Wool is the most commonly used animal fiber. The fiber is obtained from the soft, hairy covering of sheep and sometimes goats. Under the microscope, the wool fiber looks like a long cylinder with scales on it. The fiber is very curly and springy. Cloth made from wool includes cashmere, camel's hair, alpaca, covert cloth, flannel, gabardine, mohair, serge, tweed and worsted.

Silk, another common animal fiber, was once quite popular, but has been replaced to a great extent by such synthetic fibers as Nylon, Orlon, and Dacron. Silk is made by the mulberry silk worm when spinning its cocoon. Under the microscope the silk fiber appears as a thin, long, smooth and lustrous cylinder. Cloths made from silk include brocade, brocatelle, chiffon, crepe, velvet, crepe de Chine, foulard, lame, moiré, satin, taffeta, tulle, and falle.

Cotton is the most widely used plant fiber. Cotton fibers are the hairs found on the seeds of the cotton plant. If possible, obtain a cotton boll on its stem. Examined under a microscope, the cotton fibers (use a few strands of absorbent cotton) will look like a flattened, irregular, twisted ribbon. Many high school chemistry and physical science textbooks (and books on identifying textiles) have excellent pictures of fibers as seen through a microscope.

Cloths made from cotton area cheesecloth, organdy, chintz, gingham, crinoline, muslin, percale, calico, velveteen, seersucker, some poplin, sail cloth and canvas. Most cotton thread has been treated to make it smooth and lustrous; this is done by stretching the cotton and immersing it in a concentrated solution of cold sodium hydroxide (lye). Cotton treated in this manner is said to be mercerized.

Another common plant fiber is linen, which comes from the flax plant. This fiber is linen, which comes from the flax plant. This fiber is long, lustrous, and smooth. Under the microscope it looks like bamboo can, with jointed cells and split, tapered ends. Point out that linen is often used to make handkerchiefs, tablecloths, napkins, summer clothing and blouses.

Jute and hemp, other plant fibers, are not as fine as cotton and linen, and are used to make carpet backing rope, twine and sacks.

Rayon is one of the first successful artificial fibers. It is made from cellulose. When manufactured, the rayon fibers resemble silk. Under the microscope, the rayon fiber looks like a smooth, lustrous cylinder. Rayon can be made into cloth that is hard to distinguish from silk, cotton, linen, or wool. Celanese is one form of rayon.

Today there is a wide variety of synthetic fibers; all have trade names such as Nylon, Orlon, Dacron, Vinyon, Aralac, Acrilan, Velon, Dynel, Banlon and Lycra. Like rayon, these fibres resemble silk, and under the microscope look like smooth, lustrous cylinders. Synthetic fibers are easily identified because of their uniform thickness (the thickness of natural fibers varies). Synthetic fibers area made into fabrics that have special properties..

Glass and asbestos can also be spun into thread and woven into fabrics. Glass fibers are made by stretching melted glass into fine filaments, which are spun into thread for weaving into cloth. Lightweight glass fibers are used to make long lasting windows curtains, drapes, and lamp shades. Heavier glass fabrics are used to make fireproof theater and school curtains.

Asbestos is the name given to a group of minerals that occur naturally as masses of strong, flexible fibers that can be separated into thin threads and woven to make asbestos cloth. These fibers are not affected by heat or chemicals and do not conduct electricity. Asbestos cloth was used in fireproof theater curtains and protective suits for use by fire fighters. It was also used as a building material, brake pads and a range of other products.

It is now know that the fibers of asbestos are a dangerous irritant. Even exposure to small amounts of asbestos dust can lead to a range of illnesses such as asbestosis, a serious lung inflammation caused by asbestos exposure, and Mesothelioma a cancer of the chest and abdomen. Although asbestos products are rarely made these days, they can still be found, particularly in old buildings.

References;

***** **Handweavers and Spinners Guild of Victoria Inc**

Hair Structure and Life Cycle

Structure of Hair

Hair is composed of strong structural protein called keratin. This is the same kind of protein that makes up the nails and the outer layer of skin.

