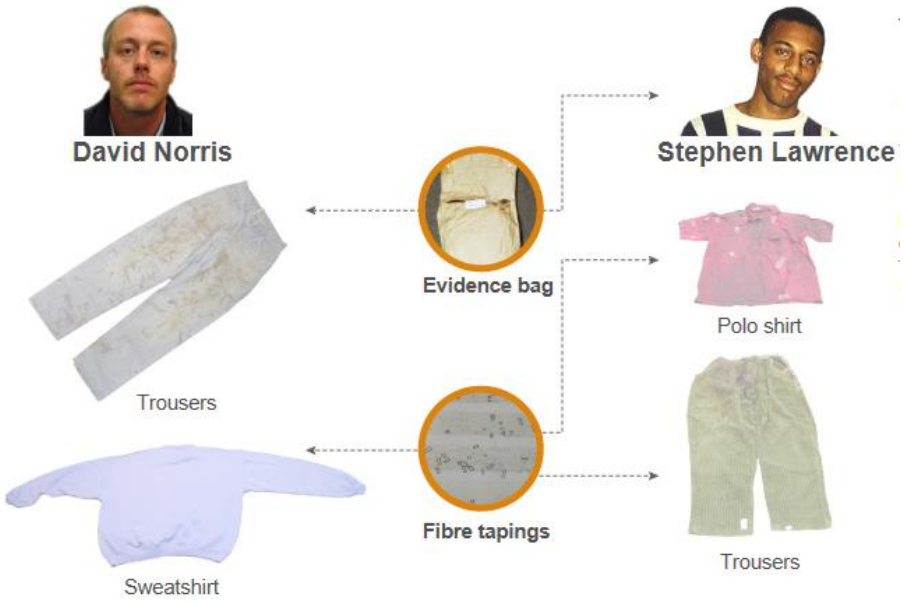


- Because textiles are **mass**-produced, they are considered **class** evidence. It is difficult to trace a fiber back to a **specific** source, yet fiber evidence is still important evidence because it creates **links** between victims, suspects, and locations.

- Fibers can come from **clothing**, coats, **carpet**, furniture, **curtains**, bedding, **insulation**, rope, etc.

THE LOCARD EXCHANGE

- Fibers may be transferred directly from victim to suspect or suspect to victim, this is called **direct transfer**.
- However, an individual may have fibers on them that they picked up from the **environment** and then transfers to the other person during contact, this is called **secondary** transfer.



Case that used Fiber Evidence:

April 1993

An eighteen-year-old is stabbed to death in an unprovoked attack by a gang of white youths as he waits at a bus stop in south-east London, with his friend.

Tiny fragments of new evidence emerged in **2007** as scientists conducted a massive "cold case review".

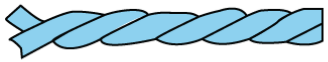
They re-examined clothing taken from the two defendants, Gary Dobson and David Norris, starting a process that eventually led to a guilty verdict for both men in **January 2012**. The Stephen Lawrence murder trial boiled down to three things; blood, fibers and hair.

Early collection of fibers is critical; most fiber evidence (**95**%) falls off or is lost from a crime scene within **24** hours.

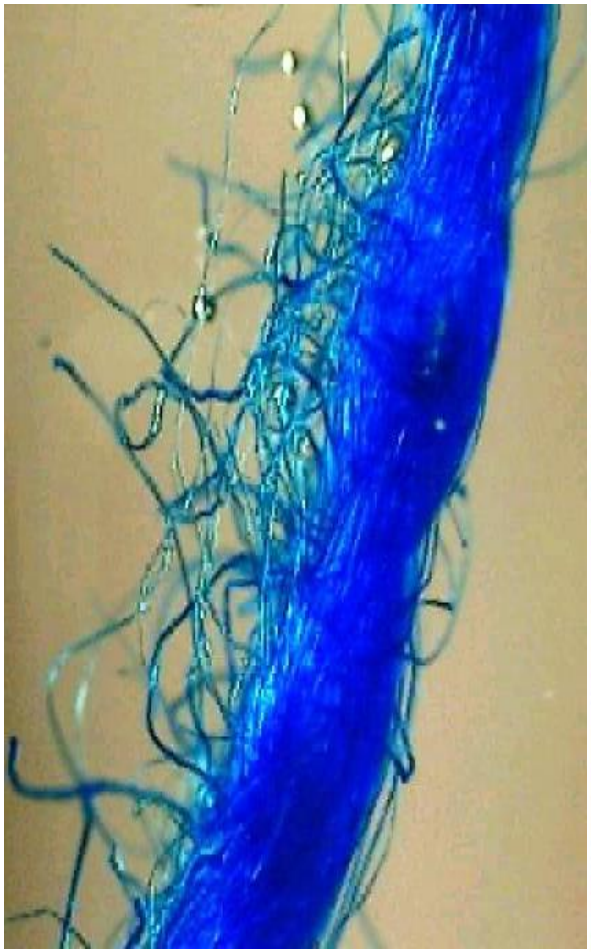
a. When using fiber as evidence, forensic scientists want to determine the following:

- Type of fiber – composition and **uniqueness**
- Fiber **color** – first step of matching fiber to location. Later, scientists can test to see if **dyes** used also match.
- **Number** of fibers found – usually the more found the easier the match. More fibers also suggest more **violent** crime or longer period of contact.

Synthetic vs. Natural Fibers



- Where the fiber was found – can you place the suspect at the scene or to the victim?
- Textile fiber originated from – What is the **source** of the fiber?
- Are there **multiple** types of fibers – several types of fibers can be more supportive.
- Type of crime committed
  - If forensic scientists know the crime, they have a better idea of what kind of fiber transfer to look for. Examples- **rape**, **kidnapping**, breaking and entering, etc.
- Time between crime and fiber **discovery** – passage of time greatly reduces the value of fiber evidence.

