

## A Fiber Glossary

the crimp make it possible to spin and felt the fleece. These characteristics help the individual fibers “grab” each other so that they stay together. They also make the product retain heat, as they trap heat in their bends. Insulation works both ways — bedouins use wool clothes to keep heat out.

The amount of crimp corresponds with the fineness of the wool fibers. A finer wool, such as merino, may have up to a hundred crimps per inch, where the coarser wools, like karakul, may have as few as one to two crimps per inch.

Hair, by contrast, has little if any scale and no crimp and little ability to bind into yarn. On sheep, the hair part of the fleece is called kemp. The relative amounts of kemp to wool vary from breed to breed, and make some fleeces more desirable for spinning, felting or carding into batts for quilts or other insulating products.

Wool grows in several natural colors such as black, brown (also called moorit) grey and the most commonly available white. Wool of any color takes dye easily and can be felted. Wool straight off a sheep is highly water-resistant. Wool also retains heat better than most fabrics when wet.

**History:** As a raw material, wool has been readily available since the widespread domestication of sheep and similar animals. The use of wool for clothing and other fabrics dates back to some of the earliest civilizations. In medieval times, the wool trade was serious business. English wool was a significant source of income to the crown. British laws controlled the wool trade, required the use of wool even in burials, and even forbade its American colonies to trade wool with anyone but England itself. Australia and New Zealand are currently the leading commercial producers of wool, however now Texas, New Mexico and Colorado also have large commercial sheep flocks.

**Uses:** In addition to clothing, wool has been used for carpeting, felt, and padding. Wool felt covers piano hammers, and it is used to absorb odors and noise in heavy machinery and stereo speakers. The ancient Greeks lined their helmets with felt, and Roman legionnaires used breastplates made of wool felt. Wool is also the main ingredient in creating flannel.



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Fashionable Questions... Careful Answers

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In This Issue...

## A Glossary of Fibers

### Some basic definitions:

**CLOTH** or **FABRIC** is a flexible artificial material made up of a network of natural or artificial fibers (thread or yarn) formed by weaving or knitting (textiles), or pressed into felt.

In the past, all cloth was made from natural fiber, including plant sources such as cotton, flax, and hemp, and animal sources such as wool, hair, and silk. In the 20th century, these have been supplemented by artificial fiber such as polyester and rayon.

Cloth is most often dyed, and fabrics are available in every color. Colored designs in fabric can be created by weaving in strands of different colors (plaid), adding colored stitches to finished fabric (embroidery), and by using various printing processes on finished fabric. Cloth is made in many varying strengths and degrees of durability, from the finest sheer fabrics to sturdy canvas sailcloths.



**TEXTILE:** A generic term which applies to any woven or knit cloth.

**FIBER:** The fundamental unit comprising a textile's raw material such as cotton, wool, etc. Fibers may be the long single-celled seed hairs of cotton, the multi-celled structures of wool, the groups of elongated cells found in flax, or the man-made filaments of nylon, polyester, and rayon. Think of “natural fibers” as things that “tie together” the parts of natural creatures or plants.

- Natural vegetable fibers generally consist of cellulose; they include cotton, linen, and hemp. Cellulose fibers are used in the manufacture of paper as well as cloth.
- Natural animal fibers include silk, sinew, hair, and wool. There are also naturally occurring mineral fibers such as asbestos.
- Man-made fibers are those that are made artificially, but from natural raw materials. Examples include fiberglass, rayon, acetate, cupro and lyocell.

- Synthetic fibers include nylon, acrylic, polyester and graphite fiber. They are 100% creations of chemists in laboratories.

Synthetic fibers and man-made fibers are the result of an extensive research by scientists to increase and improve upon the supply of the naturally occurring animal and plant fiber.

**ABACA (See also Hemp)** — A naturally occurring fiber found in the stem of the abaca plant, which is a member of the banana family. It is also known as Manila Hemp. It is widely used in marine rope and cordage, abrasive backing papers, tea bags, as well as other products that require high tensile strength.

**ACETATE** — A manufactured fiber. It is formed by a compound of cellulose, refined from cotton linters and/or wood pulp, along with acetic acid. It is extruded through a spinneret and then hardened.

Acetate can also refer to cellulose acetate. Cellulose acetate or acetate rayon fiber (1924) is one of the earliest synthetic fibers and is based on cotton or tree pulp cellulose (“biopolymers”).

Acetate was invented by two Swiss brothers, Doctors Camille and Henri Dreyfus, who originally began chemical research in a shed behind their father’s house. In 1905, Camille and Henri developed a commercial process to manufacture cellulose acetate. They initially focused on cellulose acetate film, widely used in the motion picture industry. By 1913, Camille and Henri’s studies and experiments had produced excellent laboratory samples of continuous filament acetate yarn. In 1924, the first commercial acetate filament was spun in the United States.

