



STEMsational Ag: The Virtual Farm

MIDDLE TENNESSEE STATE UNIVERSITY



Module 12: Farm Fashion UNIT 1: FANTASTIC FIBERS Grades 9 – 12



National Institute of Food and Agriculture
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Module 12: Farm Fashion
UNIT 1: FANTASTIC FIBERS
Grades 9 – 12



9th – 12th Grade:

Introduction to the Unit:

Natural fibers come from plants and animals and can be extracted for use in clothing, rope, paper, and even in composite manufacturing for several industrial applications. For many centuries, plants like cotton, hemp, flax, and pine have been grown commercially for fiber. Emerging research focused on sustainability has shown possibilities using the fibers from banana and bamboo, as well as the byproducts of plant processing like the remains of sugarcane, this useful waste material is called bagasse.

A variety of animals provide natural fibers. Wool comes from sheep, but llamas and their relatives, alpacas, guanacos, and vicuñas also provide a fiber called wool. Angora rabbits produce long angora fibers and Angora goats produce fibers called mohair. The soft fiber cashmere comes from Kashmir goats. The cocoon of the silkworm insect provides fine silk. While not exclusively fibers, the fur and skins from animals such as deer, moose, bison, mink, beaver, muskrats, porcupines and rabbits have long been important to indigenous North American people. The hides of cattle and pigs have been used to make leather.



Plant fibers are generally made up of cellulose, often in combination with other plant parts such as lignin. Fibers can come from the stem, leaf, or seed. Animal fibers consist largely of proteins. Examples are wool, animal hairs such as cashmere, mohair, and rabbit hair, silkworm silk, spider silk, sinew, and catgut. Natural fibers are considered a natural resource and are renewable because they can be grown and produced every season.

There are man-made fibers called synthetic fibers made through chemical processes. Some synthetic fibers like rayon and acetate come from chemically converted plant cellulose. Other fibers like nylon, polyester, acrylic, and spandex are made from the by-products of the oil refining process. These fibers come from non-renewable resources. Often synthetic fibers are blended with natural fibers to optimize the characteristics that each fiber holds.

Pre-assessment - On a piece of paper, write your answers to the questions below:

- 1) What do you know about different fabrics?
- 2) Create a PowerPoint presentation or a short video and tell a friend what you know about different fabrics. Include your ideas about the characteristics that different fabrics have, where they come from, and what they are used for. Upload your file to the computer.

Purpose:

To explore different fabrics and understand their characteristics and how this impacts their uses in our daily lives.

Student Learning Outcomes for the Unit:

- ▶ Student will create a fabric strength test and paper.
- ▶ Student will explore the characteristics of different fibers and the fabrics they make.
- ▶ Student will demonstrate the strength and durability of different fabrics.
- ▶ Student will analyze and identify different fabrics characteristics.

National Agriculture Literacy Outcomes:

T1.9-12

Agriculture and the Environment Outcomes, Theme 1

F. Evaluate the various definitions of “sustainable agriculture,” considering population growth, carbon footprint, environmental systems, land and water resources, and economics



Vocabulary Words:

- ▶ **Fibers:** materials from nature or man-made that form the foundation for fabric
- ▶ **Natural:** natural fibers that come from plants, animals and insects and are woven into fabric
- ▶ **Synthetic:** man-made fibers that are created from a chemical process
- ▶ **Cotton:** natural fiber that comes from the seed of the cotton plant and known for its breathable, absorbent fabric
- ▶ **Silk:** natural fiber that comes from the cocoon of the silk moth and known for its durability and strength
- ▶ **Nylon:** synthetic fiber that is made from petrochemicals that turns into fabric which is wrinkle resistant and dries quickly
- ▶ **Cellulose:** the main material found in plant cell walls that make up plant fibers
- ▶ **Lignin:** naturally abundant polymer found in plant cell walls that make up plant fibers
- ▶ **Spandex:** synthetic fiber made from polyurethane and the fabric is known for its elasticity
- ▶ **Raffia:** natural fiber extracted from the raffia palm leaves and used in twine, rope, baskets and placemats