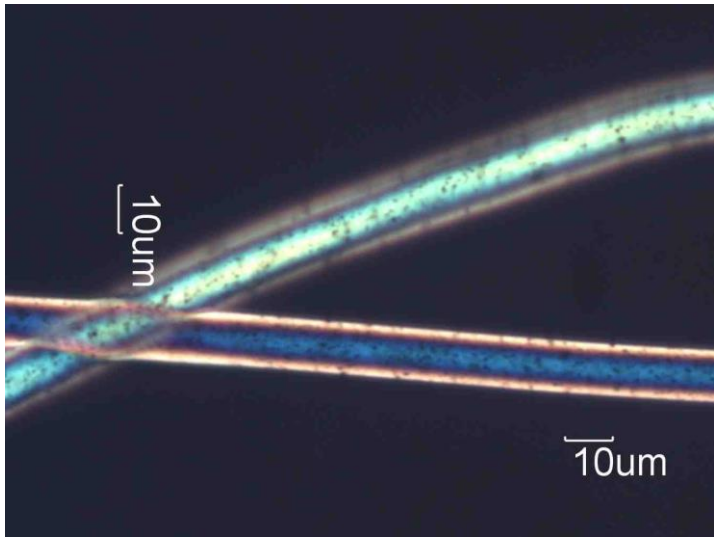


Collection of Fibers

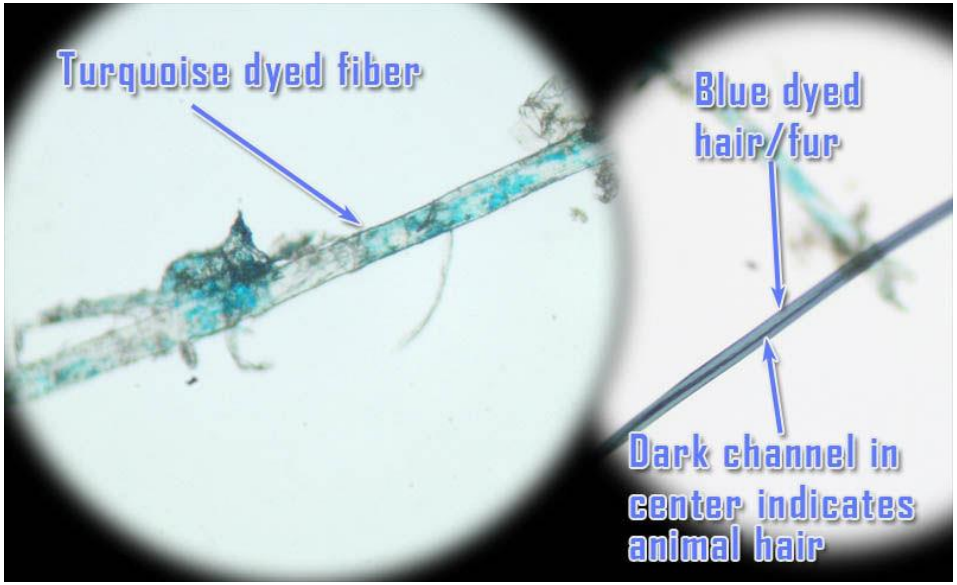
a. **Visual** search first.
b. Use of **forceps** or sticky **tape** for small areas.
c. **Vacuums** for larger areas.
d. Removed fibers should be folded into a paper **bindle** then in a coin envelope, which can be sealed and marked.
e. Each garment should be-laid on a clean sheet of paper, and separately rolled up in the paper. Bag clothing items individually in paper bags. Make sure that different items are not placed on the **same** surface before being bagged.
f. Recording where fibers were found is critical for evidence to be admissible in court.
g. **Control** samples are important also. Known samples should be taken from all possible sources for **comparison**.

Testing Fibers

- First identify the type of fiber and its characteristics using a **microscope**. Try to identify the color, texture, diameter, shape pattern, cross section appearance, etc.

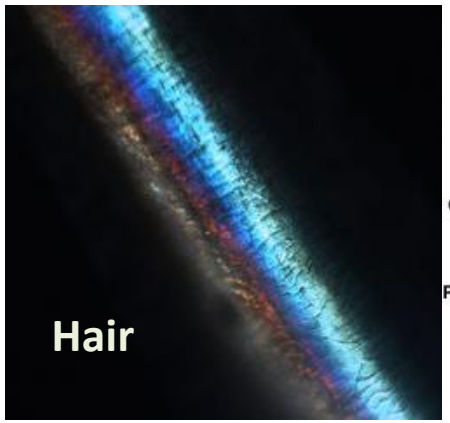


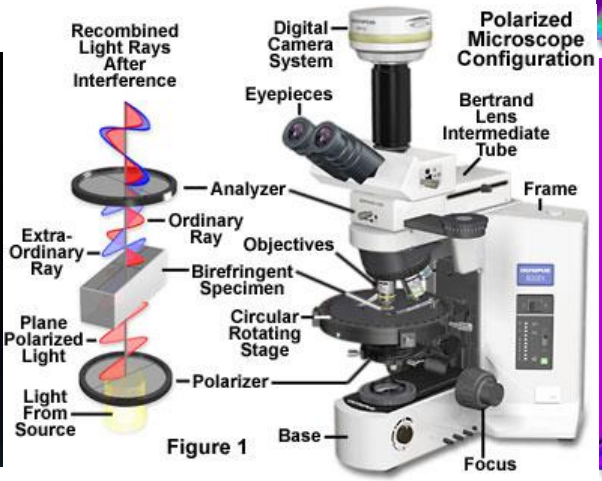
- If there is a **limited** amount of fiber found at the crime scene, it is important scientists do not perform tests that will **damage** the evidence.

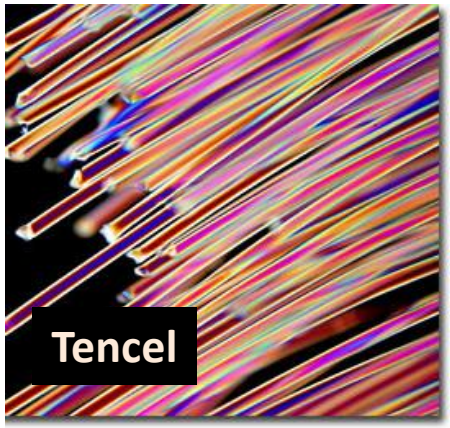


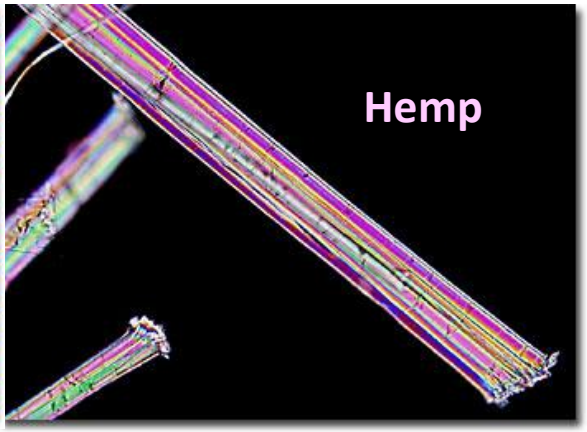
Two Non-Destructive Procedures are:

