Reimage Wool for Students

Lesson Summary: Students create a new use for underutilized wool and can enter a contest to win $1,000.

Grades 4-12

Subjects: Agriculture, Science, FACS, Technology (ISTE)

Estimated Time: Four to five 45-minute class periods

Background

The American Sheep Industry Association and Wool Council are working to find uses for underutilized American Wool.

The primary objectives of this campaign are to:

- Find viable, marketable use for underutilized American wool (>25 micron).
- Create awareness of American wool properties and uses.
- Generate ideas for new wool products, processes or tweaks on current products and processes.
- Promote American wool.
- Develop new uses for unwashed wool.
- Grow value for American sheep producers.
- Reduce waste.

Materials Needed

- Raw (unprocessed) wool
- Warm soapy water
- Spray bottles
- Cardboard, pool noodle, cookie cutters, bubble wrap, towels, etc. Depending upon what students wish to use.

Vocabulary

- **Circular economy or circular design**– system where products are designed to last longer, be repaired, reused, or recycled to minimize waste and make a positive environmental impact
- **Felting**- a process where fibers are interlocked with each other through heat, moisture, and movement.
- **Natural Fibers**- hairlike raw materials that comes directly from plants, animals or minerals
- **Scouring**– the removal of grease, soil, and suint from wool by washing with water, soap, and alkali.
- **Synthetic Fibers**- a man-made fiber produced from chemical substances

Did You Know?

Wool Characteristics

- **Many Uses**: Wool comes from a variety of sheep breeds that provide a variety of types of wool. Some breeds grow fine, extremely soft wool while other breeds produce thicker, stronger wool.
- **Temperature Regulating**: Wool can be used to keep people and products warm or cool. Wool fibers have a natural crimp or zigzag shape along the fiber that creates small air

pockets. Air does not transfer heat or cold easily. As the crimp in wool fibers creates small air pockets, air slows the flow of heat and cold. Additionally, wool can generate heat as it absorbs moisture. This provides warmth in the winter. When wool releases moisture, the evaporation process creates a cooling effect. Thus, wool is cool in the summer and warm in the winter.

- **Moisture Management**: Wool is water repellent yet moisture wicking. Wool fibers have a hydrophobic (water-hating) outer layer which repels liquid water. Yet, wool fibers absorb moisture from the air and next to the skin. Wool can absorb as much as 30 % of its weight in moisture without feeling wet. This leaves the surface next to the skin dry. Wool is also a breathable fiber. Air pockets created by the wool fiber, yarn construction, and fabric construction allow air to circulate and prevent buildup of moisture and heat. This makes the fiber comfortable to wear.
- **Odor Resistance**: Wool's ability to absorb moisture helps prevent the buildup of bacteria and odor and making wool clothing require less frequent washing compared to other fibers. Wool is a good fabric for athletic wear and for base layer (next-to-skin) clothing.
- **Durability**: Wool is elastic and durable. Because of wool's natural crimp and physical structure, wool is elastic which allows it to stretch and return to its original shape. Dry wool can stretch an additional 10-30% of its original length while wet wool can stretch 40-50%. Wool is resistant to tearing and can bend up to 20,000 times before breaking. Wool can be used in a variety of applications that require durability, including carpets, rugs, and socks.
- **Natural Flame Resistance**: Wool is naturally flame resistant. As wool naturally absorbs and holds water within the fiber, it is the only fiber that is naturally flame retardant. Wool does not burn until it reaches temperatures of over 1,000 degrees Fahrenheit. Wool does not melt and stick to the skin. It naturally self-extinguishes when the flame is removed. Wool is a widely used fiber for firefighter clothing, military clothing, insulation, bedding and other household items for its flame-retardant qualities.
- **Sound Dampening**: The dense structure of wool fibers effectively reduces sound wave energy, contributing to its use in sound insulation.
- **Controlled Felting**: Wool fibers have an outer layer of scales that provide protection to the wool while on the sheep. The scales also allow wool fibers to be felted. Felted products include cowboy hats, mats, and boot liners. Felting can also make fabrics softer and fuzzier.
- **Sustainability**: Wool is natural, renewable, and biodegradable. Each year, wool sheep grow a fleece similar to how people grow hair. Wool will biodegrade (decompose) in soil within months. When in soil, wool provides a slow-release fertilizer that delivers nitrogen, phosphorus, potassium, and sulfur. It also aerates the soil which provides increased water retention and increased microbial activity. Wool is also a prominent recyclable material, meaning that there is well-established recycling infrastructure already in place for the product, and that it can be recycled multiple times.