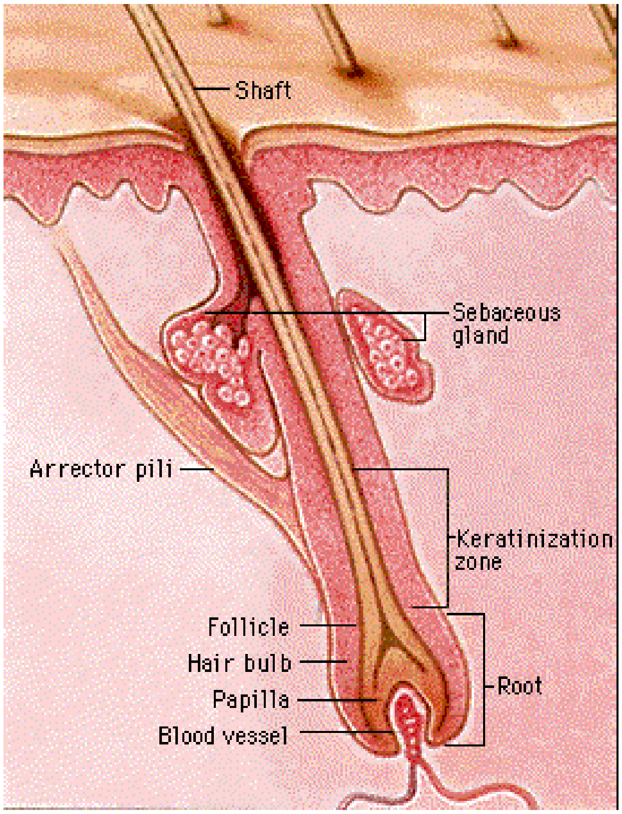
Each strand of hair consists of three layers.

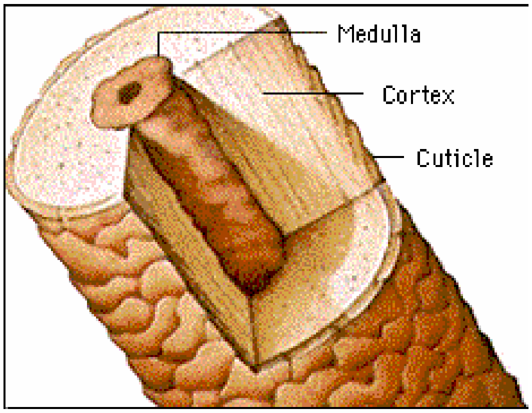
1) An innermost layer or medulla which is only present in large thick hairs.
2) The middle layer known as the cortex. The cortex provides strength and both the color and the texture of hair.
3) The outermost layer is known as the cuticile. The cuticle is thin and colorless and serves as a protector of the cortex.

Structure of the hair root

Below the surface of the skin is the hair root, which is enclosed within a hair follicle. At the base of the hair follicle is the dermal papilla. The dermal papilla is feed by the bloodstream which carries nourishment to produce new hair. The dermal papilla is a structure very important to hairgrowth because it contains receptors for male hormones and androgens. Androgens regulate hairgrowth and in scalp hair Androgens ma cause the hair follicle to get progressively smaller and the hairs to become finer in individuals who are genetically predisposed to this type of hair loss.

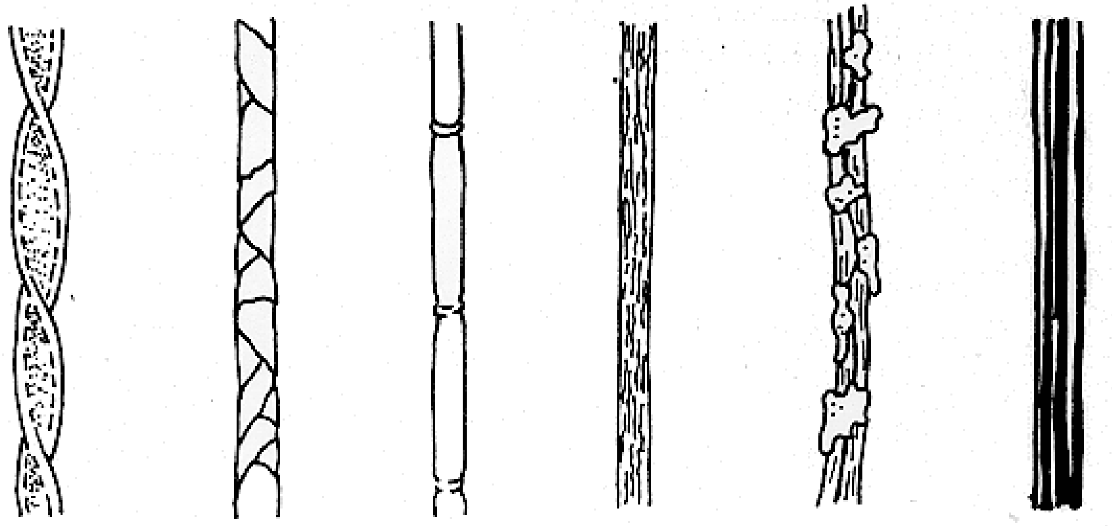
Parts of a hair





The diagram on the right shows the parts of a human hair. A hair develops from the cells of the hair bulb. These cells move up to form the root and then the shaft of the hair. The diagram on the left shows the three layers of dead cells that make up a hair