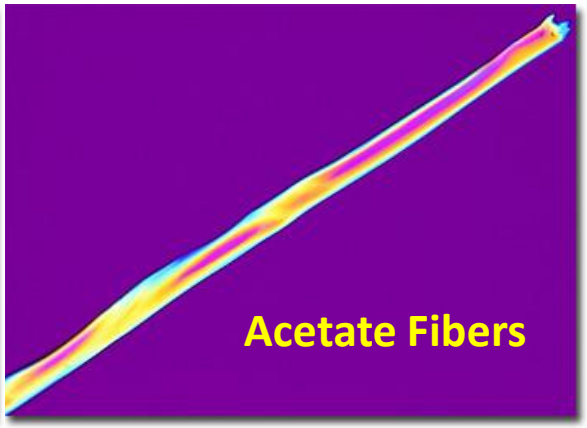
- **Polarizing** light microscopy- allows scientists to look at optical properties of the fiber using specific wavelengths of light.



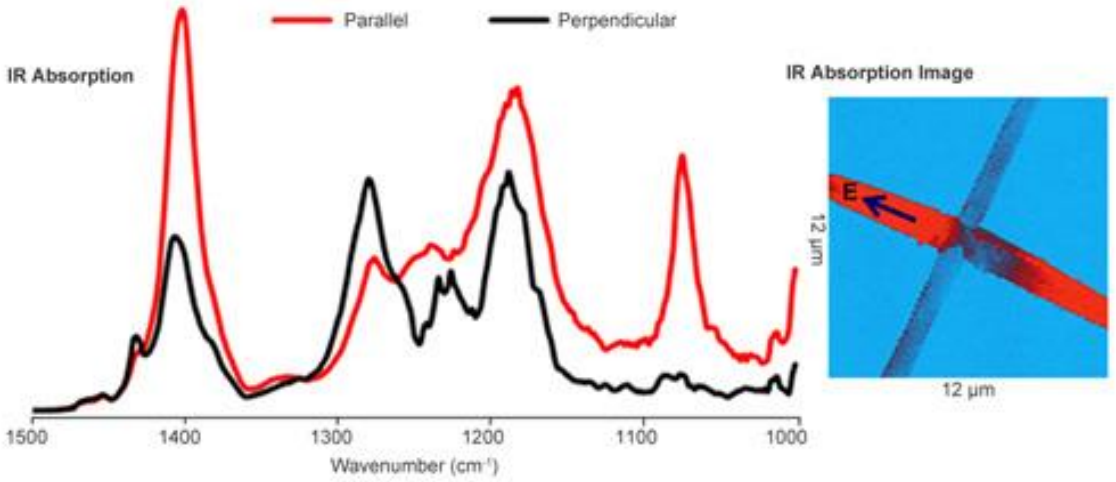


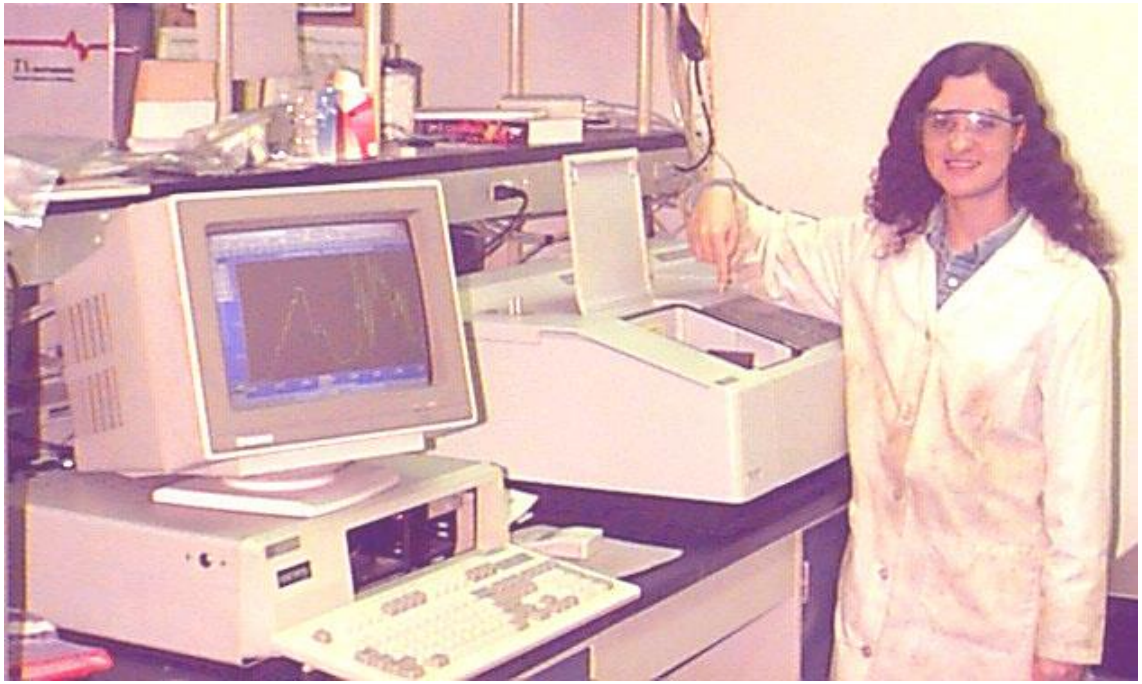






- **<u>Infrared</u> <u>Spectroscopy</u>**- allows scientists to see chemical structure of fiber using beams of light.





If **large** quantities of fibers are found, **some** of the fibers can be used for more destructive procedures, allowing for more conclusive data.