Materials Needed:

- ▶ Three pieces of clothing from your dresser or closet
- ▶ 8 by 8 samples of:
 - 100% silk
 - 100% cotton
 - 100% nylon
 - 100% spandex
- ▶ Bundle of raffia, preferably two colors
- ▶ Tape



Complete This Activity: Fiber Exploration

Materials Needed:

- ▶ Three pieces of clothing from your dresser or closet

Directions:

- 1) Go into your closet or dresser and select 3 different pieces of clothing.
- 2) Using the “Fiber Exploration Activity Chart” on the following page, examine the label on each piece of clothing and fill out the following information:
 - ▶ Type of fabric
 - ▶ Country where garment was made
 - ▶ Wash and care instructions
 - ▶ Source of fiber (natural or synthetic)
 - ▶ Type of natural resource (renewable or nonrenewable)

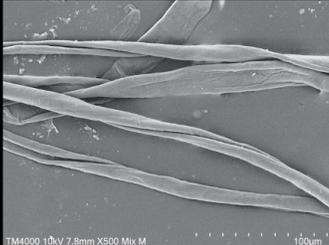
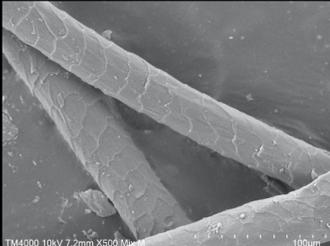
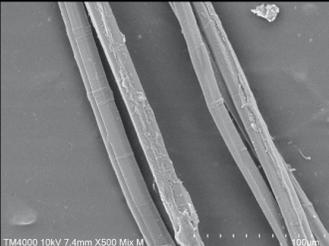
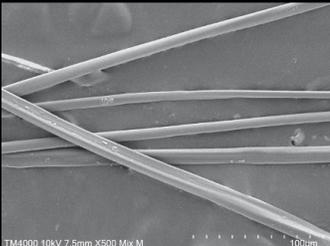
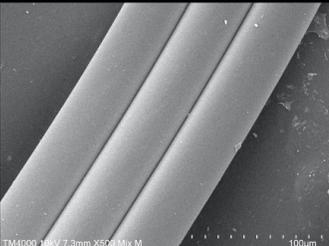
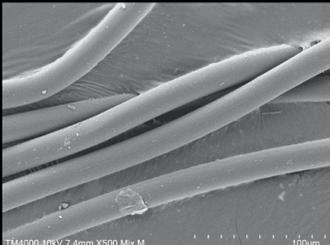
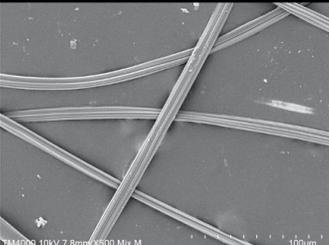


Fiber Exploration Activity Chart

TYPE OF FABRIC	COUNTRY WHERE CLOTHING WAS MADE	SOURCE OF FIBER (NATURAL OR SYNTHETIC)	TYPE OF NATURAL RESOURCE (RENEWABLE OR NON-RENEWABLE)	WASH AND CARE INSTRUCTIONS	CLOTHING OBSERVATIONS (STRETCHY, WARM, LIGHT, HEAVY, ETC.)



3) Explore the following images from the PowerPoint Presentation:
Scanning Electron Microscope Images of Different Fibers.