### Acetate fiber characteristics as related to clothing:

- Luxurious feel and appearance
- Wide range of colors and lusters
- Excellent drapability and softness
- Relatively fast drying
- Shrink, mold and mildew resistant
- Hypoallergenic
- Hydrophilic: acetate wets easily, with good liquid transport and excellent absorption; in textile applications, it provides comfort and absorbency, but also loses strength when wet
- Made from a renewable resource (reforested trees), completely recyclable
- Can be dyed, however special dyes and pigments are required since acetate does not accept dyes ordinarily used for cotton and rayon
- Easily weakened by strong alkaline solutions and strong oxidizing agents
- Can usually be wet cleaned or dry cleaned and generally does not shrink

### Major acetate fiber uses:

- **Apparel:** blouses, dresses, linings, wedding and party attire, home furnishings, draperies, upholstery and slip covers
- **High absorbency products:** diapers, feminine hygiene products, cigarette filters, surgical products, and other filters

- **Common synthetic fibers:** Rayon (1910), Acetate (1924), Nylon (1939), Modacrylic (1949), Olefin (1949), Acrylic (1950), Polyester (1953), and PLA Polylactide (2002).
- **Specialty synthetic fibers include:** Vinyon (1939), Saran (1941), Spandex (1959), Aramid (1961), PBI (1983), Sulfar (1983), Lyocell (1992).
- Other synthetic material used in fibers: Acrylonitrile rubber (1930)

Modern fibers that are made from older man-made materials include:

- **Glass fiber:** Used in industrial, automotive, and home insulation (Fiberglass), reinforcement of composite and plastics, and specialty papers in battery separators and filtration.
- **Metallic fiber (1946):** Adds metallic properties to clothing for the purpose of fashion, elimination and prevention of static charge build up, conducting electricity to transmit information, and conduction of heat.

**TEFLON®** — DuPont’s trademark for a fluorocarbon fiber with unusually high resistance to chemicals and heat. Used primarily in sewing thread and industrial applications for pump and valve packing, filters, gaskets, protective clothing, and electrical and surgical uses. It is also used as a protective fabric finish.

**TENCEL (See Lyocell)** — The brand name for a man-made, natural fiber called lyocell.

**TRIACETATE** — A manufactured fiber, which, like acetate, is made by modifying cellulose. However, even more acetate groups have been added to create this fiber. Triacetate is less absorbent and less sensitive to high temperatures than acetate. It can be hand or machine washed and tumble dried, it’s shrink and wrinkle resistant, is easily washed, and fabrics tend to maintain pleat creases and a crisp finish. Used a great deal in dresses, skirts and sportswear where pleat retention is important.

**VICUÑA** — A variety of wool made from the fleece of the Vicuña llama, the smallest species of llama and also an endangered species protected by the Peruvian government. The animal is native to the high Andean regions of Ecuador, Peru, Bolivia and northwestern Argentina. It is considered by many to be the finest of all animal fibers and is extremely rare and expensive.



**WOOL** — The fiber or fabric made from the fleece of sheep or lamb. However, the term “wool” can also apply to all animal hair fibers, including the hair of the Cashmere or Angora goat or the specialty hair fibers of the camel, alpaca, llama, or vicuna.

**Wool vs. Hair or Fur:** Most of the fiber from domestic sheep has two qualities that distinguish it from hair or fur: (1) it is scaled in such a way that it helps the animal move out burrs and seeds that might embed themselves into its skin; (*Editor’s comment: I wish my dog’s hair did that!*) and (2) it is crimped, in some fleeces more than 20 bends per inch. Both the scaling and

**History:** Silk was first developed in early China, possibly as early as 6000 BC and definitely by 3000 BC. Legend gives credit to a Chinese Empress Xi Ling Shi. Though first reserved for the Emperors of China, its use spread gradually through Chinese culture both geographically and socially. From there, silken garments began to reach regions throughout Asia. Silk rapidly became a popular luxury fabric in the many areas accessible to Chinese merchants, because of its texture and luster. Because of the high demand for the fabric, silk was one of the staples of international trade prior to industrialization.



Silk Worm Cocoons & Raw Silk

**SISAL** — A strong bast fiber that originates from the leaves of the Agave plant, which is used for hard fiber cordage and twine and also in various papers that require high strength. It is native to Central America and grown extensively in the West Indies and Africa. It's also called Sisal Hemp.

**SOYBEAN PROTEIN FIBER** — A new, healthy, comfortable and environmentally-friendly textile fiber. It's the only available "active fiber," has the luster of silk, is soft and as smooth as cashmere, has good moisture absorption, breathability, and warmth. *(For more information visit [www.swidofil.com/soybeanproteinfiberproperties.html](http://www.swidofil.com/soybeanproteinfiberproperties.html)).*

**SPANDEX** — A manufactured stretch fiber that can be repeatedly stretched over 500% without breaking, and will still recover to its original length. It is stronger and more durable than rubber. It was invented in 1959, and when first introduced it revolutionized many areas of the clothing industry. Spandex is the preferred name in North America, while "elastane" is most often used elsewhere. A well-known trademark for spandex is Invista's brand name Lycra.

