LESSON 7
Key Strategies for Our Future

NUTSHELL

In this lesson, students are exposed to different types of science and technology used in forestry and the collaborative partners that make it possible by locating examples from two readings. They also create a Fantasy Future Forest to predict future innovations and their effects. Based on their drawings, students discuss factors that influence the balance between quality of life and the quality of forests.

BIG IDEAS

- Science and technology contribute to the understanding of forests, the impacts of human actions on these systems, and how forests can be sustained. As knowledge is gained forest management is adapted. (Subconcept 50)
- Increased population and demand on forest resources leads to the need for increases and improvements in management (e.g., harvest techniques, genetics), technological systems (e.g., GIS, tools), and wood utilization. Without advances in these areas, sustainability of forests is more difficult. (Subconcept 51)
- Forest-related decisions can be affected by politics, science, emotion, and economics. The current and future relationship between the quality of human life and the quality of forests will be determined by these decisions. (Subconcept 55)
- Management for sustainable forests will continue to require creativity, innovation, and collaborative thinking by individuals, organizations, governments, and industry. (Subconcept 56)

OBJECTIVES

Upon completion of this lesson, students will be able to:

- Summarize how forest-related decisions and the factors that influence them (science, politics, emotion, economics) determine the balance between the quality of human life and the quality of forests.
- Describe the ways that science and technology contribute to our understanding of forest systems, wood utilization, human impacts, and current issues and can help us respond to future challenges in sustainable ways.
- Explain how individuals, organizations, government, and industry must use creativity, collaboration, and innovation to manage forests sustainably.

SUBJECT AREAS

Arts, Language Arts, Science, Social Studies

LESSON/ACTIVITY TIME

- Total Lesson Time: 90 minutes
- Time Breakdown:

  Introduction .....10 minutes
  Activity.....40 minutes
  Conclusion .....40 minutes

TEACHING SITE

Classroom

BACKGROUND INFORMATION

Science and technology play an important and increasing role in forestry and in other natural resource fields. As scientific and technological developments come about, changes result in the practice of forestry. For example, the use of GIS (Geographic Information Systems) and GPS (Global Positioning Systems) is now common in creating forest maps. Lasers and metal detectors are used in sawmills to increase production and reduce equipment damage. Genetic engineering can be used to promote disease resistance in some tree species.

MATERIALS LIST

FOR EACH STUDENT

- Copy of Student Pages **1A-B**, *Muskies in the Treetops* OR Copy of Student Pages **2A-B**, *Foamy Firefighting Factoids* OR Copy of Student Pages **3A-B** *What's In A Tree?*
- Copy of Student Page **4**, *Questions*
- Copy of Student Page **5**, *Fantasy Future Forest*
- Crayons or markers for creating *Fantasy Future Forest* (optional)

FOR THE TEACHER

- Teacher Page **1**, *Questions Key*

TEACHER PREPARATION

Find an example of an item made of veneer to show in the introduction. This might include the door to your classroom, a desktop, chair seat, ping pong paddle, skateboard, bottom of a hockey stick. To ensure the item is made from veneer, look for thin layers of wood that are adhered together.

The use of science and technology in forestry also impacts human actions. Paper that was once considered waste can now be recycled. Wood building products are made stronger and last longer than in the past and in some instances replace steel and iron. For example, beams that were once created of steel can now be made of wood. **Veneer**, or a thin sheet of wood cut from high-value trees like black walnut, can be used to cover the outer surface of an item. Low-grade wood is used as filler. This allows the high quality wood to go further. Science and technology also help us better understand the workings and functions of forest systems. This understanding leads to **sustainable** choices in use and protection of forest systems. As challenges arise, science and technology will contribute to sustainable solutions for humans and the environment.

Often science and technology result from partnerships and collaboration between different individuals, organizations, government agencies, and industry. This collaboration is often essential in making projects happen. Each person or group offers something that the others are lacking. Resources could include a place to research and study, staff, tools and equipment, funding, or even the motivation, inspiration, and need for the project to occur.