The first step in identifying a fibre is to determine its type. Not long ago, most fabrics were made of wool, cotton, linen or silk. It was easy to identify them just be feeling and looking. Today a wide variety of synthetic fibres has appeared on the market, and manufacturers have learn how to combine many fibres in making a single fabric, making it difficult to analyze completely or identify all fabrics.



Cotton WoolLinen Nylon Silk Rayon

Most natural fibres such as wool, cotton, and linen, have distinctive appearances that can be detected under the microscope. Wool, for example, being an animal hair, has a pattern of surface scales (although wool that is re-used may have lost there surface scales in the processing). Silk and most synthetic fibres, which are produced by the drawing out and solidifying of a liquid, have smooth surfaces. This characteristics makes them difficult to distinguish one from another merely by looking at them through the microscope in normal light.

A synthetic fibre that cannot easily be identified with the microscope can be subjected to a newer technique, called *infrared* *spectrophotometry*. This process takes advantage of the fact that all compounds absorb characteristic wavelengths of radiation. For example (to consider only visible radiation), a leaf looks green because it contains chlorophyll, a chemical that absorbs light mainly from the red and blue end of the visible spectrum, but reflects light mainly in the yellow and green wavelengths.

A scientist can identify a substance, or find our what compounds it contains, by looking at the way it absorbs light. If a beam of light containing all wavelengths is passed through the substance, and the emerging light is spectrum will appear dim and in other places bright. This variation indicates parts of the spectrum that suffer the most absorption that is those that are the dimmest are called the substance's *absorption bands*. For a specific chemical substance, the pattern of absorption bands is, in some cases, unique. It serves as a kind of "signature" for that substance. This "signature" can be detected and recorded by a machine called a *spectrophotometer*.

Besides absorbing visible light, compounds will also absorb invisible wavelengths, such as ultraviolet or infrared rays. These are the wavelengths just beyond the blue and the red ends (respectively) of the visible spectrum. Because the infrared band extends over a much wider range of wavelengths that does the ultraviolet or the visible band, it will provide a more complete signature for the substance.

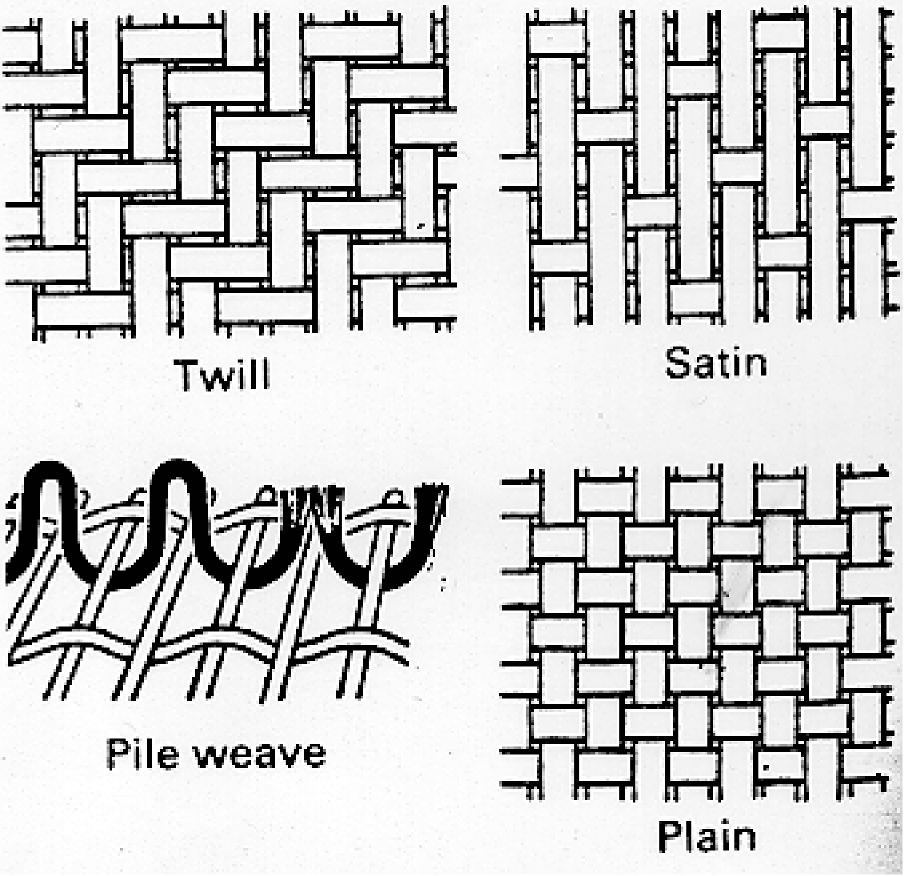
When analyzing a substance by infrared spectrophotometry, the forensic scientist first mixes it with dry salt (sodium chloride) and forms it into a disk. Salt is used because it is transparent to infrared rays. He then focuses infrared light onto the disk. The light emerges from the disk minus those wavelengths that have been absorbed by chemicals present in the sample. The emerging rays are broken into a spectrum by a prism of rock salt. The light intensities in this spectrum are then measured and plotted electronically by the spectrophotometer. The machine produces a graph of peaks and troughs. The pattern of the graph corresponds to the pattern of absorption bands. By referring to known signatures for various compounds and comparing these with the signature produced by the sample, the scientist can tell which compounds the sample contains. He can also tell from the graph how much of a compound is contained in the sample and can thus identify, for example, the origin of fibres.