<h3>Scanning Electron Microscope Images of Different Fibers</h3> <p>Photos taken by Judy Elson of NC State University</p>	 <p>TM4000 10kV 7.8mm X500 Mix M 100µm</p>	<h4>Cotton Fibers</h4> <p>Cotton fibers with smooth texture and twisting strands</p>	
 <p>TM4000 10kV 7.2mm X500 Mix M 100µm</p>	<h4>Wool Fibers</h4> <p>Wool fibers with rough, overlapping texture on strands</p>	 <p>TM4000 10kV 7.4mm X500 Mix M 100µm</p>	<h4>Flax Fibers</h4> <p>Flax fibers with segmented strands and slightly roughened, peeling texture.</p>
 <p>TM4000 10kV 7.5mm X500 Mix M 100µm</p>	<h4>Silk Fibers</h4> <p>Silk fibers with smooth, channeled strand</p>	 <p>TM4000 10kV 7.3mm X500 Mix M 100µm</p>	<h4>Spandex Fibers</h4> <p>Spandex fibers with very smooth texture, uniform round strands</p>
 <p>TM4000 10kV 7.4mm X500 Mix M 100µm</p>	<h4>Nylon Fibers</h4> <p>Nylon fibers with very smooth texture, uniform round strands</p>	 <p>TM4000 10kV 7.8mm X500 Mix M 100µm</p>	<h4>Rayon Fibers</h4> <p>Rayon fibers with smooth texture, grooved, slightly wavy strands</p>



Activity Processing Questions:

- 1) Where were the clothes made?
- 2) Where do you think the fibers were produced that made the clothes?
- 3) What characteristics can you observe about the fabrics? Are they warm? Stretchy? Moisture-resistant? What kind of fibers create these characteristics?
- 4) How does the physical characteristics of different fibers contribute to the clothing characteristics of the fabric?
- 5) What do you notice about the microscope images in the PowerPoint?
- 6) Are there differences between natural fibers and synthetic? Plant compared to animal? How do you think this might influence the characteristics of the fabric they make?



Complete This Activity: Fiber Strength Test

Materials Needed:

8 by 8 samples of:

- ▶ 100% silk ▶ 100% cotton
- ▶ 100% nylon ▶ 100% spandex

Directions:

- 1) Make an outline of your foot.
- 2) Using a ruler, construct a graph which covers the outline (squares should be 1 inch).
- 3) Count how many squares there are in the outline of your foot. Don't forget to add the fractions of squares.
- 4) Multiply that by 2 (for each foot you have).
- 5) Divide your weight by the number of squares.
- 6) Each square is a square inch. You have just figured out how many pounds per square inch you put on your feet when you're standing. The stress on your shoe increases with your movement. The side to side action in basketball or tennis and sliding into home playing baseball exerts even more stress on your shoes.
- 7) In order to understand the strength of a fabric, a shoe manufacturer needs to know which fabric can stand up to the pressures of play. The fabric has to be tested. You can test fabric without any kind of complicated equipment.
- 8) Grab each sample of fabric and pull as hard as you can. Does it tear? Does it give?
- 9) Grab each sample on the opposite corners and pull. Does it tear? Does it give? Get a partner to help you pull on each sample of material. Does it tear? Does it give? Record your observations.

Activity Processing Questions:

- 1) Was there a point where the material gave way?
- 2) What kind of wear and tear will your athletic shoes have?
- 3) How can fabrics be made stronger?
- 4) What will the composition be of your next pair of sneakers?



Complete This Activity: Fiber Rope Bracelets

A rope is a bundle of fibers twisted or braided together to increase its length and strength. Ropes were originally made by hand using natural fibers like hemp, jute, sisal, and flax. Modern ropes are made by machines and utilize synthetic fibers like nylon, polypropylene, and polyester for improved strength, durability, lighter weight, and resistance to rotting. Much of the rope manufactured today is used in maritime applications like fishing and shipping.

Rope construction begins by twisting fibers together to form a yarn. The yarn is then twisted into strands, and the strands twisted into rope. Rope can also be braided rather than twisted. Both of these processes create a stronger material than single fibers. A friendship bracelet uses the same process as a commercial produced braided rope by braided yarns together instead of being twisted into strands. This activity of making a friendship bracelet using the natural fibers from a raffia palm will remind you of the strength of fibers when pleated together.

Materials Needed:

- ▶ Bundle of raffia, preferably two colors
- ▶ Tape

Directions:

Look at the screen shots and read the narration from How to Make a Rope/ How It's Made (pages 10 - 18).