**Characteristics:** In addition to being able to stretch it repeatedly it over 500% without breaking or losing its original shape, spandex is lightweight, abrasion resistant, stronger and more durable than rubber, soft, smooth, supple, dyable, resistant to body oils, perspiration, lotions, and detergents, with no static or pilling problems.

**Uses:** All types of apparel and clothing articles where stretch is desired, generally for comfort and fit, such as: athletic and exercise apparel, swimsuits, brassiere straps and bra side panels, ski pants, slacks, hosiery, socks, and belts.

**SULFAR FIBER** — A synthetic manufactured specialty fiber characterized by remarkable resistance to heat, chemicals, acids, alkalies, mildew, aging, sun light, abrasion, bleaches and solvents. Industrial uses include electrical insulation, membranes, filtration fabrics, gaskets and packaging.

**SYNTHETIC FIBERS** — The result of an extensive research by scientists over the years to increase and improve upon the supply of naturally occurring animal and plant fibers that have been used in making cloth.

- Cellulose Acetate can be converted to a wide range of products from tough, clear, impact-resistant plastics to soft, drapeable, absorbent fabrics. As a textile fiber, cellulose acetate processes well in both weaving and knitting operations, is readily dyed, and results in breathable fabrics with excellent aesthetics and comfort.

**ACRYLIC** — A synthetic fiber consisting predominantly of acrylonitrile and related chemicals. Outstanding wickability and quick drying to move moisture from the body surface. Acrylic has a soft, wool-like hand, and can be dyed in a wide range of brilliant colors. It is usually machine washable and dryable, and has excellent color and shape retention. Acrylic is also known for its excellent sunlight/UV, chlorine, moth and wrinkle resistance. Many apparel items, carpeting, and upholstery fabrics contain acrylic fiber as a component in their yarn. Acrylic is also the common name for Plexiglas.

**ALPACA** — A natural hair fiber obtained from the Alpaca, a member of the llama family, native to the South American Andes. Soft as cashmere and warmer, lighter weight, stronger and more durable than wool, natural Alpaca fiber comes in 22 basic colors with many variations and blends. It is most commonly used in fabrics made into dresses, suits, coats, and sweaters. It has a great deal of luster and resembles mohair. True Alpaca is expensive and because of that is often combined with other fibers or imitated by them.



Alpaca

**ANGORA (Goat, Rabbit)** — The hair of the Angora goat is also known as Angora mohair. The Angora goat is native to Anatolia in the Angora province of Turkey but is extensively raised today by ranchers in Texas. Angora may also apply to the fur of the domestic Angora rabbit, bred for its long, soft hair. Any apparel containing Angora rabbit hair must be labeled as such.



Angora Rabbit

The Trelicians first bred the Angora rabbit in the southern Carpathian Mountains around the sixth century. Because of the alpine climate of their homeland, Trelicians were very interested in obtaining warm clothing. They especially valued fine fiber in their wool and sought to selectively breed domesticated mountain goats for this characteristic. When the Trelicians learned they could also harvest hare fur that was even softer than their prized goat wool they naturally applied the same moniker.

**ANIDEX** — A manufactured fiber consisting of a synthetic polymer composed of a monohydric alcohol and acrylic acid. It imparts permanent stretch and recovery properties to fabrics, even after repeated laundering and dry cleaning. Anidex improves the fit, comfort and appearance of apparel and home furnishing fabrics. Excellent resistance to fading, oxidation, sunlight, oils, and

chlorine bleach. Used in athletic wear, blouses, career apparel, dresses, foundation garments, jackets, rainwear, and more.

**ARAMID** — A manufactured fiber used in flame-resistant clothing, protective vests and helmets, asbestos replacement, hot air filtration fabrics, and sporting goods. It has no melting point, low flammability and good integrity at high temperatures. Trademarks include Kevlar and Nomex (DuPont).

**ASBESTOS** — A non-metallic mineral fiber that is non-flammable. Whenever flame-proof and heat-proof protection is needed, you will find asbestos. This includes such things as theater curtains, ironing board covers and pot holders.

**BAMBOO** — A giant woody grass, which often reaches a height of 40' or more, common in the subtropical areas of the Eastern Hemisphere and Southern United States. Companies in China have been developing Bamboo as an eco-friendly green natural fiber for the textile industry. It has a natural anti-bacterial agent which it maintains even after 50 washings. The microstructure of bamboo fiber and yarn make it extremely absorbent and it cools through evaporation.

**BANANA** — A natural fiber, similar in appearance to linen. It's lightweight, elegant in appearance, washable and easy to care for. Usually blended with other fibers such as silk or polyester.

**BAST FIBERS** — Refers to natural fibers found between the inner and outer core of many plants. They are often long and strong and have many commercial uses. The most important bast fibers include: flax, ramie, jute, hemp, pineapple fiber, and sisal. Cotton is a seed bast fiber, flax is a stalk bast fiber and pineapple is a leaf bast fiber.