Sustainability requires a balance between the quality of human life and the quality of the environment over time. This balance is affected by every forestry decision that is made. Sustainable decisions consider the needs of humans and the environment. Not all decisions consider all factors equally. However, it is important to remember that good and bad are subjective terms, and what one person perceives as good, another may perceive as bad. Forest-related decisions could be affected by many factors including science, technology, emotion, and economics. One person may choose to cut down a stand of trees for economic reasons, and another may consider that a poor environmental choice. Regardless of the situation, it is important to remember that balance doesn't always come easily. Science, technology, and collaborative efforts are helping to make advances that lead to a sustainable balance.

VOCABULARY

Sustainable: The ability for something to be maintained for use today and in the future.

Veneer: A thin layer of wood created when logs are shaved from the outside into the center.

PROCEDURE

INTRODUCTION - VENEER TECHNOLOGY

Show students an example of a wood product made with veneer. (Examples might include the door to your classroom, desks, chairs, a ping pong paddle, a skateboard, the bottom of a hockey stick.) After students have studied the item closely, ask them what type of technology they think is used in the mills that cut the logs the item is made from. *(Explain that the item is made from veneer. To make veneer:*

- *A log is debarked*
- *The log is scanned with a metal detector to ensure there is nothing in the wood, like nails, that will damage the machines that cut it.*
- *The log is soaked in hot water to make the wood softer.*
- *A computer is used to scan the log. Scanning it helps to get the most veneer out of each log. The computer ensures the machine is holding the log exactly in the center.*
- *The log is then spun very quickly. A sharp blade cuts a very thin and long sheet of wood off the log from the outside in. This thin sheet is the veneer. It can be compared to the way the paper comes off a roll of toilet paper.*
- *The last part of the process involves drying the veneer, cutting it to size, and dyeing it if needed.)*

Reinforce the idea that there is a great deal of technology that goes into producing wood products. There is also a considerable amount of science and technology in other areas of forestry, besides products. Tell students that in this lesson they will be learning about other areas of forestry where science and technology are used and the collaboration that goes into making the science and technology possible. They will also have the opportunity to predict what future science and technology will be necessary to sustain Wisconsin's forests.

ACTIVITY - TECHNOLOGY IN ACTION

1. Have each student read either Student Pages **1A-B**, *Muskies in the Treetops* or Student Pages **2A-B**, *Foamy Firefighting Factoids* or **3A-B**, *What's In A Tree?.*

2. Hand out Student Page **4**, *Questions* to each student and have them complete it. You can discuss the questions as a class or collect and evaluate them. (See Teacher Page **1**, *Questions Key* for answers.)

CONCLUSION - FANTASY FUTURE FOREST

1. Hand out a copy of Student Page **5**, *Fantasy Future Forest* to each student. Go over the known trends at the top of the page and explain any that are unclear. Have students complete the task at the bottom of the page.

2. When students have completed the worksheet, have them pair up and discuss their ideas. Discussion should include identifying the reasons that affected their vision of the ideal forest. *(These could include science, politics, emotions, or economics.)*

3. When student pairs are finished with their discussions, have them briefly share their creations with the rest of the class.

4. Ask the class to identify which ideas might prove most difficult to have co-exist. Explain that it can and will be difficult to balance the quality of human life – getting to do all the things we want to do in the forest, and the quality of the forest – preserving ecosystems, wildlife habitat, etc. Ask for ideas on how these two things might be balanced. *(Continued collaboration between groups, sustainable forest management decisions, wise use.)*

CAREERS

The career profile in this lesson features Jessie Micales, Plant Pathologist at the Forest Products Laboratory. The Career Profile is found on page 136. A careers lesson that uses this information begins on page 170.

SUMMATIVE ASSESSMENT

Have students research an area of forestry where science and technology are being used. Have them explain what innovations are being used and the collaborative partners involved. Examples include the use of lasers in lumber mills for increasing wood utilization and GIS and GPS in forest mapping and modeling. The Forest Products Laboratory in Madison, Wisconsin does research in many areas. Information is available on their website: www.fpl.fs.fed.us/

REFERENCES

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Finan, A. S. (Ed). (2000). Wisconsin's Forests at the Millennium: an Assessment. Madison, WI: Wisconsin Department of Natural Resources. PUB-FR-161 2000.

Haygreen, J. G. & Bowyer, J. L. (1989.) Forest Products and Wood Science. Ames: Iowa State University Press.

