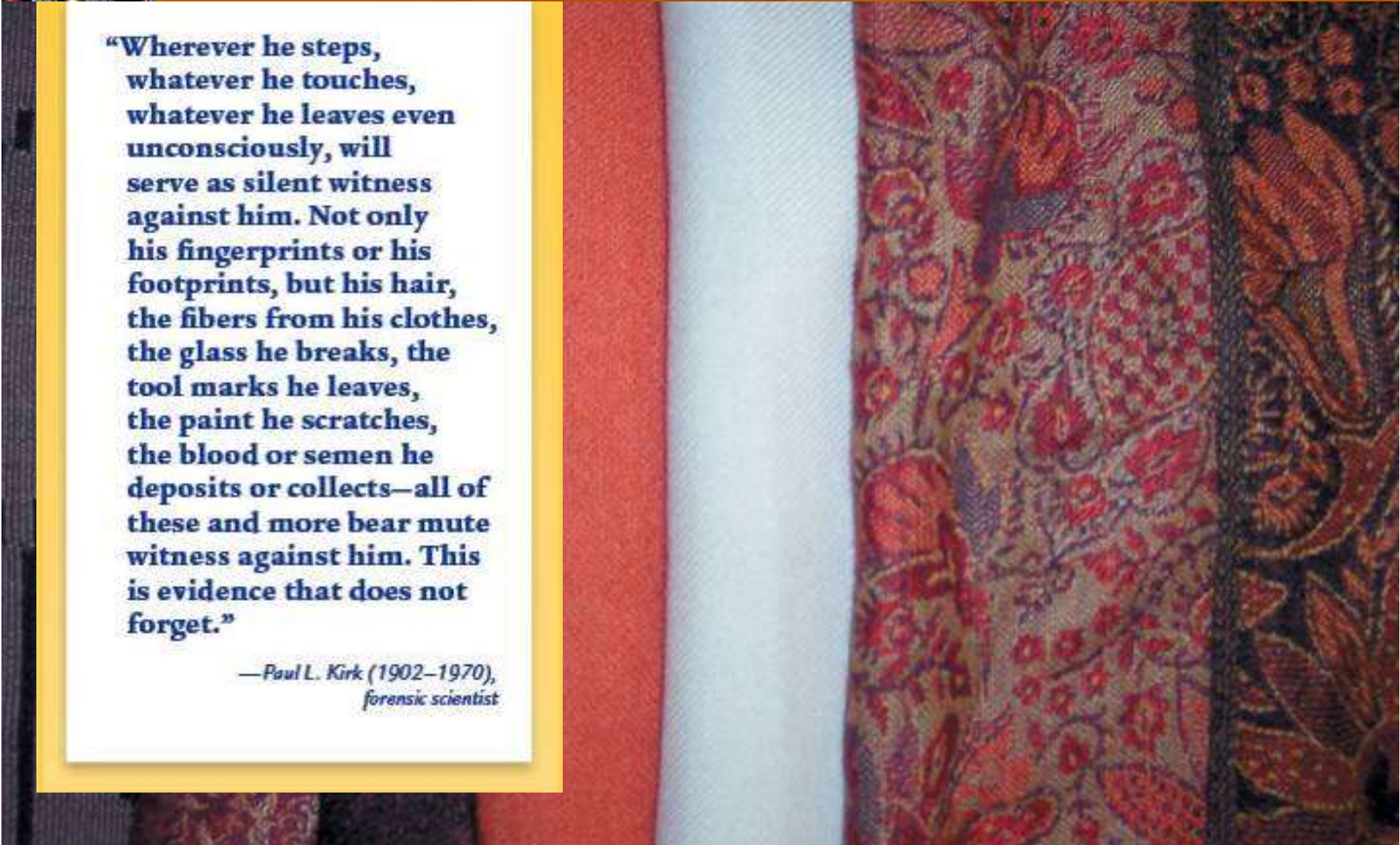




Fibers

**“Wherever he steps,
whatever he touches,
whatever he leaves even
unconsciously, will
serve as silent witness
against him. Not only
his fingerprints or his
footprints, but his hair,
the fibers from his clothes,
the glass he breaks, the
tool marks he leaves,
the paint he scratches,
the blood or semen he
deposits or collects—all of
these and more bear mute
witness against him. This
is evidence that does not
forget.”**