**CAMEL HAIR** — Hair from the camel is sometimes blended with wool or imitated in wool to decrease cost and increase the wear. Its underhair is best. It is light weight, lustrous and very soft and ranges in colors from light tan to brownish-black. It has a long nap and is quite warm. Better grades are expensive. It comes with a rich nap or a flat finish.



The term camel is also used more broadly, to describe any of the six camel-like creatures in the family Camelidae: the two true camels, and the four South American camelids: Llama, Alpaca, Guanaco and Vicuna.

**CARBON** — A pitch-based, general purpose fiber. Chopped and milled, carbon fibers are used for friction materials, reinforcement, protective products and garments, and composite materials, such as carbon paper.

**CASHMERE** — Hair fiber from the fine, soft undercoat of the Kashmir goat found in India, Tibet, Iran, Iraq and southwest China. The cashmere products of this area first attracted the attention of Europeans in the early 1800's. The Cashmere fiber is often mixed with wool or synthetics to cut costs and improve the wear. All types of weaves, but mostly plain or twill. The fiber is soft, silky and light weight, more like wool than any other hair fiber.

fibers and has been used in China over 2000 years, long before cotton was introduced in the Far East. It is used as a textile and paper making fiber.

Ramie is classified chemically as a cellulose fiber, just as cotton, linen, and rayon. Ramie is a natural woody fiber resembling flax. The fiber is stiff, more brittle than linen, and highly lustrous. It can be bleached to extreme whiteness. Ramie fibers are long and very fine. They are white and lustrous and almost silk-like in appearance. The strength of ramie is excellent, but its elastic recovery is low and elongation is poor. When combed, ramie is half the density of linen, but much stronger, coarser, and more absorbent. It has permanent luster and good affinity for dyes; it is affected little by moisture. Ramie is used as filling yarn in mixed woolen fabrics, with silk fibers, and as a substitute for flax. This fiber is also useful for rope, twine, and nets.

**RAYON (VISCOSE)** — A transparent manufactured fiber composed of regenerated cellulose, derived from wood pulp, cotton linters, or other vegetable matter. Cellulose fibers from wood or cotton are dissolved in alkali to make a solution called viscose (which means having a cohesive and sticky fluid consistency), which is then extruded through a nozzle, or spinneret, into an acid bath to reconvert the viscose into cellulose. A similar process, using a slit instead of a hole, is used to make cellophane.

Rayon was originally named artificial silk or wood silk, but the name rayon was created in 1924. Unlike nylon, rayon absorbs water, making it more comfortable to wear as a clothing textile. Characteristics of rayon are that it is highly absorbent, soft and comfortable, easy to dye, and drapes well. Rayon is used extensively in all types of apparel, home furnishings, and also has many industrial and medical applications.

The two most commonly used production methods for rayon are the cuprammonium process (cupro) and the viscose process. Viscose is becoming less common because of the polluting effects of carbon disulphide and other by-products of the process. *(For more information on the viscose process visit [www.fibersource.com](http://www.fibersource.com) and click on the "rayon" link.)*

**RUBBER** — A manufactured fiber in which the fiber-forming substance is made up of natural or synthetic rubber.

**SARAN FIBER** — A manufactured synthetic polymer fiber. It has excellent resistance to sunlight, weathering, staining, fading, and mildew. Fabrics made with Saran can be washed with soap and water and are non-flammable. Saran is heavy compared to most apparel fibers, and is primarily used in lawn furniture, upholstery, and carpets.

**SILK** — The only natural fiber that comes in a filament form. The filaments, from 300 to 1,600 yards in length, are produced by the silkworm in the construction of its cocoon, and can be woven into fine textiles. Most silk is collected from cultivated worms; Tussah silk, or wild silk, is a thicker, shorter fiber produced by worms in their natural habitat. All silk comes from Asia, primarily China. It is soft and has a brilliant sheen, considered one of the finest textiles, and is also very strong and absorbent.

times better than nylon, 2.5 times better than polyester, and twice that of rayon. Used as reinforcement in tires, cordage, racing-quality sailcloth, packaging and film.

**PINEAPPLE** — A natural fiber, similar in appearance to linen. It's lightweight, elegant in appearance, washable and easy to care for, usually blended with other fibers like silk or polyester.

**PLA FIBER (Polylactic Acid)** — A manufactured fiber made using lactic acid from the fermentation of various sources of natural sugars, such as corn and sugar beets. PLA is completely biodegradable. The fiber is suitable for a wide variety of technical textile fiber applications, especially performance apparel that requires low moisture absorption, low flammability, and a high resistance to UV. It is light weight and will dye to produce brilliant colors.