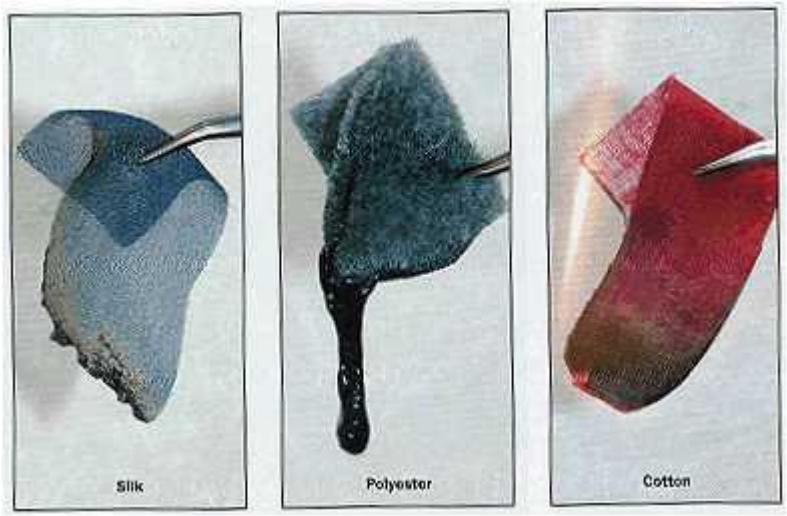
i. **Burning**- can compare melting points, odors, ash formation, etc.

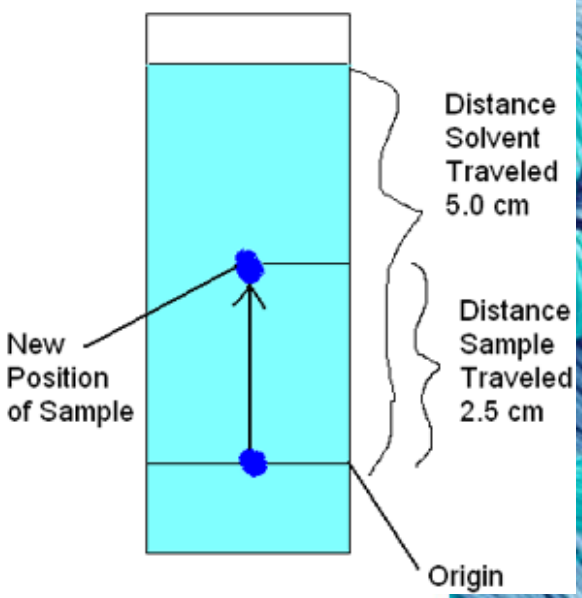
ii. **Solvents**- can compare solubility

iii. **Staining**- can compare absorption of various stains

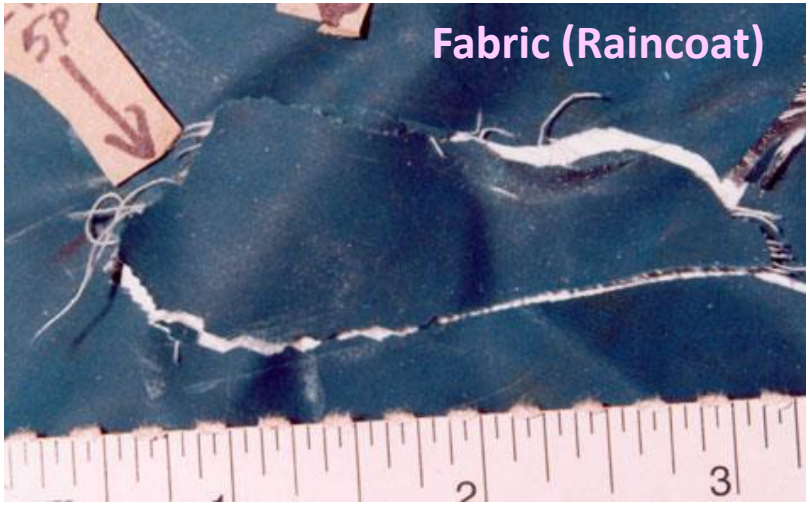
iv. **Density**- often a quick way to classify fabric origins

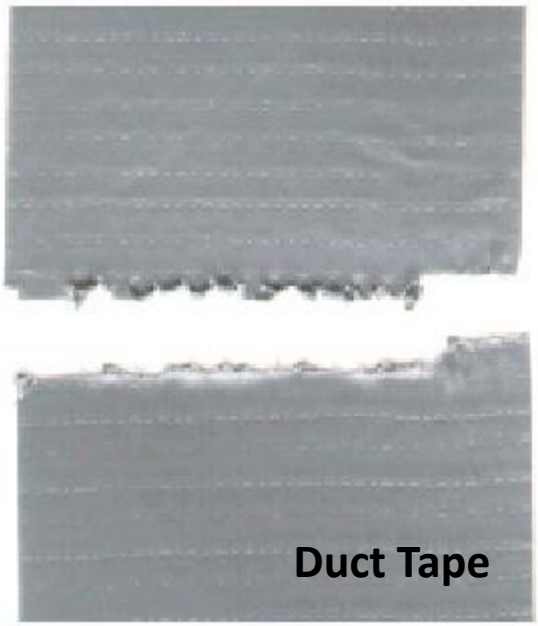
v. **Chromatography**- gives a more detailed analysis of the dye composition

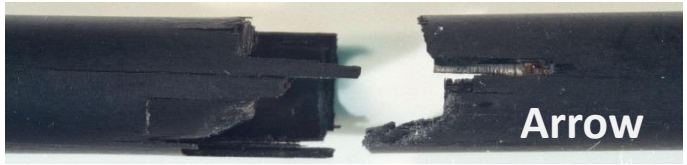




If fabric or cordage is found (many fibers still linked together) then scientists also look for a physical **match** (like puzzle pieces). They also can compare the **pattern** of knit or weave used.





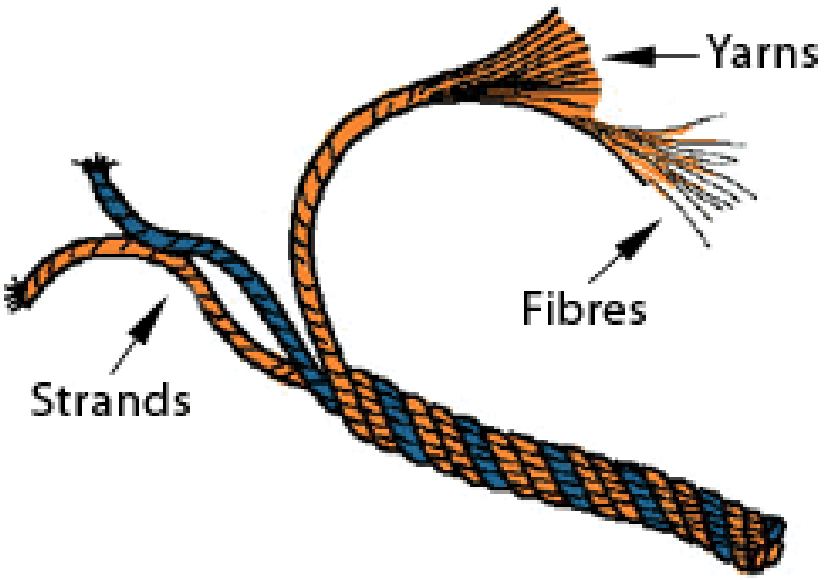


"Just as no two fingerprints are the same, no two objects can break exactly the same way every time. Physical matching (sometimes called physical fit or jigsaw fit) is the most incontrovertible evidence available."