*—Paul L. Kirk (1902–1970),
forensic scientist*



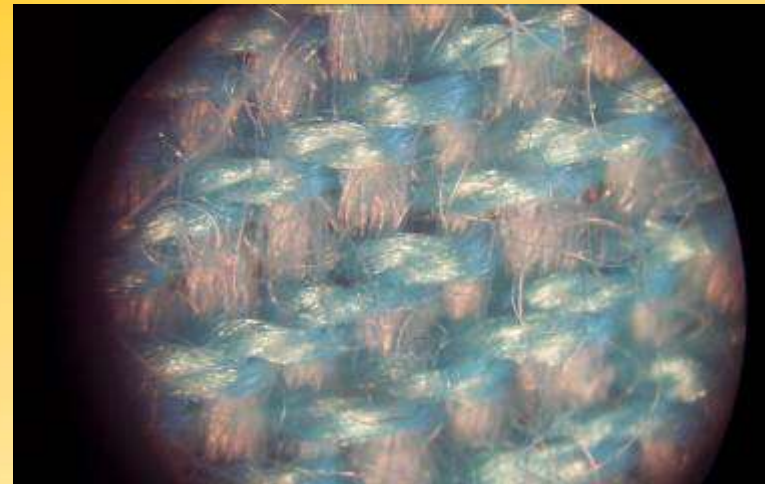
Fibers

Are considered class evidence

Have probative value

Are common trace evidence at a crime scene

Can be characterized based on comparison of both physical and chemical properties



Fabric

Fabric is made of fibers. Fibers are made of twisted filaments.

Types of fibers and fabric:

Natural—animal, vegetable, or inorganic

Artificial—synthesized or created from altered natural sources



Types of Fibers

Synthetic

Rayon
Nylon
Acetate
Acrylic
Spandex
Polyester



Natural

Silk
Cotton
Wool
Mohair
Cashmere

Classification

Natural fibers are classified according to their origin:

Vegetable or cellulose

Animal or protein

Mineral



Cellulose Fibers

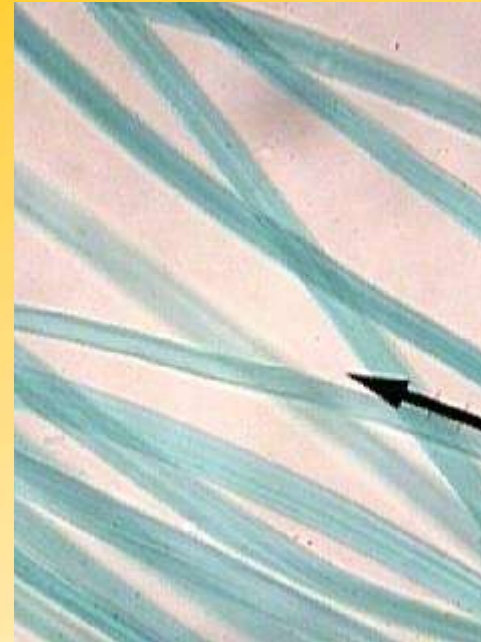
Cotton—vegetable fiber; strong, tough, flexible, moisture-absorbent, not shape-retentive

Rayon—chemically altered cellulose; soft, lustrous, versatile

Cellulose acetate—cellulose that is chemically altered to create an entirely new compound not found in nature



Fiber Comparison



Can you describe the difference(s) between the cotton on the left and the rayon on the right?

Protein Fibers

Wool—animal fiber coming most often from sheep, but may be goat (mohair), rabbit (angora), camel, alpaca, llama, or vicuña

Silk—insect fiber that is spun by a silkworm to make its cocoon; the fiber reflects light and has insulating properties



Mineral Fibers

Asbestos—a natural fiber that has been used in fire-resistant substances

Rock wool—a manufactured mineral fiber

Fiberglass—a manufactured inorganic fiber

Synthetic Fibers

Made from derivatives of petroleum, coal, and natural gas

Nylon—most durable of man-made fibers; extremely lightweight

Polyester—most widely used man-made fiber

Acrylic—provides warmth from a lightweight, soft, and resilient fiber

Spandex—extreme elastic properties

Fabric Production

Fabrics are composed of individual threads or yarns that are made of fibers and are knitted, woven, bonded, crocheted, felted, knotted, or laminated. Most are either woven or knitted. The degree of stretch, absorbency, water repellence, softness, and durability are all individual qualities of the different fabrics.



