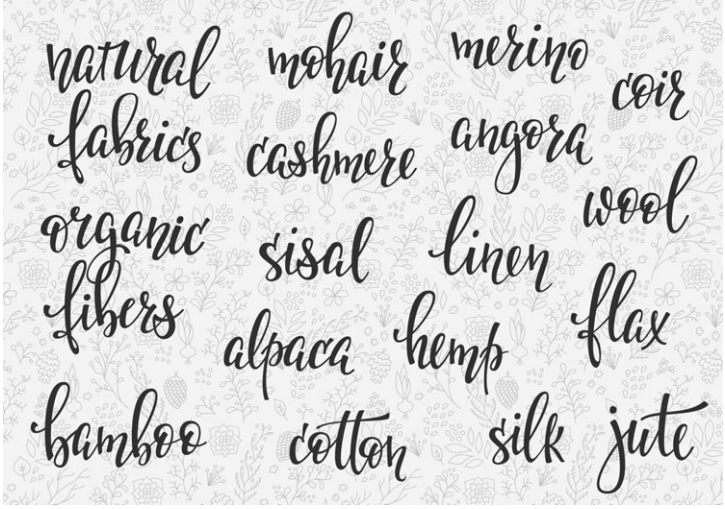
Fabrics: Natural Fibers

COTTON, linen (flax), silk, and wool are the four most common natural fibers. Natural fibers are made from plants (cellulosic fibers) and from animals (protein fibers) sources. Cotton is made from the lint in bolls, linen from the flax plant, silk from a moth's cocoon, and wool from the fleece of sheep and other animals. All these fibers produce fabrics with excellent characteristics for garments and linens and they all have a distinctive 'hand.' Hand is the way a fabric feels.



Objective:

Classify natural fibers and describe their fabric characteristics.

Key Terms:

cellulosic fibers
cotton
fiber
filaments
felting
generic name
hand
linen
manufactured fibers
natural fibers
noncellulosic fibers
pilling
polymers
retting
sericulture
silk
staple fibers
tensile strength
textile
trade name
virgin wool
wicking
wool
yarn

Natural Fiber Fabrics

A **textile** is a woven cloth or fabric made of natural or synthetic fibers: it may be and animal- or a plant-based fabric. A **fiber** is a natural or chemical structure than can be spun into

FIGURE 1. Natural fibers are made from plant and animal sources. From left to right you see three stages of yarn development: raw wool fibers, wool roving (unspun fiber strands after carding), and a yarn spool.

yarn. To the naked eye, fibers look like small threads. A **yarn** is a group of textile fibers that are grouped and twisted together: weaved, knitted, or bonded into fabrics. Fibers are classified by their origin and there are two major types: natural and manufactured.

Because no single fiber's characteristics are perfectly suited to a task, more blends are available today than ever before. For example, cotton blends include: cotton/polyester fabrics are soft and absorbent and have fewer wrinkles than cotton alone. And polyester/rayon fabrics are more durable and retain their shape better than rayon alone.

NATURAL FIBERS

Natural fibers are made from plant and animal sources including: cotton, flax (linen), silk, and wool. Natural fibers are usually measured in inches or centimeters and are shorter fibers than those produced for manufactured textiles. Silk is a filament fiber and is also a longer fiber than the other natural fibers: it is measured in yards or meters. Natural fibers that are twisted together form yarns called **staple fibers**.

Common Fibers and Fabrics: Cotton and linen fabrics are made from plant fibers (from cellulose) and wool and silk fabrics are made from animals (from protein). Wool comes from fleeces and silk is made from the silkworm's (the caterpillar of the silk moth) cocoon. Spider silk is occasionally used for textiles, too.

Expensive Fibers and Fabrics: Cashmere and angora wools are other animal fibers. Angora is from rabbit fur and cashmere is from goats. Fibers from camels, yaks, llamas, alpacas, and musk oxen are also used for textiles. [NOTE: The hair from these animals is rare (rarer than

other natural fibers) and their fibers and textiles are more expensive than other natural fibers and textiles.]