Uses of Wool in Clothing

- **Athletic clothing**: Wool is becoming increasingly popular for use in athletic clothing as it wicks away moisture, stretches, thermo-regulates, and is odor resistant.
- **Cold-weather clothing**: Wool is iconic in cold-weather garments such as sweaters, hats, scarves, and gloves.
- **Military & first responders clothing**: Due to its flame resistance, no-melt, thermo-regulation, and moisture-wicking properties, wool is ideal for military and first responder use.
- **Fashion**: Many fashion designers prefer wool because of its luxurious feel, beautiful drape, ability to dye, and sustainability. Coats, suites, and socks are popular.

Uses of Wool in the Home

- **Building Insulation**: Wool is an excellent, sustainable alternative to synthetic insulation like fiberglass. It is naturally fire resistant, manages moisture, and helps regulate indoor air temperature and quality.

- **Bedding**: Wool's ability to regulate body temperature and wick moisture creates a comfortable, dry sleep environment. It is used for filling pillows, comforters, mattresses, and mattress toppers.
- **Carpets and Rugs**: Wool's natural crimp and elasticity make it resistant to crushing and indentation, which allows carpets and rugs to maintain their appearance for decades.
- **Upholstery**: Wool is a durable and naturally flame-resistant material for furniture upholstery.
- **Soundproofing**: Wool's dense, fibrous structure effectively absorbs sound waves, making it an excellent material for acoustic panels in homes, studios, and commercial spaces.

In the Garden and Agriculture

- **Fertilizer**: As wool biodegrades, it slowly releases nutrients like nitrogen, sulfur, and carbon into the soil, acting as a natural, long-term fertilizer.
- **Mulch**: Wool pellets or mats are used as mulch to suppress weeds, regulate soil temperature, and retain moisture, which reduces the need for watering.
- **Slug Repellent**: Slugs and snails dislike crawling on wool. Wool pellets scattered around plants expand into a felt-like mat when wet, forming a barrier that repels these garden pests.
- **Compost**: Wool scraps can be added to compost piles, where they break down and add nutrients to the resulting soil.

Other Uses of Wool

- **Oil Spill Cleanup**: Wool is highly effective at absorbing oil and repelling water, making it a natural, reusable material for cleaning up oil spills in aquatic environments.
- **Packaging**: Some companies use wool as insulated packaging to keep temperature-sensitive goods cool or warm during shipping, as a sustainable alternative to polystyrene.
- **Biomaterials**: Scientific study has explored using wool fibers for biomedical applications, including wound dressings, tissue engineering, and drug delivery systems.
- **Crafting**: Wool is a beloved material for many artisans. Techniques like needle felting and wet felting use the fibers to create sculptures, decorative items, and artwork.
- **Cosmetics**: Lanolin, the fatty substance found in sheep's wool, is refined for use in lotions, lip balms, and ointments.

Background and Agricultural Connections

Wool is one of the oldest fibers used by man, first used around 8000 BC. Wool has been vital to agriculture and history, providing essential clothing and a means for human settlement to expand. Historically, sheep were domesticated for meat, milk, and skins, with wool becoming increasingly valuable for its warmth and durability, which helped civilizations thrive in colder climates. Economically, wool fueled the wealth of countries, drove the development of trade and eventually prompted the Industrial Revolution.

Today, wool continues to play an important role in agriculture. Sheep are a versatile, multi-purpose livestock that provide wool, meat, milk, and pelts. Sheep can be raised in diverse environments, including dry areas where other livestock may not thrive, and their grazing can contribute to healthy soil and pastures. Sheep provide diverse income streams including vegetation management and solar grazing, producing meat and milk products, and growing wool for a variety of high-quality and high-value products.

Lesson Activities

Day 1: Engage

Provide a small sample of raw wool and an example scenario to each group of students. Each scenario describes a farmer that has unused wool. Have each group read the scenario and discuss what the producer could do with this excess wool. Share the scenarios and student solutions.

Show students the poster and ask students if they want to win $1,000 to solve problems just like those in the scenarios.

Day 1: Explore and Explain

Wool is a beautiful natural fiber. Fine wool is used for clothing and even items that go next to the skin. Entrepreneurs are finding uses for medium and coarse wool; however, there has not yet been a viable commercial market for this wool in the United States. Wool more than 25 microns (which is considered undesirable in most markets) has been stockpiled in sheds, thrown into ditches, and even taken to landfills. We are seeking solutions and you may be able to solve this problem and WIN BIG! The American Wool Council under the umbrella of the American Sheep Industry Association is sponsoring a contest to find a viable, scalable market for wool that is more than 25 microns.