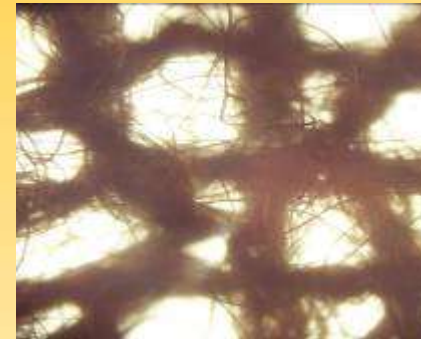
Weave Terminology

Yarn—a continuous strand of fibers or filaments that may be twisted together

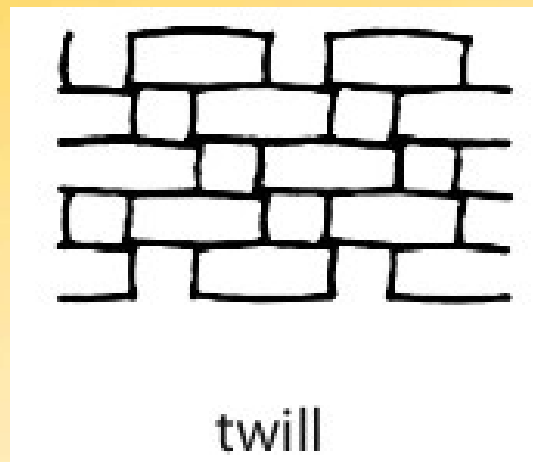
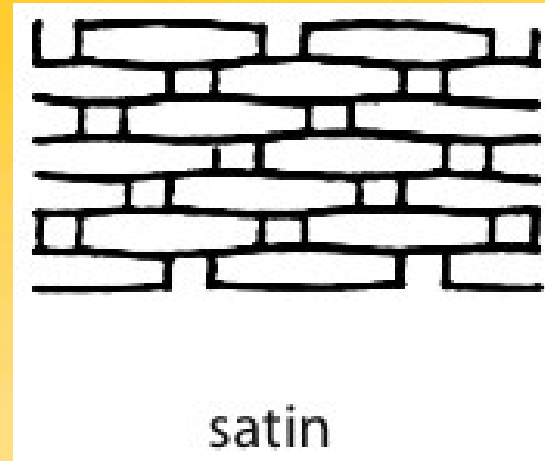
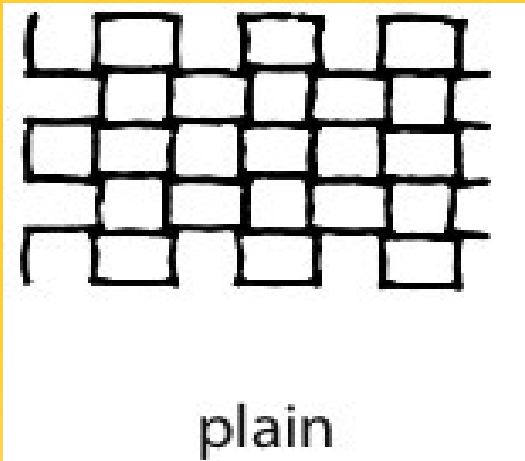
Warp—lengthwise yarn

Weft—crosswise yarn

Blend—a fabric made up of two or more different types of fibers



Weave Patterns

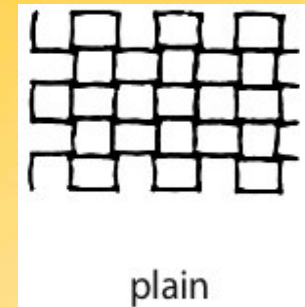


Plain Weave

The simplest and most common weave pattern

The warp and weft yarns pass under each other alternately

Design resembles a checkerboard



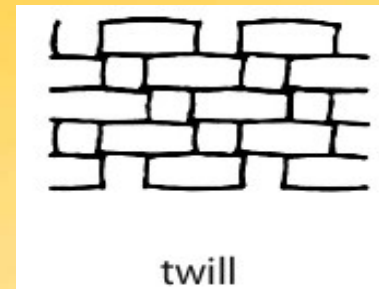
Twill Weave

The warp yarn is passed over one to three weft yarns before going under one.

