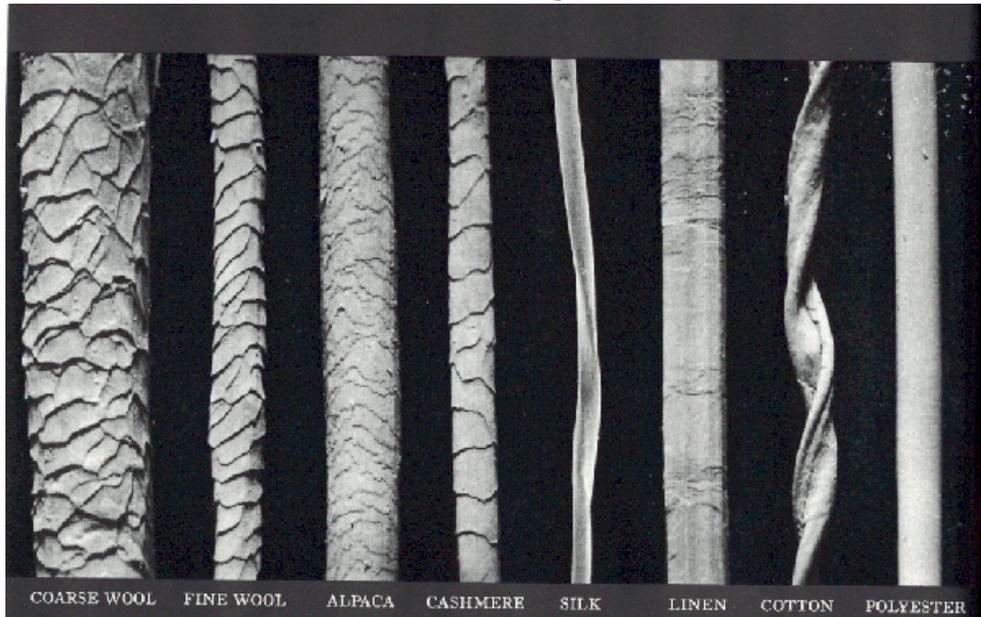


Why don't sheep shrink in the rain? (p. 50-53)
CLASSROOM RESOURCES
([Full video on YouTube](#))

Phenomenon Image ([Why use Phenomena?](#))



Different fibers under Electron Microscope. Source Unknown.

- What do you notice about the difference in structure between these different types of fibers?
- Which of these fabrics do you think would be most comfortable to wear on your skin? Which would be least comfortable?
- Why might silk and polyester sweaters feel different than wool sweaters?
- How does the microscopic structure of wool lead to some of the properties described in the Minute Earth Chapter?
- How might a cotton or polyester sweater behave in a washing machine compared to a wool sweater?

Further Questions¹

- Where do our clothes come from? What types of fabrics come from plants? Animals? Synthetics? Which fabric types are best suited for which climates?
- What types of clothing materials have more or less friction? Why might that be?
- How might you wash a wool sweater without causing it to shrink?

¹ These questions can be used as class discussion or think-pair-share after reading the chapter/watching the video. Ideally, these questions should spark students to do their own investigations, tracking down their own data or building their own models to further explore their ideas.

- Construct an explanation (with words, diagrams, or data) that answers the question “Why does wool shrink in the washing machine, but not on sheep?”

Activities & Extensions

- Have students pull their fingers back and forth on a strand of one of their hairs and discuss their observations
- Compare the number of noodle touches between cooked and uncooked pasta. Explain how this helps explain the properties of wool when dry and wet.



- Bring in shrunken wool sweaters and have students come up with a process that could help them “unshrink” them
- Examine sheep’s wool and other fibers under a microscope (see Related Videos)
- Make felt balls from wool ([4H STEM lesson](#))
- More advanced clothing and textile science unit ([4-H](#))
- Weave a bag from wool yarn ([Educational Toy Factory](#))
- Explore the OpenSciEd friction simulation ([OpenSciEd](#))
- Hands-on friction activity using quarters ([Science Buddies & Scientific America](#))
- High school friction lessons ([The Physics Classroom](#))

Related Videos

<p>095 - How to put SHEEP'S WOOL under the microscope Microscopy</p>  <p>A “How to” video on viewing sheep's wool under a microscope.</p>	<p>What Happens to My Wool Sweater in the Washer? (SciShow)</p>  <p>Hank Green explains why wool sweaters shrink in the washing machine.</p>	<p>How to Harvesting Wool - Amazing Sheep Factory - Wool Processing Mill - Modern Sheep Shearing (Noal Farm)</p>  <p>Full journey of making wool products, from shearing through processing.</p>
<p>Felting Raw Wool Fleece - Timelapse (Nymla)</p>	<p>A World Without Friction (MITK12)</p>	<p>Superlubricity-near zero friction from nanodiamonds Anirudha Sumant TEDxNaperville</p>



Watch time lapse of full process of turning raw wool into felt (adding water & agitation).



MIT students imagine a world without friction (and how hard it would be!).



Materials scientist describes new technology that reduces friction and creates "Superlubricity".

NGSS Alignment

<p>Disciplinary Core Ideas (Elementary) (Middle) (High School)</p>	<p>ESS3.A Natural resources</p> <ul style="list-style-type: none"> Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. (K-ESS3-1) Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1) <p>ESS3.C: Human Impacts on Earth Systems</p> <ul style="list-style-type: none"> Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (K-ESS3-3) <p>LS1.A Structure & Function</p> <ul style="list-style-type: none"> All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3) <p>PS1.A Structure of matter</p> <ul style="list-style-type: none"> Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3) The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (secondary to HS-PS2-6) <p>PS2.B: Types of Interactions</p> <ul style="list-style-type: none"> Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS2-6)
<p>Elementary School Performance Expectation</p>	<p>K-ESS3-1 Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. [Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]</p> <p>K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.* [Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]</p>

	<p>2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]</p> <p>2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats. [Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]</p>
<p>Middle School Performance Expectation</p>	<p>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]</p> <p>MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]</p>
<p>High School Performance Expectation</p>	<p>HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.]</p>