History: Humans have used natural fibers for textiles for centuries. Cotton was used in ancient China, Egypt, India, Mexico, and Peru and the American colonies grew cotton as long ago as the 1600's. For example:

- Cotton: Eli Whitney was a tutor on one of the cotton plantations in Savannah, GA when he invented the cotton gin. The cotton gin machine separates the cotton fibers from the seeds allowing more fibers to be separated at a greater speed.
- Linen (Flax): Linen was used as early as 30,000 BC as a fabric for the wealthy. Archeologists have uncovered mummies that were wrapped in linen.
- Silk: Silk was discovered in 27th century BC. **Sericulture** is the study of the production of silk worms and silk and was a guarded secret for many years. Silk was traded for other goods and that is how it spread from nation to nation.
- Wool: Northern European tribes used wool fabrics as early as 10,000 BC. Then, the inventions of the industrial revolution enabled wool to be produced into fabric at a greater quantity for lower prices. Wool has been used for clothing and other items continually since this time.

Manufactured Fibers

Manufactured fibers are synthetic textiles produced by scientists in a lab. Manufactured fibers were successful produced in the early 1800's. Today manufactured fibers are produced from petroleum, paper, wood pulp, and plastics. Many manufactured fibers mimic today's natural fiber fabrics. Technology is being infused in some of these manufactured fibers to keep us warmer and to register heart rates. Most new manufactured fibers repel rather than absorb water, dry quickly, and have minimal shrinkage when laundered. Manufactured fibers tend to wrinkle less than natural fiber fabrics. There are two major categories of manufactured fibers: cellulosic and non-cellulosic.

- **Cellulosic fibers** are made from wood pulp and produce the following textiles: rayon, lyocell, (trade name Tencel), acetate, and triacetate. Cellulosic fibers require a minimal number of chemical stages during production.
- **Noncellulosic fibers** are synthetics made from carbon, hydrogen, nitrogen, and oxygen molecules. These molecules form **polymers** ('poly' means many and 'mer' means unit) are large molecules composed of many repeating monomers.

All manufactured fibers have two names: a generic name and a trade name. A **generic name** is a common name for a group of similar fibers. A **trade name** is the name the manufacturer uses. For example:

- Aramid is the generic name for the trade names Kevlar and Nomex.

- Nylon is the generic name for the trade names Anso, Antron, and Zafran.
- Polyester is the generic name for the trade names Dacron, Fortrel, and Trevira.
- Spandex is the generic name for the trade name Lycra.

General Fiber Characteristics

A fiber's characteristics influence its use in fabrics. Fiber characteristics include:

1. **Tensile strength**: ability to withstand tension or being pulling apart
2. Durability: ability to resist wear
3. Resiliency: ability to spring back into shape
4. Elasticity: ability to return to form after stretching
5. Abrasion resistance: ability to withstand wear (scraping, scuffing)
6. Shape retention: ability to keep its form after wearing
7. Wrinkle resistant: ability to repel creasing
8. Luster: ability to retain sheen
9. **Wicking**: the ability to draw moisture from body
10. Absorbency: ability to attract moisture

FIGURE 2. The Kevlar (or carbon fiber) fabric that is used in vests, helmets, etc. is very pliable.

FIGURE 3. Fabric with moisture-wicking ability makes the garment more comfortable for the wearer. Rainwear and athletic wear benefit from a fiber's ability to wick moisture away from the body. Some fabrics that wick moisture are natural fiber fabrics and others are manufactured fiber fabrics.

NATURAL FIBER CHARACTERISTICS

Cotton, flax (linen), silk, and wool are the four common natural fibers. Ramie, specialty animal fibers, and natural rubber are also considered natural fibers.

Cotton

Cotton is a textile made from soft, fluffy plant fibers from the lint in the boll. Cotton has many "feels" and, as such, is used for many different garments. Cotton is a cellulosic fiber (a material that comes from a plant). Cotton is separated from the seed in the ginning process where the lint is gathered. Long cotton staple fibers are desired because the length makes it easier to spin and to be twisted with other fibers to form yarns. Characteristics of cotton fabrics include:

FIGURE 4. Cotton is the most widely used natural fiber and is produced from these cotton bolls. Cotton garments are a great choice for hot days.