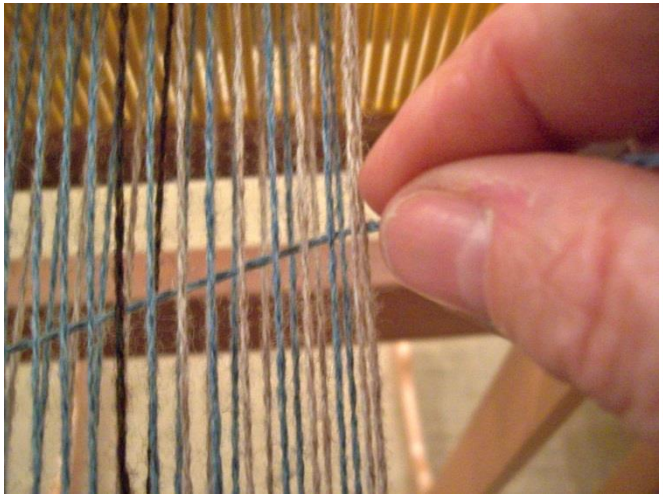
Classification of Fibers

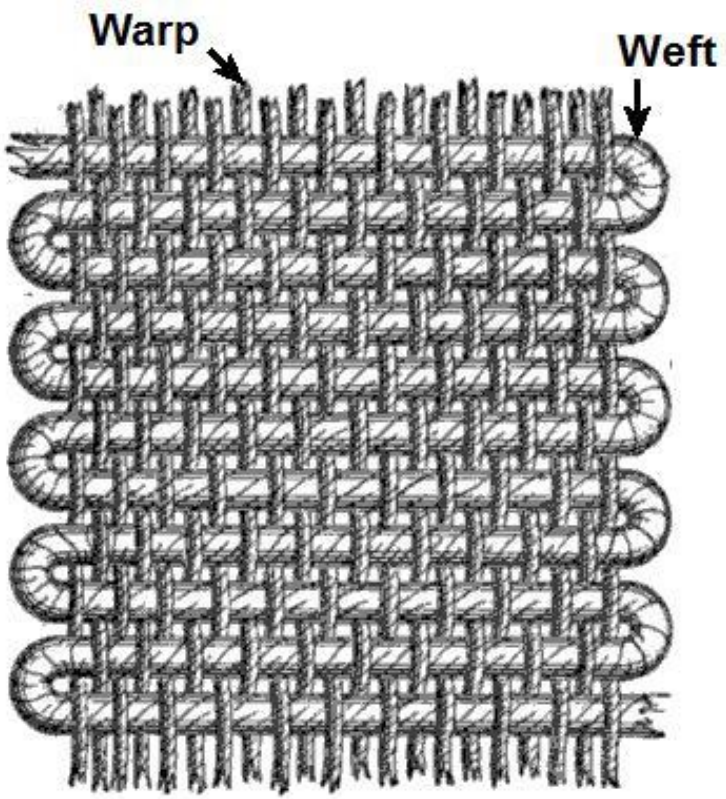
Fiber → Yarn → Textile

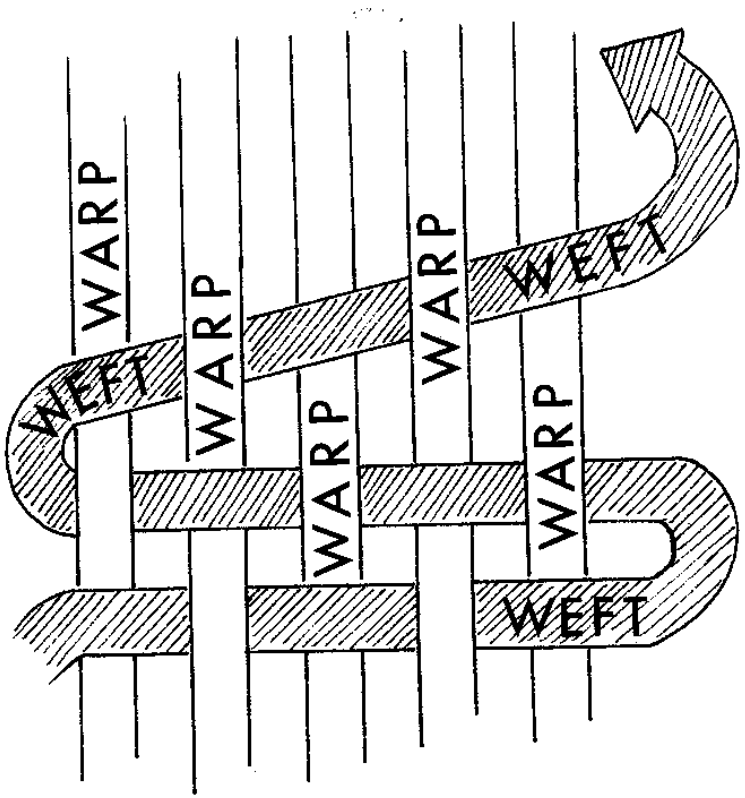
i. A fiber is the **smallest** indivisible unit of a textile
ii. Fibers too short to be used to make textiles in their raw state may be **spun** together to make **yarns**.
iii. Yarn is woven, with different **patterns**, into **textiles**