**POLYESTER** — A synthetic, man-made fiber produced from synthetic polymers. Some characteristics of polyester include: crease, mildew, and abrasion resistance, ability to dry quickly, shape retention in garments, high strength, and easily washed with minimum care. Polyester is a very important fiber in upholstery fabrics and is widely used in every type of apparel. It's also used in hoses, ropes, nets, thread, tire cord, and fiberfill. Often found blended with other yarns, particularly cotton, to add texture and mixed color effects.

**POLYPROPYLENE FIBER** — A manufactured fiber characterized by its light weight, high strength, and abrasion resistance. Polypropylene is also good at transporting moisture, creating a wicking action. The fiber may be used for satiny silk-like fabrics or for heavy wool-like yarns with strengths comparable with nylon. End uses include active wear apparel, rope, indoor-outdoor carpets, lawn furniture, and upholstery. It melts at a low 348° and cloth containing polypropylene cannot be ironed.

**POLYSTYRENE FIBER** — An extremely fine fiber made with minute air spaces between the fibers. It is used for low temperature insulation, soundproofing, and for buoyancy in floats and life vests.

**POLYURETHANE FIBER** — A man-made fiber, with a low melting point, high elongation and strength. It was first made in Germany during World War II. When it was discovered that polyurethanes could be made into fine thread, they combined them with nylon to create more lightweight and stretchable fabrics, such as spandex. Polyurethane coated fabrics meet the need of today's fashion trends. It is durable, abrasion-resistant, and yet soft, light and breathable. Used frequently in weatherproof clothing, imitation suede, and man-made leather garments.

**QIVIUT** — The fine, downy underwool of the Musk Ox. This fiber is the basis for an entire knitting industry in Alaska that complements the lifestyle of the Eskimo people. The softness of qiviut compares with cashmere.



**RAMIE** — A plant of the nettle family native to tropical regions of Asia and other warm climates. The bast fiber from the stalk of the plant, is similar to flax, and fabric made from it resembles silk or linen. Ramie, also known as China Grass, is one of the oldest vegetable

Cashmere doesn't stand up well to hard wear because of its extremely soft downy finish. Its natural colors are grey, brown, and white but it can be dyed any shade.

**Primary Uses:** Men's and women's coats, jackets and blazers, skirts, hosiery, sweaters, gloves, scarves, mufflers, caps and robes.

**Characteristics:** Luxuriously soft, with high napability and loft; provides natural light weight insulation without bulk. Cashmere is extremely warm (its original purpose was protecting goats from cold mountain temperatures). Fibers are highly adaptable and are easily constructed into fine or thick yarns, and light to heavy-weight fabrics. Appropriate for all climates. A high moisture content allows insulation properties to change with the relative humidity in the air.

**Types of fiber:** 1) Virgin — New fiber that has not been processed in any way, or has been made into yarns, fabrics or garments for the first time. 2) Recycled — Fibers reclaimed from scraps or fabrics that were previously woven or felted and may or may not have been used by the consumer.

**COIR** — (From Malayalam kayaru, or cord) A coarse fiber extracted from the husk of a coconut. The coir fiber is relatively water-proof and is the only natural fiber resistant to damage by salt water. The fiber is then woven into coir or coir-foam—rubberized coir—which is used to make mattresses and pillow-covers. These have gained popularity due to their softness and durability. Many floor mats, carpets, handicraft items like bags, wall hangings, dolls and animal figures are made out of coir. The jewelry made out of coir is fascinating because of its intricate and delicate designs.



**COTTON** — A soft, natural, vegetable fiber obtained from the seed-pod of the cotton plant. The fiber is spun into thread and then used to make soft, breathable textiles. Cotton is the most widely used fiber in the world because of its versatility and ability to provide good comfort.

**History:** Cotton has been used to make very fine lightweight cloth in areas with tropical climates for thousands of years. Some authorities claim that it was likely that the Egyptians had cotton as early as 12,000 BC, and they have found evidence of cotton in Mexican caves, which date back to approximately 7,000 years ago. There is evidence that people in both South America and India domesticated species of the cotton plant around 3,000 years ago.



**Composition:** Cotton is almost pure cellulose. In its raw, undyed form, the normal color of cotton is a light to dark cream, though it may also be brown or green depending on the variety. Cotton fiber lengths vary from less than one-half inch, to more than two inches. Generally, longer length cotton fibers are of better quality. Cotton is a valuable crop because only about 10% of the raw weight is lost in

processing. Once traces of wax and protein are removed, the remainder is a natural polymer of pure cellulose, which gives cotton its unique properties of strength, durability, and absorbency. Each fiber is made up of twenty to thirty layers of cellulose coiled in a neat series of natural springs. When the cotton boll is opened, the fibers dry into flat, twisted, ribbon-like shapes and become kinked together and interlocked, ideal for spinning into a fine yarn.

**Uses:** In addition to the textile industry, cotton is used in fishnets, coffee filters, tents and in bookbinding. The first Chinese paper was made of cotton fiber, as are the modern U.S. dollar bill and federal stationery. Fire hoses were once made of cotton. The cottonseed, which remains after the cotton is ginned, is used to produce cottonseed oil, which after refining can be consumed by humans like any other vegetable oil. The cottonseed meal that is left is generally fed to livestock.