- Comfortable (breathable, releases heat)
- Highly absorbent (athletic wear, baby clothes, towels)
- Easy to launder
- Easily accepts dyes
- Can be made into high or low luster textiles (attractive)
- Hand can be stiff, smooth, or rough (**Hand** is how the fabric feels.)

Uses. Cotton is adaptable to many garments and linens: baby clothes, t-shirts, sheets, window coverings, rugs, and blue jeans.

Appearance. Cotton does wrinkle easily unless a finish is applied. Cotton has an appropriate appearance for casual, athletic, as well as for evening events.

Care. If cotton isn't preshrunk it will shrink. The softness of cotton allows the fabric to stretch and it will continue to stretch over time. Cotton can be machine or hand washed in cold water and dried on a line or on low heat in a dryer.

COTTON Advantages	COTTON Disadvantages
Soft	Wrinkles unless treated
Breathable and comfortable	Shrinks
Absorbent	Will mildew
Strong and durable fiber	Flammable

Linen

Linen is a textile made from the stems of the flax plant: a cellulosic fiber. It is used to make twine, rope, fabric, damask, etc. Flax plants are pulled up by hand or are machine harvested. **Retting** is the separation of the fibers from the stem. Then, flax stalk are submerged in water and the moisture and microorganisms cause the woody portion to swell, thereby loosening the bask (outer) fibers. Characteristics of linen fabrics include:

FIGURE 5. Linen is produced from this flax plant and, although it wrinkles badly, it is breathable and fast drying on a hot summer day.

- Light and cool, perfect for high temperature areas
- Flax is very absorbent but linen dries very quickly
- Able to be ironed at high temperatures without scorching
- Wrinkles very easily

Uses. Linen is used in high fashion apparel, furnishings and some upholstery, table linens, and bags and purses.

Appearance. Linen is often used for dresses and dressy clothes. It has an excellent luster that it is great for evening garments. The texture ranges from thick to thin and it has a stiff hand. Because linen wrinkles easily it is not a good choice for all garments.

Care. Linen can be hand or machine washed or dry-cleaned. Linen upholstery is steam cleaned. When ironing linen a very hot temperature is needed.

LINEN Advantages	LINEN Disadvantages
Strong and durable fiber	Wrinkles
Absorbent	Low resilience
Lint free	Shrinks
Fast drying	Mildews
Does not scorch at high temperatures	Hard to remove the creases

Silk

Silk is a textile made from protein fiber **filaments** (threads) spun by moth larvae. Silk is an animal (protein) fiber. The silk fiber resembles a glass rod with an irregular surface when looked at through a microscope. Characteristics of silk fabrics include:

- Accepts dyes easily including brilliant colors
- Soft luster
- Generally smooth appearance
- Soft hand
- Strongest of the natural fibers
- Comfortable (absorbs body perspiration and resists wrinkling)

FIGURE 6. Silk is produced from the moth larvae cocoon and spun into scarves with a beautiful sheen and soft hand.

Uses. Silk is used in a variety of garments due to the beautiful colors and its wrinkle resistance. It is a good choice for dress/evening clothing, handbags, and scarves. It is also used in window treatments, upholstery, pillow covers, linens, etc.

Appearance. The high luster and bright colors enhance many fashion choices. Hand is soft and smooth.

DIGGING DEEPER...

UNCOVERING ADDITIONAL FACTS: Spider Silk: Another Natural Fiber

Spider silk is a protein fiber spun by spiders. The sticky spider web fibers are typically used to catch other animals, as nests or cocoons to protect their offspring, or to wrap up prey. Mechanically, spider silk is strong, dense, and equal to steel in strength (weight for weight). To find out more about spider silk fabric, read the article, "Fabric Made From Spider Silk Could Be Coming Our Way Very Soon," https://fashionmagazine.com/fashion/spider-silk-fabric/.