- Share this slideshow with students Reimagine Wool
- Watch the video: Wool Experiments
- In groups, give students time to brainstorm solutions to underutilized wool in the United States and plan experiments to try. Ask them to provide a list of needed materials and their plans for the next day's experiments. (Depending upon age, students might be limited to not using matches, electric hot plates, knives, etc. for safety reasons.) Provide this Lab Report for students. They may need more than one per group.

Day 2-3: Conduct Experiments

Engage: Provide all materials students listed in the lab reports for the experiments including extra raw wool. Return lab reports with notes if more detail is necessary prior to beginning the experiments.

Lesson:

- Ask students to review the lab report notes made by the instructor prior to starting.
- Observe students and check for safety.
- Students complete lab reports and prepare at least one item to display for the next day.
- Students take some wool home for extra experiments and trial tests.

Day 3-4 or 4-5: The Challenge

Engage: Place student lab reports and products around the room. Conduct a gallery walk of wool experiment results, letting students observe and read each one. Bring students together for a discussion of what was learned. Provide more background on wool if necessary.

Lesson:

- Ask students to write down their 'Best and Biggest Idea' for using wool.
- Allow students to create their own poster design featuring their best and biggest idea. Pair students if desired.
- Review the Reimagine Wool Digital Poster Contest rules and requirements. Challenge students to create a digital poster to show their original idea for using underutilized wool.

Elaborate:

Use any of the following activities to provide added learning.

Wet Wool Felting

Supplies:

- Raw or washed wool
- Water-proof tray
- Soapy water
- Spray bottle
- Towel, cardboard, bubble wrap, pool noodle, or other items to roll and agitate wool.

Activity:

1. Place the tray, towel, and cardboard on the tray. Cardboard on top.
2. Pull pieces of wool apart and into a thin layer. Lay thin pieces side by side in the same direction.
3. Create another layer going in the other direction.
4. Spray with warm soapy water.
5. Continue to layer wool until desired thickness.
6. Spray warm, soapy water over the wool until it is completely wet.
7. Place a pool noodle or stick near the end of the wool and cardboard. Roll up tightly.
8. Roll the cardboard back and forth putting more and more pressure on it. Water will seep out so use the towel or go outside to a non-grassy area.
9. Roll for 5-10 minutes and check the felting of the wool.
10. Open up the project once it is firm. Rinse out the soapy water. If there are bare spots, fill them with wool and spray and roll again.
11. Squeeze out as much excess water as possible using paper towels.
12. Let the project dry completely.

Cookie Cutter Wool Felting in the Classroom

Supplies:

- Wool roving (may be dyed or natural colored)
- Water-proof tray
- Soapy water
- Spray bottle
- Cookie cutter

Activity:

1. Create a Design: Place the cookie cutter on the tray. Fill the cutter with thin layers of wool roving, creating a marbled design if desired.
2. Add Soapy Water: Gently pour warm, soapy water over the wool until it is completely wet.
3. Agitate the Fibers: Use your fingers to poke and press the wool, which opens the fibers. Continue poking until the wool feels flat and matted. You can flip the project and poke the other side to ensure the fibers connect on both sides.
4. Rinse and Dry: Once the project is firm, rinse out the soapy water. Then, squeeze out as much excess water as possible using paper towels. Let the project dry completely.

Felted Wool Marbles

Supplies:

- 2" x 2" (5.08 cm x 5.08 cm) pieces of dyed wool, batting or roving, 1 per student
- Bowl of warm, soapy water

Activity:

1. Separate the fibers from a 2” x 2” (5.08 cm x 5.08 cm) piece of dyed wool until you have a puff of wool.
2. Lightly and gently roll the wool in your hands to create a loose ball.
3. Dip the wool into warm soapy water.
4. Roll the wool between your palms in a gentle but quick circular motion. Do not press or squeeze the wool.
5. Continue rolling until the wool starts to stick together and looks like felt. This should take about five minutes. Continue rolling until the desired density is reached.
6. Allow the marble to dry.