If a sample of fabric is available a forensic scientist might look at the construction of the fabric to help trace it back to a particular type of clothing or particular weave patterns in the fabric might help in the search for evidence. Some common weaving patterns are shown at the right.

The edges and shape of a piece of cloth might also be examined to help in making a physical fit with clothing or fabric from a crime scene, victim or suspect.

There are also some simple tests which help greatly in distinguishing fabrics, the most common being the burning test and chemical tests.

Clues from Hair



These days hair may be used to help identify individuals through DNA analysis. Traditional methods of hair analysis are still used as hair evidence will not always allow DNA analysis or the DNA analysis may be inconclusive or even not useful.

Some preliminary examination of the hair may also help in determining the value and direction of the DNA analysis. If physical analysis tells you the hair has no root material attached than DNA analysis will probably not be helpful. If it tells you you have dog hair it is no use testing a suspect, though it might be worth testing his dog!

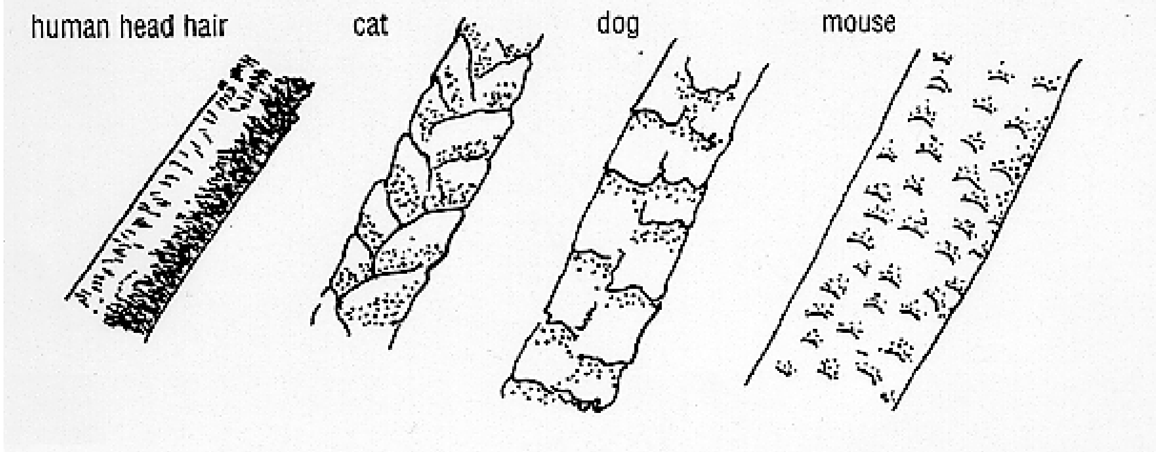
Microscope examination of hair can determine the following information:

- Whether it is human or animal
- If human, which race
- Whether it fell out or was pulled
- If animal, which species
- The part of the body it came from
- How it was cut or dressed

How do they do this?