Kildow, B. Forest Ranger, Wisconsin Department of Natural Resources. [Email]. (January 2003).

Webster's College Dictionary. (1991). New York: Random House.

RECOMMENDED RESOURCES

●●● WEBSITE ●●●

USDA Forest Service Forest Products Laboratory
www.fpl.fs.fed.us/
Find information on research being conducted in many areas of forestry, wood utilization, and forest products in Madison, Wisconsin.

CAREER PROFILE

JESSIE, PLANT PATHOLOGIST

Jessie enjoys studying fungi that grow on trees and wood.

Meet Jessie Micales. She is a Plant Pathologist at the Forest Products Laboratory in Madison, Wisconsin. The Forest Products Laboratory conducts research on forests and forest products. Jessie supervises a group of people who study fungi that break down wood or grow in people's houses and cause health problems. As a supervisor, Jessie attends meetings, manages a budget, and writes grants to secure funding for new projects. The research part of Jessie's job involves traveling around the world to study foreign plant diseases to prevent them from entering the United States.

To become a Plant Pathologist, Jessie earned a degree in Agronomy (study of field crops) and a PhD in Plant Pathology. She also did several years of research to gain experience. For a while she even worked in a secure greenhouse where she had to wear special clothing and shower before leaving.

Universities and other researchers, private companies, homeowners, and the general public all benefit from the work Jessie and the other scientists at the Forest Products Laboratory do. Their research helps make forest products safer and longer lasting.

Jessie's favorite part of her job is "working in the laboratory and getting out into the field, especially when I am with other scientists who can teach me new things." She suggests that if you want to have a job like hers, take a lot of classes in science, chemistry, biology, statistics, and genetics. It is always good to get laboratory experience by volunteering to work for a scientist or having a summer job in a lab.

QUESTIONS KEY

1. **What types of science and technology were used in the stories *Muskies in the Treetops* and *Foamy Firefighting Factoids*?**

   In *Muskies in the Treetops*, university graduate level research is being used to determine the connection between human land use and fish habitat in lakes. Fish were counted and observed in their natural habitat. Light and soil type in the surrounding forest were measured. Tree samples were studied with a high-power microscope. Computer modeling will be used to predict fish habitat. A computer model will be created to illustrate how human land use affects fish habitat.

   In *Foamy Firefighting Factoids*, chemical companies developed foam that helps fight wildland fires and is environmentally sound. Based on scientific principles, using foam allows water to absorb into fuels and absorb more heat than if it were not present.

2. **Give an example from each story of how this science technology will contribute to sustaining Wisconsin's forests.**

   In *Muskies in the Treetops*, the computer model that is developed will help determine a balance between human land use and healthy ecosystems. Educational information and regulations can be developed to help landowners around lakes ensure their land use is sustainable.

   In *Foamy Firefighting Factoids*, new foam technology will lead to more efficient firefighting and forests will be protected from fire damage. Advances in science and technology will also reduce the environmental impacts of the foam itself.

3. **What individuals, organizations, governmental agencies, industries, etc., worked together to make the science and technology possible in each story?**

   In *Muskies in the Treetops*, the students did the research, the Lake Katherine Riparian Owners Association participated, the University of Wisconsin-Stevens Point and Wisconsin Department of Natural Resources partnered to provide funding, and the Wisconsin Cooperative Fisheries Research Unit and USGS provided the project.

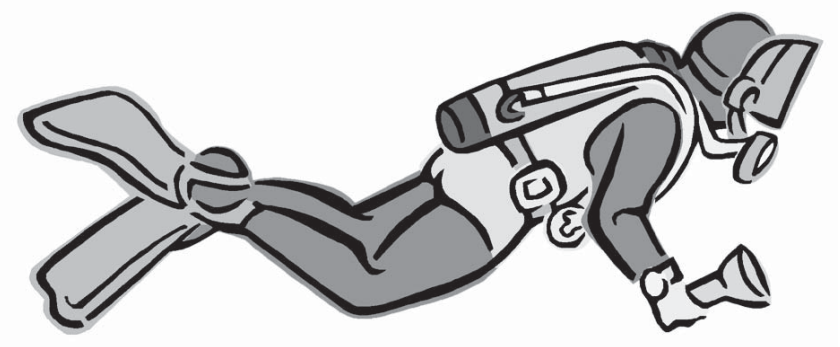
   In *Foamy Firefighting Factoids*, the wildland firefighters, including the Wisconsin Department of Natural Resources, work to put out the fires and industry develops the foam.

