Lesson 9 – Forest Products and Technology

In a Nutshell

Wood and other forest products continue to be heavily used in our everyday lives. The Forest Products Laboratory (part of the US Forest Service), located in Madison, Wisconsin, researches these products in order to discover how we can best use them. Students will learn about the work done at the Forest Products Laboratory by acting as wood scientists.

Concepts

- Technology has aided in wise use of forest resources.
- Research into forest products and their use is ongoing.
- Much wood research takes place here in Wisconsin at the Forest Products Laboratory.

Objectives

At the end of this lesson, students will be able to:

- Conduct their own experiments.
- Explain what is done at the Forest Products Laboratory.
- Describe one scientific advance the Forest Products Laboratory is responsible for in wood use.

State Standards

ELA	S	SS	EE
C.4.1	C.4.2	A.4.4	A.4.1
C.4.2	G.4.1	A.4.9	B.4.10
C.4.3		B.4.8	
D.4.1			
F.4.1			

Total Estimated Time

1 hour and 40 minutes

Vocabulary

Cellulose – a part of the cell walls of plants
Collapse – to fall down suddenly
Colleague – a fellow worker
Conserve – to keep safe and sound
Fiberboard – a wood product made up of strips of wood fiber all with their grains going in the same direction
Fungi – a group of lower plants such as mushrooms, mold, and some bacteria
Grain – the arrangement of fibers in wood
Laboratory – a place where experiments are done
Oriented strandboard – a wood product made up of layers of very small fibers; the grain or each layer is opposite that of the layers surrounding it
Particleboard – a wood product made up of very small pieces of wood; it can even be made from sawdust
Plywood – a wood product made up of several sheets of wood with the grain of each layer going in the opposite direction of the layers on either side of it
Preservative – something that keeps things from breaking down or decomposing
Railroad tie – a wooden support to which railroad rails are attached
Slash - leftover parts of trees that have been cut down

Materials

Wrapped ream of paper
8.5x11 paper
Scissors
Tool box with: plastic bags, plastic wrap, duct tape, sponge, paper clips, scissors, glue, thumbtacks

Fake railroad ties
Glue
Wax paper
Lab coats
Water tubs

Teacher Preparation

Put tool boxes together and fill tubs with water for each group. Prepare paper examples (explained in lesson)of plywood, fiberboard, particleboard, and oriented strandboard.

Background Information

Wisconsin's forests and the products that come from them have been important as long as people have been living in the state. After most of the Northwoods had been cutover, people began taking steps to conserve and protect what forests were left and replant new forests. In addition to these efforts, in 1910 the Forest Products Laboratory was established in Madison, Wisconsin by the United States Forest Service. The Forest Products Lab conducts scientific research on wood, wood products, and how to attain better use of both.

Much of the early research that took place at the Forest Products Lab had to do with wood drying and the physical properties of wood. As time went on, much work was done to conserve our wood resources. A great example of this kind of work accomplished by the Forest Products Lab has to do with railroad ties.

Before 1880, it is estimated that 410 ties per mile of track had to be replaced every year. This meant that each tie lasted an average of 7 years. By 1910, the year the Forest Products Lab was opened, 239 ties were replaced per mile of track every year. This meant that the average life of a tie had gone up to 11 years. By 1990, only 61 ties per mile per year were replaced. The lifespan of a tie was 20 to 40 years. Less wood was needed as time went on due to the development of wood preservative treatments, such as creosote. These have been improved through research throughout the 20th century. In fact, now we are facing quite an opposite problem with railroad ties. When they finally do need to be discarded, they won't break down due to their preservative coating. In the year 2000, scientists at the Forest Products Lab were studying preservative-tolerant wood decay fungi that would biodegrade treated wood waste.

The list of other such conservation-minded products and research at the Forest Products Lab is lengthy. Production of plywood, fiberboard, and particleboard have made it possible to use less wood, lower quality wood, and wood scraps. Through a process called oriented strandboard (OSB) manufacturing, smaller diameter trees can now be harvested for wood than was previously possible. This allows the surplus from forests that need thinning to be used. Thanks to research, wood that used to go to waste is now usable.

Research has also been conducted by Forest Product Lab researchers on paper recycling, use of alternative tree species, better wood strength assessment resulting in less wood necessary for building, fuel production, better and safer wood glues, and saw improvements that have resulted in less wood waste. The list goes on and on.