When it is sent for examination to the Forensic Science Laboratory hair is normally dry mounted on a glass slide for viewing under a comparison microscope.

To examine it in cross section, the specimen is mounted in a wax block from which wafer-thin slices are cut and mounted on glass slides. The cross-sectioned shape and appearance of the medulla is then viewed microscopically. Impressions of the cuticular scales are sometimes made on cellulose acetate for detailed study. The forensic scientist also has a variety of tests available for dealing with dyed hair and examining for age.



Some pictures of different hairs and fibres under magnification.

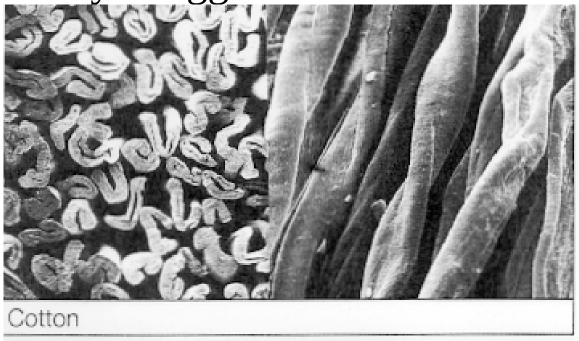
The brilliance of the forensic laboratory cannot shine, however, without the most thorough and painstaking work of investigating officers at the scene of the crime: fortunately, in regard to hair nature is on the side of the crime investigator. The hair of every part of the body has a definite period of growth and is continuously lost and replaced: minute examination of clothing and other articles can therefore pay dividends. Identification cannot be made with certainty on hair evidence alone. Hair may also be treated or dressed to alter its natural appearance. This may help or confuse identification. The best the scientist can do is to say that a suspect's hair matches a crime sample. This can prove valuable corroborating evidence of guilt as numerous murder cases have shown.

Decomposed remains

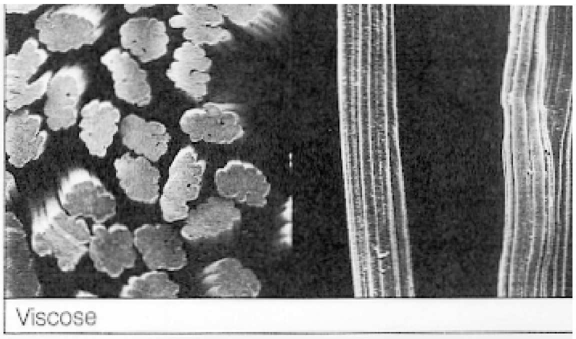
Evidence provided by hair has played an important part in a number of murder investigations. In October 1942, the badly decomposed remains of a woman's body were found buried on a heath near Godalming, Surrey. It was estimated that the body had been lying in the heather for about five weeks. This was the so called "Wigwam" murder, in which the victim, who had been stabbed and beaten about the head, lived in a crude shelter made of branches and heather.

Police searching the heathland made several discoveries which enabled them to confirm the victim's identity as Joan Peale Wolfe. They also found a heavy birch branch with hair adhering to it lying in long grass about 400 yards from the body. Laboratory examination identified this as the weapon responsible for the head injuries; nine head hairs sticking to the heavy end of the branch proved to be identical with the head hair of the victim. August Sangreat, a French Canadian solider from a nearby camp, had been living with the girl in the "Wigwam" for several months. He was tried for murder found guilty and executed at Wandsworth

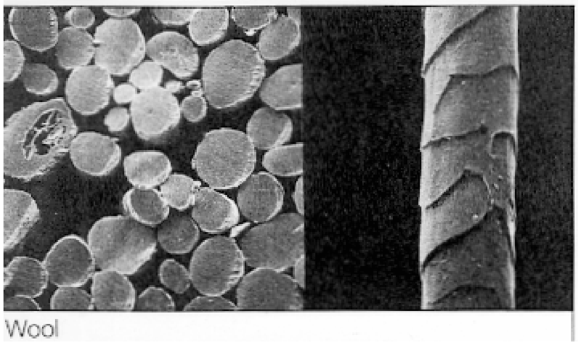
In any struggle between victim and attacker hairs and fibres from one are inevitably transferred to the other. The importance of hair in criminal investigation was realised at an early stage in the development of forensic science, and one of the first scientific papers on the subject was published in France in 1857. By the early 1900s microscopic examination of hair was well established, and in 1931 Professor John Glaister published his *Hairs of Mammalia from the Medico-legal Aspect*, which became a standard reference work.



