NO PREP

Natural vs. Synthetic Fibers

Includes: Student reading, case study, differentiated questions, teacher key

Name: Period: Date:

Natural vs. Synthetic Fibers

Everything You Wear Started as a Fiber

Pick up any piece of clothing you own and follow it backward far enough and you arrive at the same place: a fiber. A fiber is the smallest unit of a textile, a strand so fine that a single one is barely visible and useless on its own. Fibers get twisted together into yarn, yarn gets woven or knitted into fabric, and fabric gets cut and sewn into the shirt on your back. Every decision made at that first stage travels all the way up the chain. A fiber that hates water produces a shirt that will not absorb sweat. A fiber that melts at low heat produces a shirt that a hot iron will ruin in about two seconds. This is why the fiber content tag matters more than almost anything else on a garment, and why federal law requires it to be there. The Textile Fiber

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The Fibers That Grow

Natural fibers come from living sources, and they divide neatly into plant fibers and animal fibers. Plant fibers are built from cellulose. Cotton, harvested from the seed pod of the cotton plant, is the most used natural fiber on the planet because it is soft, absorbent, breathable, and cheap. It also wrinkles enthusiastically and shrinks if you wash it hot, and unlike most fibers it is actually stronger wet than dry, which is why cotton tolerates aggressive laundering. Linen comes from the stalk of the flax plant and is the strongest common plant fiber, cool to wear, and famous for wrinkling the moment you sit down. Hemp, jute, and ramie fill out the plant family in ropes,

bags, and blends. Animal fibers are built from protein instead of cellulose, and that single chemical difference changes everything about how they are cared for. Wool comes from sheep and has a natural crimp that traps air, which is why it insulates even when damp, and microscopic surface scales, which is why heat plus moisture plus agitation locks those scales together and shrinks a sweater into doll clothing permanently. Silk, unwound from the cocoon of the silkworm, is the only natural filament fiber, meaning it comes in a continuous strand rather than short pieces. It is remarkably strong for its weight, takes dye brilliantly, and degrades in direct sunlight. Specialty animal fibers like cashmere, mohair, and alpaca are prized for softness and priced accordingly.

The Fibers That Get Invented

Synthetic fibers are manufactured rather than harvested, and most of them begin as petroleum-based chemicals. The raw material is turned into a thick liquid polymer, then pushed through a spinneret, a device that works on the same principle as a shower head, extruding continuous filaments that harden as they cool. Because the process is engineered rather than grown, manufacturers can dial in the properties they want. Polyester is the workhorse and grew to become the single most produced fiber in the world. It is strong, resists wrinkles and shrinking, dries fast, and holds a pleat. Its weakness is that it repels water rather than absorbing it, so sweat sits on the skin and body oils cling to the fiber, which is why polyester athletic shirts develop a permanent smell that cotton shirts do not. Nylon was the first fully synthetic fiber to reach the market and remains the champion of abrasion resistance, which is why it shows up in hosiery, backpacks, and outerwear. Acrylic was engineered to imitate wool at a fraction of the cost and does a decent job of it, though it pills badly with wear. Spandex, also sold as elastane or Lycra, can stretch five to seven times its own length and snap back, and it is almost never used alone. A pair of jeans with two percent spandex behaves completely differently from the same jeans without it. All of these share one critical vulnerability: they are thermoplastic, meaning heat softens and melts them rather than scorching them, so a hot iron does not leave a brown mark on polyester, it leaves a permanent hole.

The Ones in Between

A third category confuses almost everyone, including shoppers who assume it belongs on one side or the other. Manufactured cellulosic fibers, sometimes called

regenerated fibers, start with a natural raw material and then get dissolved and chemically reformed in a factory. Rayon, also labeled viscose, is made from wood pulp or bamboo that is broken down into a solution and extruded through a spinneret exactly like a synthetic. The result feels cool and drapes beautifully, which is why it appears in so much affordable dressy clothing. It is also the fiber most likely to disappoint a first-time buyer, because rayon loses significant strength when wet, which means a garment that survives dry cleaning may shrink, stretch, or tear in a home washing machine. Modal and lyocell are newer versions engineered to fix that weakness, and lyocell, often sold under the brand name Tencel, is produced in a closed-loop process that recovers and reuses most of the solvent, which makes it one of the more environmentally defensible options on the shelf. Acetate is another cellulosic, used in linings, and it dissolves in acetone, which is why nail polish remover can put a permanent hole in a jacket lining. The practical takeaway is that a fiber's origin story does not automatically predict its care requirements. Bamboo rayon is marketed as natural and is chemically closer to a manufactured fiber. Read the care label rather than the marketing.