4. **Predict what might be different in one of the two stories if science and technology were not available.**

   Answers will vary.

MUSKIES IN THE TREETOPS

Brian Achuff enjoys the days he spends watching fish swim around the branches of trees. “I see huge muskies and a lot of bluegills,” says Brian. Is he dreaming? How can fish swim in the tops of trees? For one group of graduate students, putting on scuba gear and watching the habits of fish swimming among trees is part of their job. They are studying the connection between human land use and fish habitat. The habitat is created by trees that have fallen from the forest into Lake Katherine near Minocqua, Wisconsin.



Projects like this depend on students who do the research. They also depend on funding partners and local landowner groups such as the Lake Katherine Riparian Owners Association. Brian and the other graduate students work for the Wisconsin Cooperative Fisheries Research Unit. The unit is part of the United States Geological Survey (USGS). Their project is funded through a partnership between the University of Wisconsin-Stevens Point and the Wisconsin Department of Natural Resources. It has been ongoing for several years. The goal is to create a computer model that shows how human land use around lakes affects fish habitat in lakes.

MUSKIES IN THE TREETOPS

During the first part of the study, students watched and counted fish in their natural habitat. They studied the types of habitat fish like and determined fallen trees were important. The second part of the project involved connecting land use to the lake habitat. Brian investigated disturbances that occurred in the forest around the lake.

He also measured the amount of sunlight and the type of soil in the area. He then aged the trees in the lake by studying samples under a high-power microscope. Brian was able to determine when trees fell into the water, how fast they were decaying, and why they entered the water in the first place. Once this is done, computer modeling will be able to show how land use will affect future fish habitat in the lake. This model will be able to predict what the fish habitat will look like hundreds of years into the future.

Tourism in Northern Wisconsin is increasing. This creates pressure to protect and preserve the remaining natural ecosystems. Finding a level of sustainable use can help. Brain says, "Ecosystems have amazing resilience. We have to figure out how far the system can be pushed before it can't bounce back. We hope to provide landowners with education and encourage regulations for lakeshore use. This will lead to a balance between human use and healthy ecosystems. With the proper balance, these lakes will take care of themselves. We won't have to create artificial habitat for the fish."

FOAMY FIREFIGHTING FACTOIDS

Trivia Question: You are camping and want to put out your campfire. Should you use fresh cold water or your dirty dishwater? Why?

The answer: Your dirty dishwater would better at putting out the campfire. Soapsuds reduce the surface tension of water. With a lower surface tension, water can soak into the fuel better. Have you ever noticed that when you drop water on a burned log it beads up and runs off? When soap is added to the water the mixture can be absorbed into the fuel and take up heat. The soapy foam also acts as a barrier between the flames and the fuel.

Foams are used in wildland firefighting. They aren't exactly dish soap, but they have similar properties. The foam used to fight forest fires is thicker than dish soap and contains more air. The air is important because it insulates the fuel from heat. This makes it effective as a fire retardant. Foam can be sprayed on buildings ahead of oncoming fires. The foam protects buildings from the heat of the fire. A thick foamy mixture also sticks to vertical surfaces like buildings and trees.

Brad Kildow is a Wisconsin Department of Natural Resources Forest Ranger at the Whiting Ranger Station in Central Wisconsin. He estimates that they use foam on 70 percent of the wildland fires they fight. Wildland fires are not always near a water source.

Making a limited water supply last is important. Brad says, "Unless it is a real small fire and more water is close at hand, I use foam a lot. It makes the 190 gallons I can carry on my truck really stretch." Mixing foam with the water makes it last four times longer. This would be the same as the truck carrying 760 gallons of water. If compressed air is used to make the foam even frothier, it can go ten times as far as just plain water. The foam is effective and relatively inexpensive so Brad says that for wildland firefighters it is the way to go. Eventually all the tanker trucks used by the Wisconsin DNR will have foam systems.