Ziploc Felting

Supplies:

- Natural and dyed wool, batting or roving
- Tulle fabric
- Sandwich-size resealable bags, 1 per student
- Soapy water

Activity:

1. Cut a rectangular, flat piece of wool small enough to fit inside the resealable bag.
2. Create a design by layering dyed wool on top of the rectangular piece.
3. Place rectangular pieces of tulle on the top and bottom of the wool. The texture of the tulle will help speed up the felting process.
4. Place the wool and tulle inside the bag.
5. Pour enough soapy water into the bag to completely saturate the wool.
6. Place the bag flat onto a towel.
7. Squeeze the excess water out of the bag by pressing with your hand from the bottom of the bag to the top.
8. Seal the bag and work the wool by poking and pounding with your hands from the outside of the bag until the wool becomes firm and felt like.
9. After the wool has felted, remove it from the bag, discard the tulle, and gently rinse with water, alternating hot and cold.
10. Roll the felt in a towel to squeeze out any excess water. Lay flat to dry.

Additional Videos & Resources

How to Wet Felt Beads the Easy Way
Felting Soap with Wool | Easy Felted Soap Tutorial | How to Make Wet Felted Soap

Making felt, from Freshly sheared sheep's wool - A homemade project, An experiment, Part 1
Beginner Wet Felting and Nuno Felting Tutorial | How to Felt a Purse and Sew a Purse Clasp
How to Make Wet Felted Loops for Bag handles, Hooks, Claps, Jewellery & more!

Day 5-6: Evaluate

- Lab Reports
- Poster
- Questions/Exit slips:
    - What did you learn about wool? (Ask for 3-5 items)
    - What are the pros and cons of scouring wool?
    - What is a circular design/economy and why do we want one?

Recommended Companion Activities

America's Heartland: Wild & Wooly Roundup video
Breeds of Sheep website
Ewe Want to Keep Me Warm video
From Fiber to Fabric . . .Wool's a Natural video
From Sheep to Sweater book
Hands On Wool activity
On the Flip Side kit
Sheep See and Do lesson plan
Sheep-Utah's Agricultural Cornerstone video
Sheepology: The Ultimate Encyclopedia book
A Common Thread: The Significance of Wool in Medieval England lesson plan
Selectively Breeding Sheep–Punnet Square Practice lesson plan
Unraveling Fibers book
Wool Samples kit
Wool Spinning kit
Cotton wool for oil spills | DW English video

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Standards

ISTE (International Society for Technology in Education) Standards

1.1 Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
1.3 Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
1.4 Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
1.5 Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

1.6 Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
1.7 Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.

National Middle School Agricultural Literacy Outcomes

T1.6-8.c Discover how natural resources are used and conserved in agriculture.
T1.6-8.h Recognize the factors of an agricultural system which determine its sustainability.
T3.6-8.i Identify sources of agricultural products that provide food, fuel, clothing, shelter, medical, and other non-food products for their community, state, and/or nation.
T4.6-8.i Provide examples of science and technology used in agricultural systems

National Middle School Science Standards

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*
MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*
MS-ES3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

National Middle School ELA Standards

Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
Literacy.RST.6-8.9Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading literacy.

National Standards for Family and Consumer Sciences Education

2.4 Evaluate the effects of technology on individual and family resources in a global context.
3.4 Analyze resource consumption for conservation and waste management practices.
3.5 Demonstrate skills needed for product development, testing, presentation and waste management practices.
11.0 Apply design knowledge, skills, processes, and theories and oral, written, and visual presentation skills to communicate design ideas.
11.9 Develop a global view to weigh design decisions with the parameters of sustainability and socioeconomic and cultural contexts within the housing, interior design, and furnishings industries.

National High School Science Standards

HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
HS-ESS3-2.
HS-ESS3-4. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios
Evaluate or refine a technological solution that reduces impacts of human activities on natural systems

National High School Agricultural Literacy Outcomes

T1.9-12.f Evaluate the various definitions of “sustainable agriculture,” considering population growth, carbon footprint, environmental systems, land and water resources, and economics.
T2.9-12.d Evaluate evidence for differing points of view on topics related to agricultural production, processing, and marketing.
T4.9-12.c Discuss population growth and the benefits and concerns related to science and technologies applied in agriculture to increase yields and maintain sustainability.
T4.9-12.d Evaluate the benefits and concerns related to the application of technology to agricultural systems (e.g., biotechnology).
T4.9-12.e Identify current and emerging scientific discoveries and technologies and their possible use in agriculture.
T4.9-12.g Provide examples of how processing adds value to agricultural goods and fosters economic growth both locally and globally.

National High School ELA Standards

Literacy.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Literacy.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
Literacy.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information
Literacy.RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Acknowledgements

Written by Amy Benz
Sponsored by the American Wool Council
Supported by the American Sheep Industry Association