Makes a diagonal weave pattern.

Design resembles stair steps.

Denim is one of the most common examples.



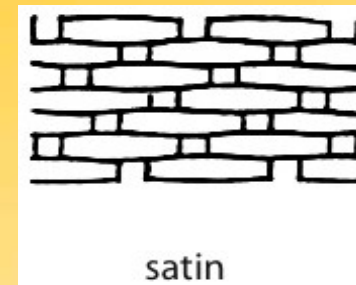
Satin Weave

The yarn interlacing is not uniform

Creates long floats

Interlacing weave passes over four or more yarns

Satin is the most obvious example



Knitted Fabric

Knitted fabrics are made by interlocking loops into a specific arrangement. It may be one continuous thread or a combination. Either way, the yarn is formed into successive rows of loops and then drawn through another series of loops to make the fabric.



Polymers

Synthetic fibers are made of polymers, which are long chains of repeating chemical units.

The word *polymer* means many (*poly*) units (*mer*).

The repeating units of a polymer are called monomers.

By varying the chemical structure of the monomers or by varying the way they are joined together, polymers are created that have different properties.

As a result of these differences, they can be distinguished from one another forensically.

Filament Cross Sections



Round



4-lobed



Trilobal



Octalobal



Irregular

Dogbone or
DumbbellMulti-lobed
or Serrate

Synthetic fibers are forced out of a nozzle when they are hot, and then they are woven. The holes of the nozzle are not necessarily round; therefore, the fiber filament may have a unique shape in cross section.

Testing for Identification

Microscopic observation

Burning—observation of how a fiber burns, the odor, color of flame, color of smoke, and the appearance of the residue

Thermal decomposition—gently heating to break down the fiber to the basic monomers

Chemical tests—solubility and decomposition



Testing for Identification

Density—the mass of an object divided by the volume of the object

Refractive index—measurement of the bending of light as it passes from air into a solid or liquid

Fluorescence—absorption and reemission of light; used for comparing fibers as well as spotting fibers for collection



Dyes

Components that make up dyes can be separated and matched to an unknown.

There are more than 7,000 different dye formulations.

Chromatography is used to separate dyes for comparative analysis.

The way a fabric accepts a particular dye may also be used to identify and compare samples.



Collection of Fiber Evidence

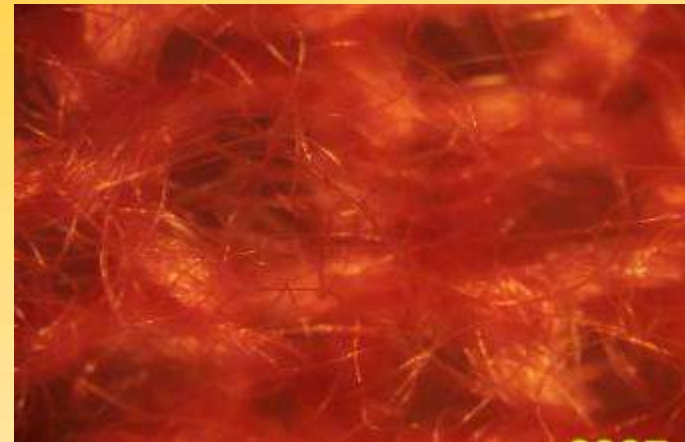
Bag clothing items individually in paper bags. Make sure that different items are not placed on the same surface before being bagged.

Make tape lifts of exposed skin areas and any inanimate objects.

Removed fibers should be folded into a small sheet of paper and stored in a paper bag.

Fiber Evidence

Fiber evidence in court cases can be used to connect the suspect to the victim or to the crime scene. In the case of Wayne Williams, fibers weighed heavily on the outcome of the case. Williams was convicted in 1982 based on carpet fibers that were found in his home, in his car, and on several murder victims.



More about Fibers

For additional information about fibers and other trace evidence, check out truTV's Crime Library at:

www.crimelibrary.com/criminal_mind/forensics/trace/1.html