FOAMY FIREFIGHTING FACTOIDS

This innovation wouldn't be possible without the help of industry. Chemical companies that make the firefighting foam continuously research and develop more effective products. The foam is a chemical. There are some environmental concerns with its use. Releasing the foam into the environment could affect some ecosystems. This means the solution must be made nontoxic. According to one foam manufacturer – a true environment-friendly foam is one which:

- Extinguishes the fastest
- Creates the least amount of pollution in the air and water
- Provides the least amount of environmental upsets as a result of release

When wildland firefighters use the foam, they work hard to keep it out of surfacewater and focus it on soil where it is more biodegradable.

There are always choices to be made when trying to balance the quality of human life and the quality of the forest. Humans benefit from efficient fire suppression. This comes at some cost. The development of new technologies will be important in responding to future forest-related challenges.

WHAT'S IN A TREE?

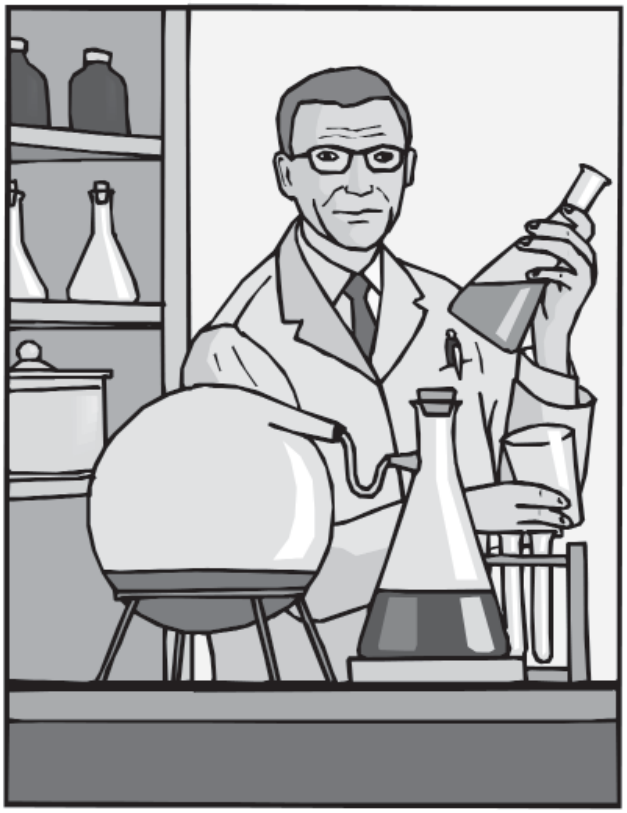
What's in a tree? When we think of all the products we get from trees, some come to mind easily.

- wood furniture
- firewood
- lumber
- toothpicks
- fences

Other products we get from trees are harder to remember and we may not know about them at all. Did you think of these?

- paper
- chemicals
- fuel

Scientists use a process called biorefining to get multiple products from biomass, like trees. Right now, researchers already have ways to hydrolyze wood to release sugars. When you hydrolyze wood, you use a chemical reaction between water and the wood. The result is the release of sugars stored in the wood. The sugars can be made into chemicals and fuels (like ethanol).