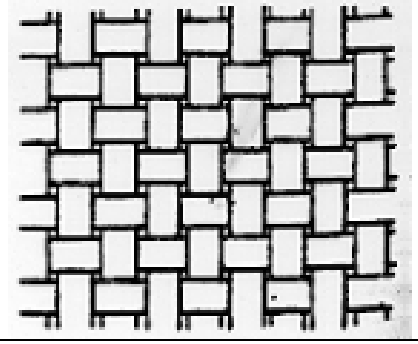
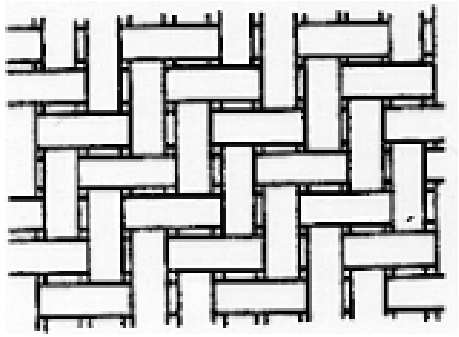
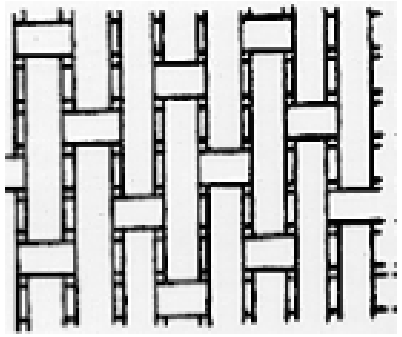
Weaving consists of arranging lengthwise threads (called the **warp**) side by side. Then crosswise threads (called the **weft**) are woven back and forth in one of many different patterns.





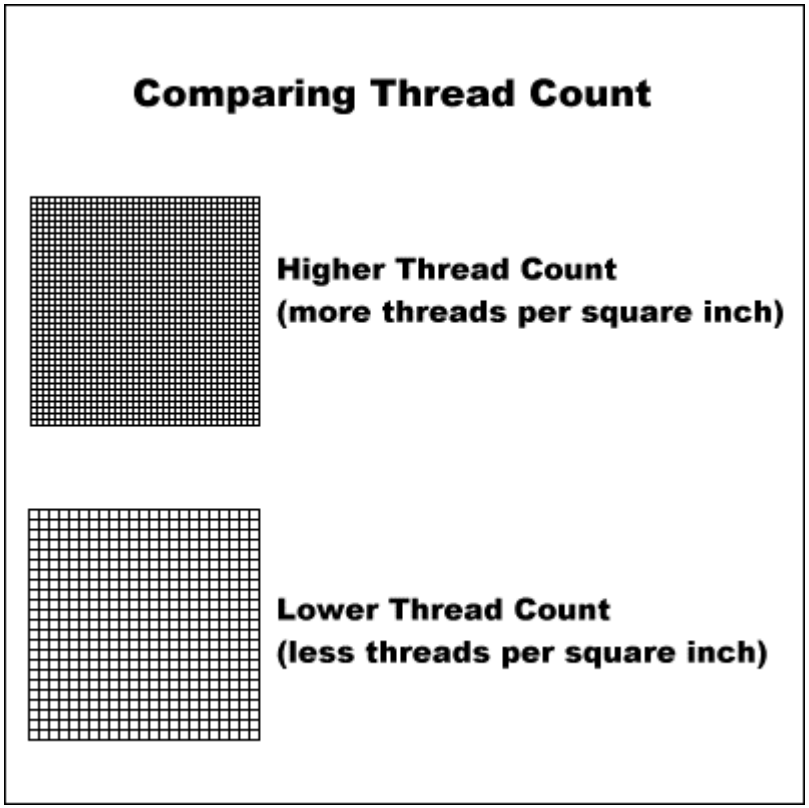


Weave patterns are determined by **number** of threads jumped as weave over and under. Weave patterns vary and can be used as forensic evidence.

Plain	Twill	Satin
		
• Simplest and most common weave • Warp and weft pass under each other alternately • Create even patterns of 1/1 and 2/2 • Design resembles a checkerboard • Snag resistant but tends to wrinkle	• Create by passing the warp yearn over three weft yarns before going under one • Makes a diagonal weave • Design resembles stair steps • Denim is the most obvious example • Soft and pliable, yet strong	• One weft crosses over three or more warp threads • Interlacing may not be uniform. • Shiny, little friction with other garments. • Not durable; tends to snag or break

Thread Count

The number of threads that are packed together for any given amount of fabric; it also varies and can be used as forensic evidence.



Most people associate this with bed sheets:

Balancing softness and affordability: You will find the widest variety of sheets with 300 to 500 thread count. These sheets will offer excellent softness at an affordable price.

Designer styles: Many designer sheets and other novelty-print sheets have a thread count of around 200 to 300.

The feeling of luxury: Luxury sheets will have a thread count of 800, 1000, or even 1200. Luxury sheets are usually also made of very fine materials, like Egyptian cotton.

Vs.

a. Fibers may be **natural** or **synthetic**
   i. Natural fibers come from **animals**, **plants**, and mined **minerals**.
   ii. Synthetic fibers are **man**-made.


Wool Fiber


Synthetic Fiber

Natural Fibers

Animal fibers

- All animal fibers are made of **proteins**.
- Animals provide fibers from 3 sources: **fur**, **hair**, and **silk** webbing.

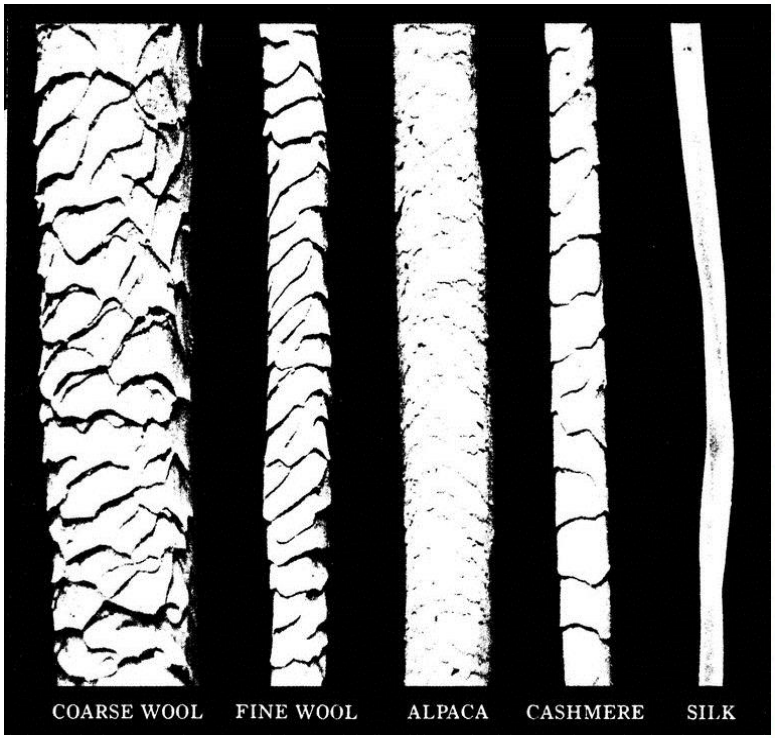
Fur is a good donor of fibers, but not for textiles. Instead, fur is left on the skin and treated, then used to make **coats** and gloves.