**CUPRO (cuprammonium rayon)** — One of the earliest varieties of rayon, cupro fibers are white, transparent and very silk-like. It's frequently made into chiffons, satins, nets, and other sheer fabrics.

**DACRON** — The DuPont trademark for a synthetic polyester textile fiber.

**FIBERFILL** — Generic term for all stuffing fibers or materials used in battings, quiltings, sleeping bags, and pillows.

**FIBERGLAS** — Trademark of Owens-Corning for glass fiber.

**FLAX** — Common flax (also known as linseed) is a member of the Linaceae family which includes about 150 plant species widely distributed around the world. Some of them are grown in domestic flower beds, as flax is one of the few true blue flowers. (Most "blue" flowers are really purple.)



Flax is grown both for seed and for fiber. The seeds produce linseed oil which is one of the oldest commercial oils, used for centuries as a drying agent in painting and varnishing. The use of flax seed and flax seed oil (high in omega-3 linolenic acid) as a nutritional supplement is increasing.

**History:** Flax fiber is amongst the oldest fiber crops in the world and the use of flax for the production of linen goes back 5000 years, evidenced by pictures on tombs and temple walls which depict flowering flax plants. The use of flax fiber in the manufacturing of cloth in Northern Europe dates back to pre-Roman times. In the U.S., flax was introduced by the Pilgrims. Currently all flax produced in the U.S. and Canada are seed flax types for the production of linseed or flaxseed oil.

**Characteristics:** Flax fiber is soft, lustrous and flexible. It is stronger than cotton fiber but less elastic. The best grades are used for linen fabrics such as damasks, lace and sheeting. Coarser grades are used for the manufacturing of twine and rope. Flax fiber is also a raw material for the high quality paper industry for the use of printed currency notes and cigarette paper.

**NYLON** — Produced in 1938, the first completely synthetic fiber developed.

Known for its high strength and excellent resilience, nylon has superior abrasion resistance, is easy to wash, lustrous, resistant to damage from oils and many chemicals, dyes well, and is highly flexible. Nylon filament yarns produce smooth, soft, long-lasting fabrics. Spun nylon yarns create fabrics that are light-weight and warm. Nylon is great blended with natural fibers for durability and stretch.

Nylon is a synthetic polymer, a plastic, invented on February 28, 1935 by Wallace Carothers at the E.I. du Pont de Nemours and Company of Wilmington, Delaware, USA. The material was announced in 1938 and the first nylon products: a nylon bristle toothbrush made with nylon yarn was introduced on February 24, 1938, and more famously, women's nylon stockings were introduced on May 15, 1940. Nylon fibers are now used to make many synthetic fabrics, and solid nylon is used as an engineering material. You'll find nylon in everything — blouses, lingerie, ski apparel, swimwear, carpets, upholstery, parachutes, sleeping bags, racket strings, hoses, tires and dental floss.

Even though the word nylon was coined, it was never trademarked. A 1978 publication by DuPont explained that the name was originally intended to be "No-Run" ("run" in this context meaning "unravel"), but was then modified to avoid making such an unjustified claim and to make it sound better. The story goes that they changed one letter at a time until DuPont's management was satisfied.

**NYTRIL FIBER** — A manufactured fiber that is soft and resilient, but sensitive to the higher temperatures of ironing. It's used in articles that do not require pressing such as sweaters, pile fabrics, fake furs and wool blends, where it helps with shrink resistance and shape retention.

**OLEFIN FIBER** — A manufactured fiber; the most popular types are polypropylene and polyethylene. They are abrasion resistant, color fast, quick drying, low static, resistant to deterioration from chemicals, mildew, perspiration, rot and weather. They resist dyeing so color must be added during the manufacturing process. Olefin fabrics are also stain and soil resistant, strong, sunlight resistant, wick moisture from the body, and are comfortable and lightweight. Olefin fiber is a generic description that covers all thermoplastic fibers derived from olefins (an alkene hydrocarbon). The name derives from the term olefiant gas, an early name for ethylene meaning "oil-forming." Olefin fiber is used in all types of activewear, socks, thermal underwear, automotive interiors, indoor and outdoor carpets, upholstery, wall coverings and furniture.

**PBI FIBER (Polybenzimidazole)** — A manufactured fiber that has no melting point, will not ignite, retains its fiber integrity and suppleness even upon flame exposure, dyable, and resistant to mildew, age and abrasion. Primary uses are in high-performance protective apparel such as firemen's jackets and astronaut's space suits.

**PEN FIBER (Polyethylene Naphthalate)** — A new generation high performance member of the polyester family. Its resistance to deforming is 5

**MELAMINE FIBER** — A manufactured fiber designed for its heat stability, solvent resistance and flame resistance. It's used for fire blocking fabrics, protective clothing and heat resistant gloves.