Why Almost Everything Is a Blend

Once you understand that every fiber has a specific weakness, blends stop looking like a cost-cutting trick and start looking like engineering. A blend combines two or more fiber types in one yarn or one fabric so that the strengths of one cover the failures of another. The classic example is the sixty percent cotton, forty percent polyester t-shirt. Cotton contributes softness and absorbency; polyester contributes wrinkle resistance, shape retention, and faster drying. Neither fiber could deliver that combination alone. Dress shirts blend cotton with polyester so they survive a workday without looking slept in. Denim adds one to three percent spandex so jeans move with the body and return to shape instead of bagging out at the knee. Wool blended with nylon produces socks that stay warm but do not wear through at the heel. The trade-off is that blends complicate care, because the finished garment must be treated according to its most fragile component. A fabric that is ninety-five percent cotton and five percent spandex cannot go in a hot dryer, because heat destroys the elastic fiber and the garment loses its stretch permanently even though the cotton would have been fine. When you read a fiber

content tag, find the most delicate fiber listed and let that one set the rules for the whole garment.

Key Information: The Three Fiber Families

Detail	Information
Fiber	Smallest unit of a textile; spun into yarn, then made into fabric
Plant Fibers	Cellulose-based: cotton, linen (flax), hemp, jute, ramie
Animal Fibers	Protein-based: wool, silk, cashmere, mohair, alpaca
Synthetic Fibers	Petroleum-based: polyester, nylon, acrylic, spandex
Cellulosic Fibers	Natural source, chemically reformed: rayon, modal, lyocell, acetate
Spinneret	Shower-head-like device that extrudes liquid polymer into filaments
Thermoplastic	Synthetics melt rather than scorch; hot irons burn holes
Blend Rule	Care for the whole garment based on its most delicate fiber

Case Study: Jordan and the Practice Jersey Problem

Jordan is a sophomore who runs cross country and works part time at a sporting goods store. His team buys two sets of practice shirts, and by October the athletes have split into two loud camps. The one hundred percent cotton shirts feel soft and cool in the store, but after two miles they are soaked, heavy, and cold on the ride home. The polyester shirts stay light and dry fast, but three of them now smell so strongly that Jordan's mother has banned them from the laundry room. A customer at the store asks Jordan which shirt to buy for her son, and he realizes he cannot explain either problem. That night he pulls up his FACS notes and finds the sentence he had highlighted and forgotten: cotton absorbs moisture into the fiber, polyester repels it. He writes underneath it, so the cotton is holding the sweat and the polyester is holding the oil, and I have been blaming the wrong shirt both times.

1. Using what the reading says about absorbency, explain why the cotton shirts felt heavy and cold after a run while the polyester shirts stayed light.

2. Jordan concludes that polyester is holding body oil rather than sweat. Explain how the reading supports that, and what it means for washing those shirts.

Multiple Choice

1. What device extrudes liquid polymer to form synthetic filaments?

    a) A spinneret

    b) A carding drum

    c) A bobbin winder

    d) A loom beater

2. Why does a hot iron burn a hole in polyester instead of a brown scorch mark?

a) Polyester absorbs water and boils from deep within

b) The dye reacts chemically with steam

c) The fiber is too absorbent to hold its shape

d) Synthetics are thermoplastic and melt with heat

3. According to the reading, how should a cotton and spandex blend be cared for?

a) By the average of the two fibers' requirements

b) By whichever fiber makes up the largest percentage

c) By the country of origin listed on the tag

d) By the most delicate fiber in the blend

Matching

Write the letter of the correct definition on the line next to each term.

Term	Definition
1. ___ fiber	A) The device that pushes liquid polymer into continuous filaments
2. ___ spinneret	B) A property meaning heat softens and melts the fiber
3. ___ thermoplastic	C) Two or more fiber types combined so strengths cover weaknesses
4. ___ cellulosic fiber	D) The smallest unit of a textile, spun into yarn before weaving
5. ___ blend	E) A natural raw material dissolved and chemically reformed in a factory

Fill-in-the-Blank

1. The strongest common plant fiber comes from the _____ plant.

2. The only natural filament fiber is _____.

3. Wool shrinks because heat and agitation lock its surface _____.

Short Answer

Answer each question in 2-4 complete sentences.

1. Why does the reading say the fiber content tag matters more than the price tag?

2. Explain why rayon confuses shoppers who sort fibers into natural and synthetic.

3. Why would a manufacturer add two percent spandex to a pair of jeans?