Natural Fibers

Animal fibers

Hair can be **brushed** out of an animal's coat, **shed** naturally and collected, or **clipped** off.

- Sheep- **wool**
- Goats- **cashmere**, mohair
- Rabbits- **angora**
- Alpacas, llamas, and camels



Natural Fibers

Animal fibers

1. Silk comes from the **cocoons** of the silkworm caterpillar, *Bombyx mori*.
2. Silk fibers tend to be very long and therefore do not **shed** as easily as hair fibers.

silk

Natural Fibers

Plant fibers

i. All plant fibers are made of **cellulose**, a **carbohydrate** polymer.

ii. Plant fibers are grouped by the **part** of the plant that they come from.

- Seed- **cotton**
- Fruit- Coir

(surrounding of a coconut)

- ❖ Often used for **doormats** and baskets.

Natural Fibers

Plant fibers

- Stem
  - ❖ **hemp** (*Cannabis*)- popular alternative to cotton
  - ❖ **jute**- used in rope, mats, handbags, burlap sacks
  - ❖ flax- used in **linen**

Natural Fibers

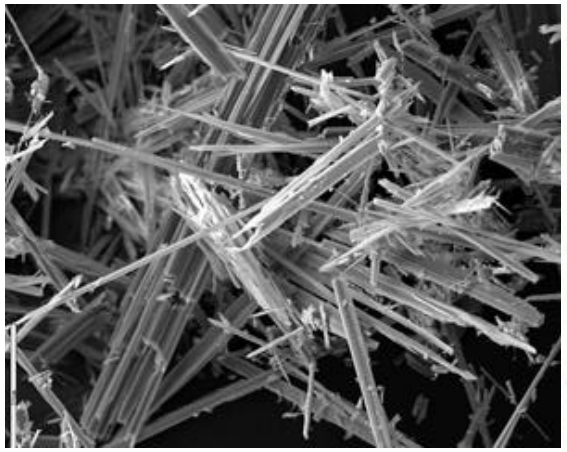
Plant fibers

- Leaf
  - ❖ **Manila**, relative of the banana tree- used to make paper and envelopes
  - ❖ Sisal, a desert plant- used to make **rope**, twine, and netting.

Natural Fibers

Mineral fibers

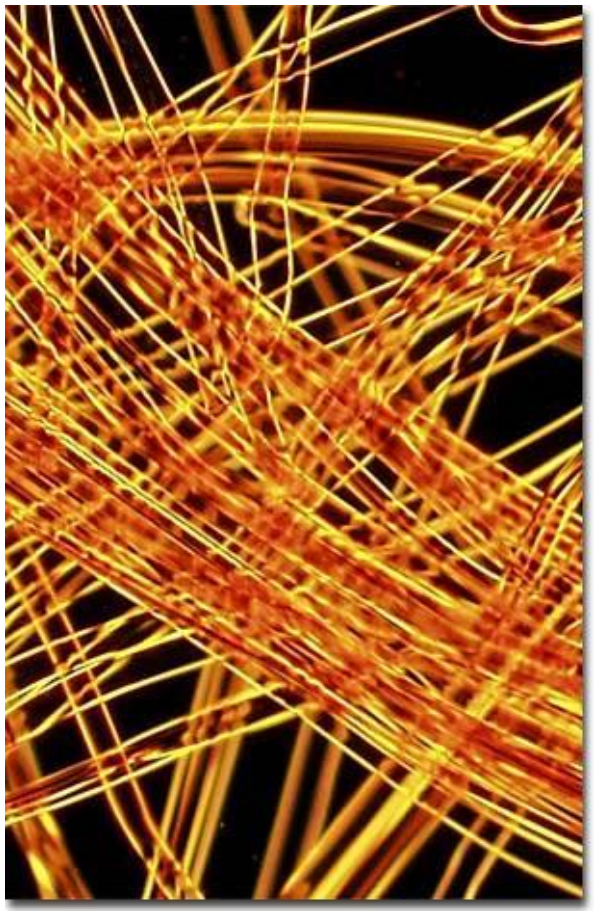
- Mineral fibers are **neither** protein nor cellulose.
  - **Fiberglass**- a fiber form of glass; used to insulate buildings
  - **Asbestos**- mineral found in rocks; used mainly because of its **fire** resistance. Found around pipes and fireplaces, in ceiling and floor tiles, fire resistant cloth, shingles, home siding, and insulation.
    - Asbestos is known to cause **cancer**. When broken we can inhale tiny fragments and damage the lungs. **Scar** tissue can then become cancerous.



Synthetic Fibers

Half of the fabrics produced today are **man**-made, synthetic fibers.

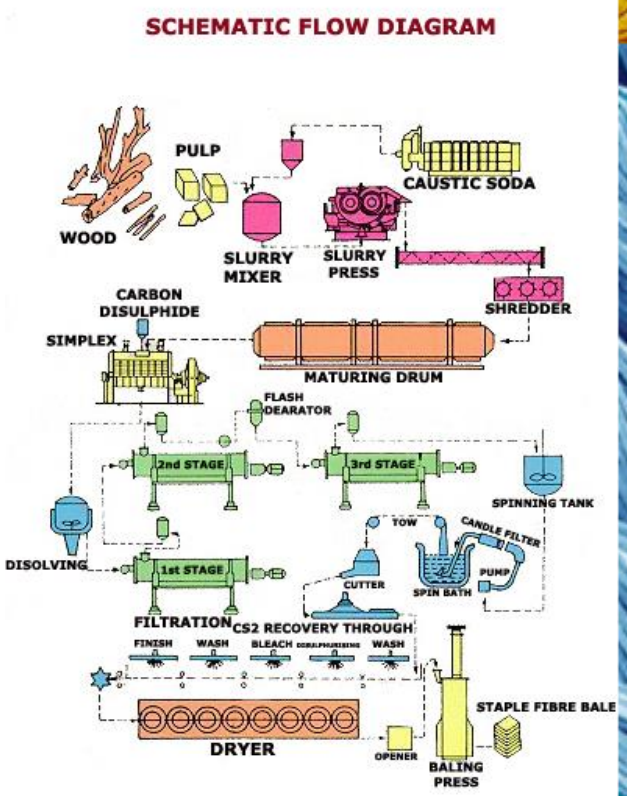
- Synthetic fibers are made of **polymers** which are long string of repeating chemical units, called **monomers**.
- By varying the chemical structure of the monomers or by varying the way they are weaved together, polymers are created that have different **properties**. As a result of these differences, forensically they can be distinguished from one another and be used as physical evidence.
- They can be broken down into two groups: **Regenerated** fibers and **Synthetic** polymer fibers