**MERINO** — The highest, finest and best wool obtained anywhere in the world. This fiber is used only in the best of woolen fabrics. It resembles cashmere.



**METALLIC FIBER** — A manufactured fiber composed of metal, plastic-coated metal, or metal-coated plastic. It's used in textiles, which are either composed of metal, or fibers of other materials with a metal coating. Uses include decorative purposes in apparel, braids, draperies, laces, uniform decorations, ribbons, table linens and upholstery. Metallic fabrics are often used in formal and evening wear.

**MODACRYLIC FIBER** — Modacrylic, also called modified acrylic, it is a medium weight fiber that is highly resistant to sunlight. Modacrylic fibers have characteristics of being soft, resilient, easy to dye to bright shades, abrasion resistant, flame resistant, quick drying, resistant to acids and alkalis, and it retains its shape. It can be made into fabrics like fleece, knit-pile backing, and nonwoven fabrics. It is suitable for making garments such as deep-pile coats, trims and linings, simulated fur, wigs and hair pieces, children's sleepwear, career apparel, blankets, carpets, flame-resistant draperies and stuffed toys.

**MOHAIR** — A long, white, lustrous hair obtained from the Angora goat, one of the oldest animals known to man. The goats are primarily raised in South Africa, Western Asia, Turkey, and some are in the U.S. Angora is 2-1/2 times as strong as wool. Mohair plush is a fabric with a cut pile of mohair yarns. It is lustrous, smooth, glossy, extremely strong, and will hold a permanent embossing. End uses include sweaters, coats, suits, and scarves.



**NOMEX®** — DuPont trademark for a high temperature heat resistant aramid fiber. Nomex is the brand name of a flame retardant meta-aramid material marketed and first discovered by DuPont in the 1970s. It is sold in both fiber and sheet forms and is used as a fabric wherever resistance from heat and flame is required. Both the firefighting and vehicle racing industries use Nomex to create clothing and equipment that can stand up to intense heat.

**Uses:** A Nomex hood is a common piece of firefighting equipment. It is placed on the head on top of a firefighter's face mask to protect the portions of the head, not covered by the helmet and face mask. Race car drivers commonly use a similar hood. Military pilots wear one-piece flight suits made of over 92% Nomex.

**GLASS FIBER** — A manufactured fiber in which the fiber-forming substance is glass. Specially prepared glass marbles are melted in a furnace. The melted glass is then extruded through tiny orifices to form continuous filaments and then drawn out to the desired size.

**GORE-TEX®** — A lightweight, durable synthetic fiber used as a tissue filler. First introduced in 1978, Gore-Tex fabric is created by laminating a patented Gore-Tex membrane to high-performance textiles, which are used by authorized garment manufacturers to make outerwear, accessories, and footwear. The Gore-Tex membrane has 9 billion pores per square inch, with each pore 20,000 times smaller than a water droplet, too small for water and wind to pass through. These same pores are large enough for moisture vapor to pass through, so perspiration is able to escape so the wearer doesn't get clammy and uncomfortable. A Gore-Tex garment is considered "waterproof and breathable."

**GUANACO** — The fleece hair from the guanaco, a relatively rare cross breed of the llama and alpaca. The fleece is very fine and silky and ranges in color from reddish brown to white.



**HEMP** — A coarse, durable bast fiber obtained from the inner bark of the hemp plant. Used primarily in twines and cords, and recently also in apparel. Hemp is Cannabis grown for fiber, food, fuel, or other non-drug uses. Historically, the textile uses have been most important.

Cannabis grown as hemp is the same species as that grown for marijuana, although millennia of selective breeding has resulted in strains that look quite different. Hemp is planted closely, resulting in tall, slender plants with long fibers. Hemp use dates back to the Stone Age, with hemp fiber imprints found in pottery shards in China over 10,000 years old.

Three groups of cannabis varieties are cultivated today:

- Varieties primarily cultivated for their fiber, characterized by long stems and little branching, called industrial hemp
- Varieties grown for seed from which hemp oil is extracted
- Varieties grown for medicinal or recreational purposes.

**Uses:** Until its rediscovery in the late 1980s, the use of hemp for fiber production had declined sharply over the past decades, but hemp still occupied an important place amongst natural fibers as it is strong, durable and unaffected by water. The main uses of hemp fiber were in rope, sacking, carpet, nets and webbing. A hemp clothing industry was reborn in the West in 1988, and hemp is being used in increasing quantities in paper manufacturing.

**HYDROPHILIC FIBERS** — Fibers that absorb water easily such as cotton, linen, or rayon.

**HYDROPHOBIC FIBERS** — Fibers that are normally non-absorptive and repel water such as nylon and polyester.

**JUTE** — A long, soft, shiny fiber that can be spun into coarse, strong threads. It is one of the cheapest natural fibers, and is second only to cotton in amount produced and variety of uses. Jute fibers are composed primarily of the plant materials cellulose, lignin, and pectin. Natural jute is yellow to brown or gray in color, and has a silky luster. It is difficult to bleach completely, so many fabrics are bright, dark, or natural brown. It has a good resistance to microorganisms and insects. Moisture increases the speed of deterioration, but dry jute will last for a very long time. Both the fiber and the plant from which it comes are commonly called jute.