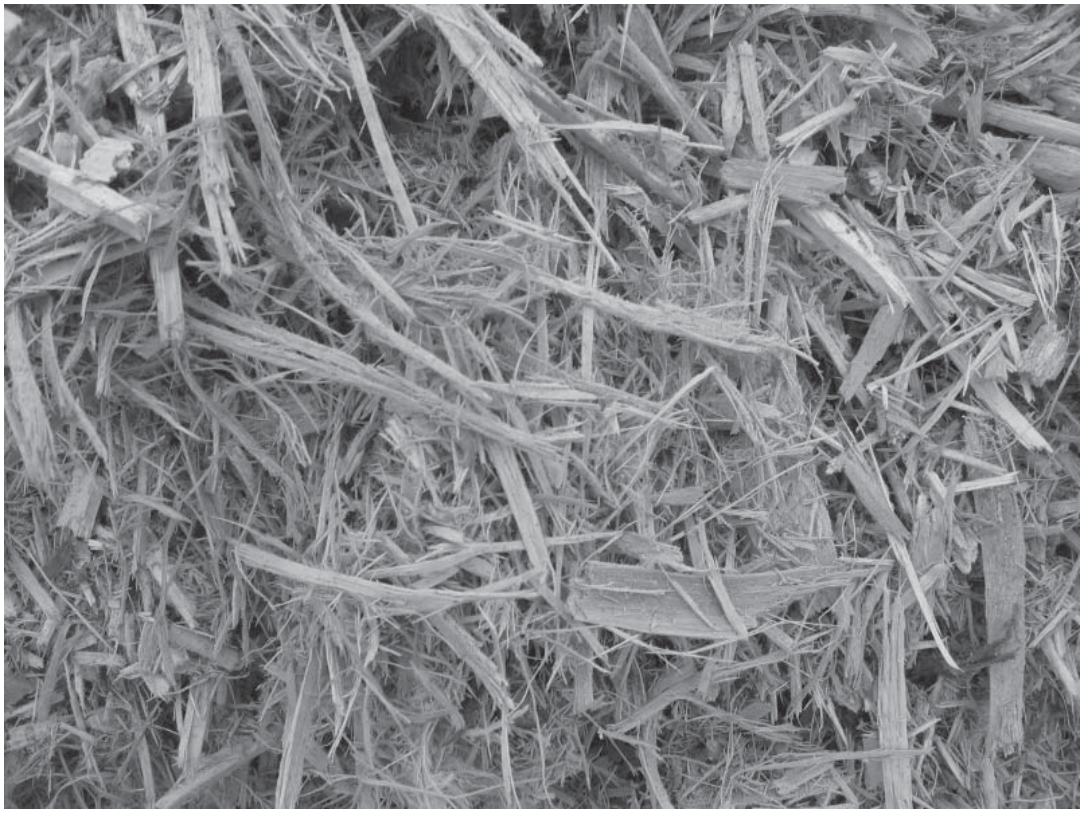


WHAT'S IN A TREE?

New research being done at the United States Department of Agriculture, Forest Service, Forest Products Laboratory is striving to find a way to get sugars from the wood, and also get paper and other chemicals from what's left. Getting multiple products from the same batch of wood chips means a more cost efficient and resource efficient process. Biorefining at work!

In the new process, a chemical compound is used to pretreat wood chips. From this, the sugars are removed. Finally, the rest is made into paper pulp. The process saves energy, reduces the number of chemicals used. It even produces stronger paper products.

Along with the Forest Products Laboratory, a technology and consulting company called Biopulping International, Inc. is cooperating on this project. These partnerships allow scientists to collaborate and share resources.



QUESTIONS

1. What story did you read?

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2. What types of science and technology were used in your story?

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3. Give an example from each story of how this science technology will contribute to sustaining Wisconsin's forests.

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4. What individuals, organizations, governmental agencies, industries, etc., worked together to make the science and technology possible in each story?

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5. Predict what might be different if science and technology were not available.

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FANTASY FUTURE FOREST

Now it is your turn to predict the fate of Wisconsin's forests. Here are some known trends:

- Human population is increasing.
- Forestland is increasing as marginal agricultural land is converted back to forest.
- The list of threatened and endangered species is growing.
- Forest disturbance patterns have shifted. Human-caused disturbance is now more prevalent than fire, windthrow, and disease.
- Forests are becoming more fragmented as human development increases.
- Demand for forest products is increasing.
- Demand for forest-based recreation is increasing.
- Recycling is increasing.
- The efficiency of wood use has increased. Technology helps get more useable wood from a single tree.
- The amount of privately owned forested land available for public use is decreasing.
- Development is increasing in fire-prone areas.
- Urbanization and development is increasing.

Here is your task:

1. Divide the back of this page into four sections.
2. In one section, represent what you predict Wisconsin's forests could look like in the year 2100 based on the known trends. You may do this with a picture, poem, story, description, etc.
3. In another section, represent what your ideal Wisconsin forest could look like in the year 2100.
4. In another section, represent the science and technology that will need to be used or developed to allow for your ideal Wisconsin forest to exist.
5. In another section, represent all of the collaborative partners that will need to be involved in order for the your ideal forest to exist.