Synthetic Fibers

Regenerated Fibers

- Cellulose esters-- These are derived from cellulose and produced by chemically **modifying** the natural polymers to create an entirely new compound **not** found in nature. Examples:
  - ❖ **Rayon**- most common. first man-made fiber; soft, versatile.
  - ❖ **Acetate**- less expensive, less polluting than rayon.

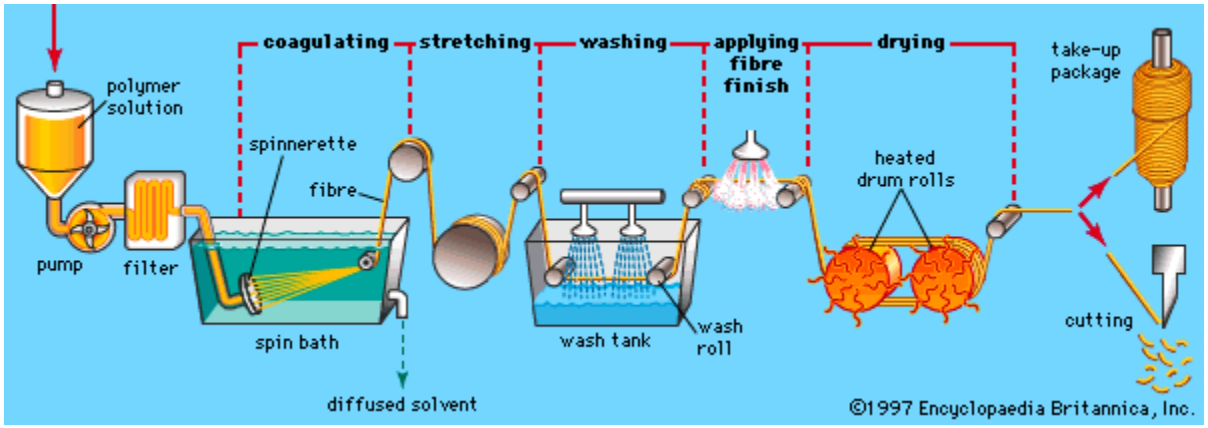


Synthetic Fibers

Synthetic Polymer Fibers

i. Petroleum Plastics- these originate from derivatives of petroleum, coal and natural gas. They are **totally** man-made. Examples:

1. **Nylon**- most durable man-made fabric; extremely light weight. First introduced as artificial silk for pantyhose.
2. **Acrylic**- most widely used man-made fiber. Inexpensive and tends to ball easily.
3. **Polyester**- -provides warmth from a lightweight, soft and resilient fabric. Common in polar fleece and many wrinkle resistant pants.
4. **Spandex**- extreme elastic properties.

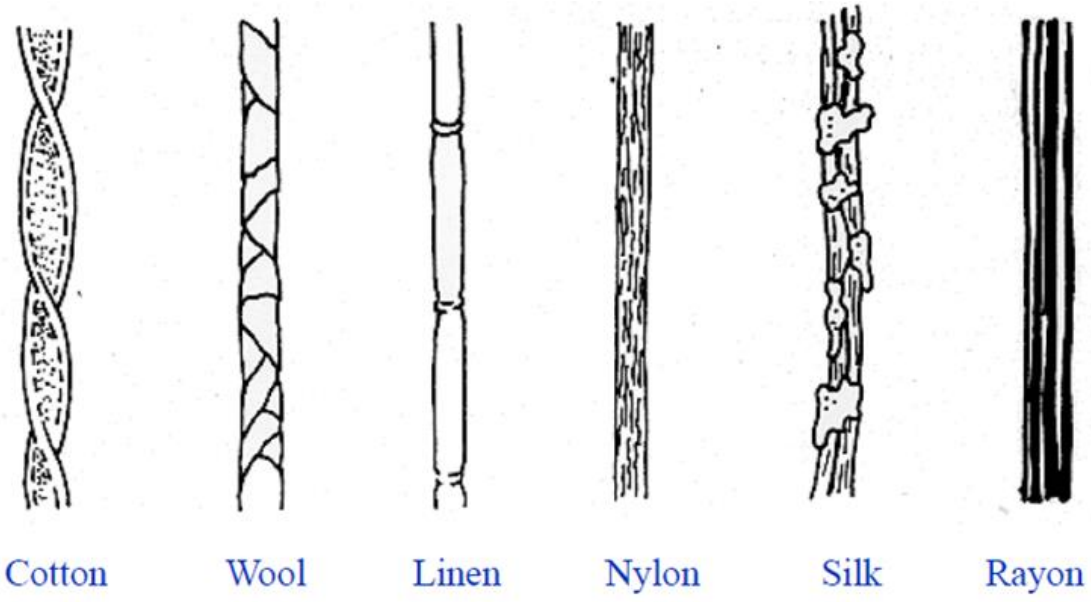


Comparison of Natural and Synthetic Fibers

a. Synthetic fibers are much **stronger** than natural fibers.
b. Unlike natural fibers, synthetic fibers are not **damaged** by microorganisms.
c. Synthetic fibers can deteriorate in bright **sun** and melt at a **lower** temperature than natural fibers.
d. Under magnification, all synthetic fibers have very regular **diameters**.
e. Hairs have a **cuticle**.

Wool Fiber

Synthetic Fiber



Activity:

Find a partner and compare the fabric of your shirts. (What do they look like? Feel like?)

Then look at the tag inside your shirts. (What are your shirts made of? Did you expect this?)