Spider silk fibers are stronger than moth larvae fibers.

Care. May be hand laundered or dry-cleaned. Silk will shrink if laundered incorrectly. Due to the brilliance of some colors, silk colors may bleed. Silk scorches easily (a press cloth is a must).

SILK Advantages	SILK Disadvantages
Natural luster	Weakened by sunlight
Strong while being light weight	Shows perspiration
Smooth	May spot with water
Accepts dyes easily	

Wool

Wool is a textile made from animal fur staple fibers (usually from sheep or lamb fleece). Wool fibers have a long staple length: 2 to 8 inches. Sheep are the main wool producers but some wool is gathered from goats, camels, alpacas, etc. Wool is valued for its warmth. Woolen fabrics are recorded as far back as 10,000 BC. Wool is processed in a 5-part process: shearing, sorting and grading, washing, carding (to straighten the fibers), and yarn making.

Virgin wool is fibers and yarns that have never been processed, used, or woven. Wool is sometimes felted. **Felting** is the application of heat, moisture, and pressure to wool that causes

the tiny wool fiber scales to open up, lock together, and shrink. This process makes the wool fibers and yarns smaller, stronger, and warmer. Characteristics of wool fabrics include:

- Resists wrinkling
- Resilient (returns to its original size and shape after stretching)
- Naturally flame resistant (e.g., A wool blanket can be used to put out a fire.)
- Can be worn in all seasons
- Dry cleanable (helps keep size and shape from changing)

FIGURE 7. Wool comes from sheep but other animals also produce wool. What clothing do you own that is made from wool?

Uses. Wool is a good fiber for garments that keep a person warm: coats, jackets, hats, gloves, scarves, sweaters, blankets, etc.

Appearance. Wool's appearance is versatile. It can be rough or smooth or soft and crepe-like. Wool fabrics are subject to pilling. **Pilling** is a tangled ball of fibers on the surface of the fabric. Pills are usually the result of wear, rubbing, or abrasion. Woolen fabrics are also subject to matting (compressed fibers).

Care. Wool loses strength when it is wet and must be handled carefully to avoid shrinkage. Some cleaning detergents can harm wool so reading all laundry symbols and care instructions is recommended. Wool scorches easily and becomes brittle when dry heat is applied.

WOOL Advantages	WOOL Disadvantages
Very versatile	Damaged by insects, moths
Warm	Shrinks and loses strength when wet
Durable and resists abrasion	Dry clean only
Resilient and resists wrinkling	Matting and pilling
Flame resistant	Absorbs odor
Absorbent	

Summary:

Cotton, linen (flax), silk, and wool are the four most common natural fibers. Having a basic knowledge of these fibers' characteristics ultimately makes you a better consumer. It also helps you develop a seasonal wardrobe that meets your needs including your desired comfort level. When you need to purchase a basic black t-shirt that doesn't stretch, you'll know what to look for on the garment tag–a natural fiber.

Checking Your Knowledge:

1. Describe the terms 'hand' and 'wicking' as they relate to fabrics.
2. List 5 characteristics of cotton fabrics.
3. List 5 characteristics of linen fabrics.
4. List 5 characteristics of silk fabrics.
5. List 5 characteristics of wool fabrics.

Expanding Your Knowledge:

Make a trip to a fabric store. Find a sample of all four natural fibers. Read the care labels on each of the samples. Feel each sample, how comfortable would it be for you to wear? Ask the sales clerk's advice about which garments would be best constructed with each sample. What did you learn from this activity? How will this information help you in future garment purchase decisions?

Web Links:

Characteristics of Natural Fiber
http://www.fiberworks.com/reources/products/resource/about-our-rugs/characteristics/-of-natural-fibers/

Discover Cotton
https://thefabricofourlives.com/

How to Wash Wool
http://wwwwikihow.life/wash-wool

Types of Linen Fabric
https://oureverydaylife.com/types-of-linen-fabric-12154753.html

Types of Silk Fabric With Pictures and Names
https://www.pandasilk.com/silk-fabric-types/