How to Make Rope | How It's Made

Also available online at: www.youtube.com/watch?v=thDYZ3tzUN8



Woven from manila, sisal, or flax fibers, traditional ropes are a binding element in our world.



The process starts with racks of natural fiber yarns.



The yarns are funneled through separators which configure them to twist evenly together.



The fibers then travel through tubes that squeeze them into bundles.



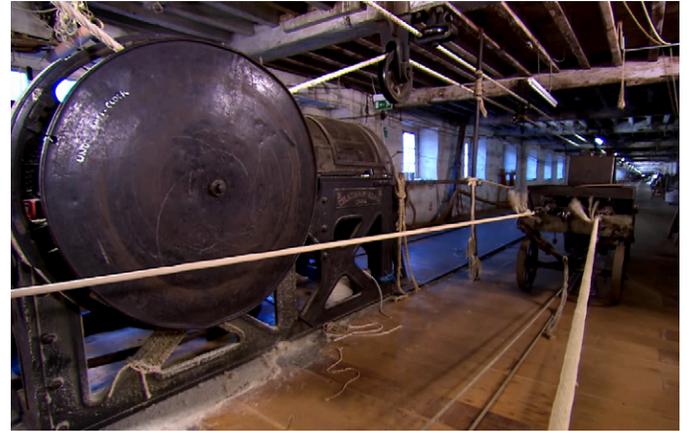
Workers tie the ends of the bundles onto ...



a wheeled vehicle called the forming machine.



They roll the machine back until there's no slack in the bundles.



The machine is then sent to the opposite end of the factory, over 1,000 feet away!



As the machine travels backward, its gears turn hooks twisting the yarns into a tight configuration.



The formation of the twists ensures an even distribution of tension. This is what makes ropes so strong.



This long indoor space is called a ropewalk; there aren't many of them left in the world.



When the machine reaches the back wall, it stops, and workers cut both ends of the strands.



They tie them to posts to maintain tension and prevent unraveling.



On one side, they tie three of the strands to a machine that will transform them into a rope.



Halfway down, they bring in a cart that holds a piece of grooved wood known as a top.



They tuck the twisted strands into the grooves of the top.



They then roll the cart down to face the rope-making machine.



A worker ties rope around the strands on the top.



This holds them in place as the rope-making machine twists the three strands into one.



The rope machine with twisting hooks remains in the same place.



When the cart arrives at the opposite side of the building the rope is formed.



A worker removes the ties around the top.



They now have a piece of rope that's over 700 feet long ...



and almost 5 inches in diameter.

- What were the steps of the process?
 - How many strands of yarn were in the first twist?
 - What do you think this rope is used for?
- ▶ Pull two strands of raffia from each color and cut each to 5 feet in length.
- ▶ Twist the raffia in the middle of the strands and then fold and make a knot. This gives you a loop at the end of your bracelet.





- ▶ Tape the loop to the table to secure it.
- ▶ This bracelet will create a fishtail braid. Start by dividing the strands in two sides, with four strands on each side and two of each color on both sides.



*Separate your
8 strands with
4 strands on each side.*

- ▶ Start with bringing the strand most left to the left side of the four strands on the right.



- ▶ Now take the strand on the far right and bring this to the right side of the three strands on the left.





- ▶ When you continue this process using the outermost strands, you will create a small fishtail braid.



Keep your braiding tight for a tidy-looking bracelet.



The fishtail pattern will emerge as you continue braiding.

- ▶ When your bracelet is long enough to wrap around your wrist you can tie it off with a knot.
- ▶ To wear the bracelet, thread the tail of raffia through the loop and make a knot.



The raffia bracelet is a reminder of the importance of fibers in our everyday lives!

Post Assessment

Record your answers on paper:

- 1) What have you learned about different fabrics?
- 2) Recall the PowerPoint or the video you created in the pre-assessment.
- 3) Did anything change?
- 4) What new information do you know?
- 5) Write as many ideas down that you can and make another PowerPoint or video and share it with a friend.