The Forest Products Laboratory has six different areas of emphasis. These are: conservation of resources;

environmental research; sustaining ecosystems; social and economic vitality; foundation research; and public service. Researchers at the Forest Products Lab continue to learn more and more about our precious resource.

Introduction

Ask your students to ponder the following problem. Let's say that they are responsible for building a wooden bridge that people will use to cross 50 feet above a river below. They are not sure how much wood is needed to support the bridge and the people using it. Would they chance it and use less wood than they think is necessary, or use enough wood so that even eighteen-wheelers could cross the bridge? Have your students discuss this with a partner. Then have pairs of students express their opinions to the class.

Activity 9.1 – Changing Ties (45 min)

Of course you would use more wood than you thought necessary to make sure the bridge wouldn't collapse. It makes more sense to waste some wood than to endanger people's lives. Wouldn't it be nice, though, to know exactly how much of a load different kinds of wood can handle? This way, no wood would be wasted, and no lives would be in danger. That kind of wood research is exactly what is done at the Forest Products Laboratory in Madison, Wisconsin.

The Forest Products Laboratory was established in 1910 by the United States Forest Service. The national government thought that research of forest products would help forestry by conserving wood. Ask your students to brainstorm ways that studying wood and wood products could aid in conservation. If they are having trouble, remind them of the bridge-building example. How would knowing the strength of wood aid in conservation? You might also want to ask other leading questions. Was wood ever wasted in the forestry practices of the early 1900's? Do you think research could have helped in that area? How?

Let your students know that they are going to learn about the research done at the Forest Products Lab by becoming wood researchers! Divide your students into groups of about 4. If you have science lab coats that they can wear for their experiments, that would be great. Each group should have their own lab station with a "toolbox" and a tub of water.

Ask your class if anybody knows what a railroad tie is. Railroad ties are the individual pieces of wood laid down next to each other on which the railroad tracks are built. You are all scientists at the Forest Products Lab in the year 1911. Were railroads important in getting around in 1911? You bet! You and your colleagues have discovered that these wooden railroad ties don't last too long. After only about 7 years they need to be replaced. This means that every year, about 410 ties per one mile of track need to be replaced. The main problem seems to be water. After these ties are exposed to rain and snow, they begin to break down.

You and the other scientists in your group need to figure out a way to prevent your railroad tie (hand out "railroad ties") from getting wet. You must use the resources in your scientist's

toolbox to accomplish this task. The railroad tie must be able to be submerged in the tub of water without getting wet. Give your students about 15 minutes to create their solution and allow five minutes for all of the groups to share their findings.

After all of the groups have presented their results, tell the class that they were very successful. In fact, thanks to their work and other scientists like them, by 1990 each railroad tie would last from 20 to 40 years instead of just 7. This meant that only 61 ties had to be replaced per mile of track per year. Great job!

Uh oh, but by the year 2000 some problems were found with your great discoveries. You see, even though the railroad ties last for a long time, they don't last forever. When they finally do get replaced, what do you think happens to the old railroad ties? They get thrown away. What do we want to happen to wood when it is thrown away? We want it to break down. Well, it seems that whatever keeps the water away from your railroad tie keeps it from breaking down. Now your challenge is to find a way water can get in contact with your altered railroad ties. Again, give the groups time to come up with a solution and then have them present them to the class.

The example that we just worked with actually happened to Forest Product Lab scientists. Before 1880, ties would only last for about 7 years. Research done at the Forest Products Lab as well as other research facilities led to the use of preservatives on wood that keep water from soaking into it. Do any of you have a wooden deck or porch? These items are often treated with preservatives so that water will not damage them. This research has been so useful that by 1990, railroad ties were lasting 20 to 40 years. This, as you can imagine, saved a lot of wood since a real railroad tie is about twice your height.

Unfortunately, recent findings have shown that the treated wood will not break down once thrown away. Researchers at the Forest Products Laboratory have been working on finding fungi that are not harmed by the treated wood and can help break it down.

Activity 9.2 – That's Made From Trees?! (15 min)

Tell your students that you are going to name some products. Have them raise their hands if they think that the product comes from trees. You could also have all of the products on hand and have your students group them.