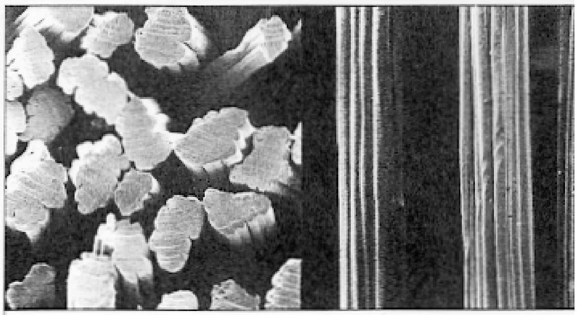
Cotton



Viscose



Wool



Triacetate

Hair can provide crime investigators with important clues. Apart from burning, hair is virtually indestructible. It remains identifiable even on bodies in an advanced state of decomposition or attached to objects after a crime has been committed.

The forensic scientist using a microscope can make even a single head hair yield information about the race, sex an age of its owner, and while hair does not have the same individual character as a fingerprint it can provide vital evidence. For example, in August 1951, a woman's body was found in a rural sport near Nottingham. The victim, Mable Tattershaw, a 48 year old housewife, had been strangled. Minute inspection of her clothing revealed some hairs which were immediately sent to the forensic laboratory, where microscope examination showed them to be identical with the head hair of Leonard Mills, an 18 year old clerk and the chief suspect. Together with other damning evidence, these hairs helped to take a murderer to the scaffold.

Cloth fibres are often found at the scene of the crime or on a suspect. In some cases, a small piece of cloth may be found. The police may even find a matching piece of cloth whose torn edge will fit the torn edge of the first piece. Such a match is called a jigsaw fit. Most cloth is made of fibres woven or intertwined in some way. The kind of fibre and the way in which it is intertwined determine the character of the resulting cloth.

More often, the police have only tiny fibres with which to work. It is surprising how often such fibres are left behind, or picked up, by the criminal. A sweater will shed its own fibres easily and hold foreign fibres deposited by contact. Even a closely woven garment, rubbing against a door jamb will leave a few fibre fragments. A car striking a pedestrian is likely to pick up tiny fragments of the victim's clothing, even if only a smooth part of the car comes into contact with the person. These fibres can be removed from the car by applying sticking tape to the surface, pulling the tape away, and the removing the fibres from the tape with liquid.

What is hair used for?

Unless it is burnt, hair is extremely durable. It remains identifiable on bodies in an advanced state of decomposition or attached to a murder weapon long after the crime is committed. Hair is composed of protein substances, chiefly keratin, and head hair grows at an average weekly rate of about 2.5mm, the beard growing faster and body hair more slowly. Growth ceases at death, but as the skin shrinks the hair, especially the beard, becomes more prominent, giving rise to the murder myth that hair grows after death. The absorbent property of hair makes its examination important in cases of arsenic poisoning. Hair picks up the poisons from the bloodstream, and it is possible to work out the approximate strength and frequency of the dosage by analysis.

Hair can be used in helping to reconstruct events. Collection of hair and fibres can indicating contact with surfaces or individuals and so where individuals have been. Examination of the root structure can indicate whether hair has fallen out or been forcefully removed, indicating a struggle.

These days hair can also be used to assist identification through DNA analysis. If some root structure is present standard DNA profiling can be used. Even if you only have the shaft, mitochondrial DNA testing can be tried.

Learn more about hair?

What are Fibres?

Fibres are the basic unit of raw material in textile production having suitable length, pliability, and strength for conversion into yarns and fabrics. A fibre of extreme length is a filament. Fibres can occur naturally or can be produced artificially. Fibres also cover some structural materials as in asbestos fibres (rare these days) and glass fibres.

Not long ago, most fabrics were made of wool, cotton, linen or silk. It was easy to identify them just be feeling and looking. Today a wide variety of synthetic fibers has appeared on the market, and manufacturers have learn how to combine many fibers in making a single fabric, making it difficult to analyze completely or identify all fabrics. However, there are some simple tests which help greatly in distinguishing fabrics, the most common being the burning test and chemical tests.