Jute is used chiefly to make cloth for wrapping bales of raw cotton, and to make gunny sacks and gunny cloth. The fibers are also woven into curtains, chair coverings, carpets, and burlap. However, jute is gradually being replaced by synthetic materials for these uses. Very fine threads of jute are made into imitation silk. The fibers are used alone or blended with other types of fibers to make twine and rope. Jute butts, the coarse ends of the plants, are used to make inexpensive cloth.

**KEMP** — A coarse fiber, usually of wool or hair, that is usually short, wavy, and white. It has little affinity for dye or spinning. Used mainly for carpets and decorative uses.

**KENAF** — A bast fiber. The kenaf stalk, offers the opportunity to extract fibers that may be used in various textile end products. The fiber extraction process can be achieved by either bacterial or chemical processes and affects the final fiber properties, which are important for the making of the final textiles and paper products.



Kenaf Plants

**KEVLAR** — Kevlar is a synthetic fiber that is five times stronger than steel, weight for weight. Kevlar is very heat resistant and decomposes above 400°C without melting. It is usually used in bulletproof vests, in extreme sports equipment, and for composite aircraft construction. It is also used as a replacement for steel cords in car tires, in fire suits and as an asbestos replacement. Kevlar was invented by the DuPont Corporation in the early 1960s. Kevlar's main weaknesses are that it decomposes under alkaline conditions or when exposed to chlorine (*I guess that means don't wear your bulletproof vest in a swimming pool*). In structural applications, Kevlar fibers can be bonded to one another or to other materials to form a composite.

**LAMB'S WOOL** — Elastic, soft, resilient wool fibers obtained from lambs when they are 7 or 8 months old. It's the first or virgin clipping of the animal and is used in better grades of fabrics.

**LINEN** — A fabric made from linen fibers obtained from inside the woody stem of the flax plant. Linen fibers are much stronger and more lustrous than cotton. Linen fabrics are very cool and absorbent, have no fuzziness, don't soil quickly, and have a natural luster and stiffness. It can wrinkle very easily, unless blended with manufactured fibers. Linen is one of the oldest textile fibers. Uses of linen include tablecloths, canvas, sails, tents, paper, toweling,

dress linens, doilies, sportswear, and more. Due to its strength, in the Middle Ages linen was used for shields and gambesons, as well as for underwear and other clothing.



When linen fibers are twisted together (spun), it is called yarn. It is strong, durable, and resists rotting in damp climates. It is one of the few textiles that has a greater breaking strength wet than dry. It has a long "staple" (individual strand length) compared to cotton and other natural fibers.

Up until the 1950's or so the finest linen yarn was made in Scotland, Ireland, and Belgium. The climates of these locations were ideal for natural processing methods called "retting." As years went by many of the finest factories in those areas closed, and most linen is currently made in China.

The decrease in use of linen may be attributed to the increasing quality of synthetic fibers, and a decreasing appreciation of buyers for very high quality yarn and fabric. Very little top-quality linen is produced now, and most is used in low volume applications like hand weaving and as an art material.

Due to its one-time common use to make fine fabric, "linens" became the generic term for sheets and pillowcases, although these are now often made of cotton or synthetic fibers. Linen is available in different qualities varying from almost silk-like to sack-linen. Linen is usually white to ivory, may be washed at 95°C, and should be ironed when damp. A characteristic often associated with linen yarn is the presence of "slubs," or small knots that occur randomly along its length. However, these are actually defects associated with low quality. The finest linen has a very consistent diameter with no slubs. When being washed the first time, linen shrinks significantly.

**LYCRA (See Spandex)** — INVISTA's trademark for a synthetic fiber material with elastic properties of the sort known generically as spandex. Lycra is commonly used in athletic or active clothing.

**LYOCELL FIBER** — This manufactured fiber is made from wood pulp cellulose, the main material in plant cells. It was first manufactured in 1992, and is now manufactured under the trademarked brand name Tencel. The F.T.C. classifies Lyocell as a sub-category of rayon, and possesses many properties of other cellulose fibers, such as cotton, linen, ramie, and rayon. It's a manufactured but non-synthetic fiber. The production process of Lyocell is considered extremely environmentally friendly. It has all the advantages of a natural material and is 100% biodegradable and recyclable. It's soft, strong, absorbent, wrinkle-resistant, shrink-resistant, has excellent wet strength, dyes well, and can be hand washed or dry cleaned (*depending on the care label*). Lyocell fabrics can simulate the looks of silk, suede or even leather. The fiber is used in the production of many clothes, such as jeans, dresses, slacks, and coats, and is used as well in hygiene, medical and technical applications.