<u>Products</u>

Pencils	Make-up
Mouthwash	Toilet paper
Car tires	Pencil erasers
Candy wrappers	Buttons
Life jacket stuffing	Matches
Ice cream	Ping-pong balls
Baseballs	Toothbrushes
Soap	Medicines
Maple syrup	Salad dressing
Chewing gum	Camera film
Lemons	Rayon shirt

Explain to your students that all of the items you just named (or showed them) come from trees! Are they surprised? Usually when we think of forest products, we think of things that we can tell are made of wood, like pencils or furniture. There are a lot of parts of

trees that can be used to make things we might not have associated with the forest.

Most paper products, including toilet paper and candy wrappers, are made from trees. Bark is used in baseballs and some medicines. Cellulose, which is a part of plant cells, is used to make plastic-like products such as buttons, ping-pong balls, and cloth. Cellulose also helps make liquids thicker, which is why it is used in ice cream. Sap from trees is used in products like chewing gum and make-up. Many fruits and spices come from trees. Finally, combinations of various tree parts can be used to make products like stuffing for life jackets. The more research that is done, the more uses for trees are discovered. Where would we be without trees?

Have your students take an inventory of the items in their desk. How many of them came from trees? Does that surprise them?

Activity 9.3 – This Piece of Wood Is Not Like the Other (20 min)

Think back to how the lumberjacks of the early 1900's cut down trees. Have your students tell you about what they learned back in lesson 3. Ask questions to jog their memory. Were all kinds of trees cut down? All sizes? Was the whole tree used? Who cut off the tree limbs?

Now ask your students if they can see where trees or parts of trees were wasted in this process. Again, it may help if you ask some leading questions. What about the stumps left behind? What about the limbs that were cut off? What about small trees and different tree species? Who remembers what slash is? Make a list on the board of their ideas.

Another thing that the Forest Product Lab in Madison Wisconsin has done is researched how wood that used to be wasted can be used. It used to be that only large chunks of wood could be used. Explain to your students that you are going to use a wrapped ream of paper to represent a large chunk of wood.

In the more than ninety years that the Forest Products Lab has been around, several alternatives to using large, solid pieces of wood have been found. The first of these is plywood. Plywood is made up of several thin sheets of wood. Each layer of wood has its grain going the opposite way of the one before it. Show your students what this means by using several 8.5x11 sheets of paper on which you have drawn line lengthwise. Stack the pieces of paper on top of each other so that the lines on one piece of paper are perpendicular to the ones on the next piece. Put glue between the pieces and explain to your students that glue and pressure are used to put the separate pieces of wood together. Show your students a stack of five pieces of paper that you put together in advance to represent plywood.

Another kind of wood product is called fiberboard. Fiberboard is made of strips of wood fiber. To show your students what fiberboard is like, cut up pieces of paper into lengthwise strips. Then glue these strips together so that they are parallel but overlapping.

Particleboard is made up of even smaller pieces of wood. In fact, it can be made from sawdust! To demonstrate how fiberboard is made, rip a few pieces of paper into very small pieces. Next, mix these pieces with glue and flatten them out to form a flat sheet.

The most recently developed technique is the production of oriented strandboard, or OSB. OSB is made up of wood fibers, too, but like plywood, layers of fibers are placed with their grain in opposite directions. To show your students what you mean, lay out strips of paper next to each other so that their edges are parallel. Then, glue a layer of strips on top of those so that the strips in the second layer are perpendicular to those of the first.

Ask your students if they can think of why plywood, fiberboard, particleboard, or OSB would be better than a large chunk of wood the same size. Which do they think is stronger? Would it be good to be able to use up smaller pieces of wood? Why?

Conclusion

As you can see, the Forest Products Laboratory has been doing and continues to do research on how to use wood products more wisely. Thanks to the researchers at the Forest Products Lab, many tree products can be recycled, many wood products last longer, and kinds and sizes of trees that were not used in the past can now be utilized.

Evaluation

- Evaluate your students on their ability to work in groups and think creatively during the experiments as well as in discussion.

Extension

- Bring in examples of the different kinds of board and have your students choose which is which.
- Have your students come up with new wood conservation ideas.
- Have your students research how fungi helps break things down.
- Visit a sawmill.

Resources

Forest Products Laboratory Website
http://www.fpl.fs.fed.us

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