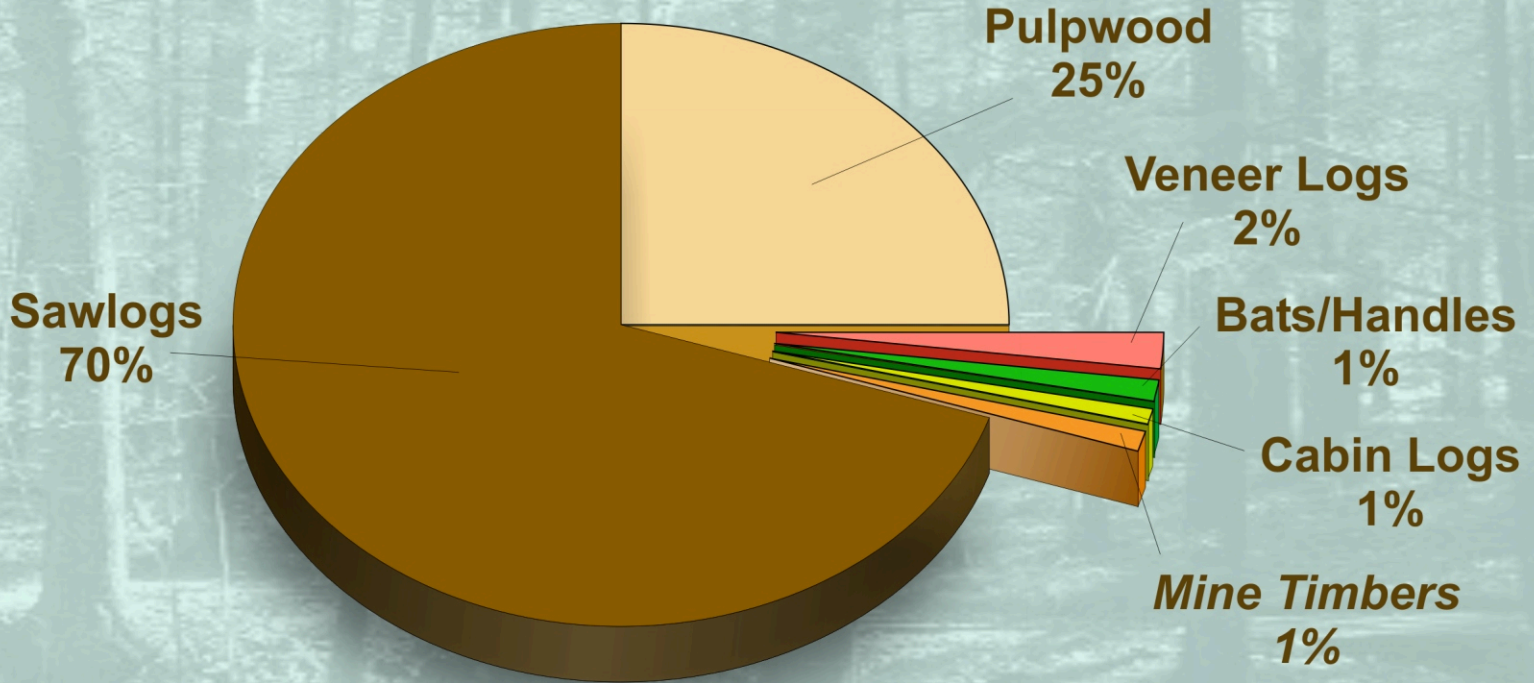
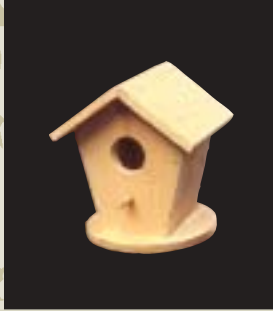


Main Forest Products of Pennsylvania




Based on USDA Forest Service Resource Bulletin NE-130 1988

FROM THE WOODS

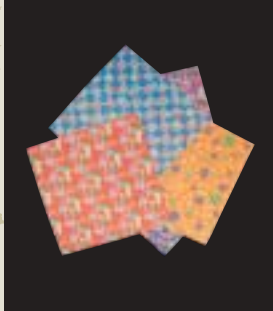


Incredible Wood

PENNSTATE



College of Agricultural Sciences
Cooperative Extension



AN EDUCATIONAL SERIES ABOUT FORESTRY FOR YOUTH

Wood is from trees...but is that all? Hardly!

Wood is a natural, attractive, versatile, and useful material that we use in thousands of ways. You may think you know many ways to use wood, but you might be surprised. A recent count listed over 5,000 products made with wood, and the list keeps growing. Wood is a truly renewable natural resource. If forests are cared for and managed properly,



trees keep producing more wood.

One reason we can use wood for so many different things is that there are many different species of trees. Each species of tree produces wood with its own properties. For example, some woods are hard and some are soft; some are flexible and some are stiff. Approximately 30 of Pennsylvania's 108 tree species have commercial importance; their wood is

harvested from forests across the state to meet people's needs.

WOOD STUFF

Just what is wood? Wood is the hard, fibrous, inner part of trees and is mostly dead cell walls. All wood is formed from the same five chemical substances: cellulose, hemicellulose, lignin, ash-forming minerals, and "extractive" chemicals. How these substances vary in their volume and characteristics is what give each species its unique wood properties.

Cellulose, hemicellulose, and lignins account for about 97 percent of all wood. Cellulose and hemicellulose are what make up the wood's cell walls, and lignin acts like a glue holding the cells together. The other two substances—ash-forming minerals, and "extractive" chemicals—make up only about 3 percent of wood by weight. The ash-forming materials are minerals the tree extracted from the soil. The extractive chemicals are essentially the waste products from when the tree's cells were living. Extractive chemicals often give wood its color and odor.

When people think of wood, they think of its appearance. Wood is attractive to look at, and each species has its own unique look or *figure*. Figure

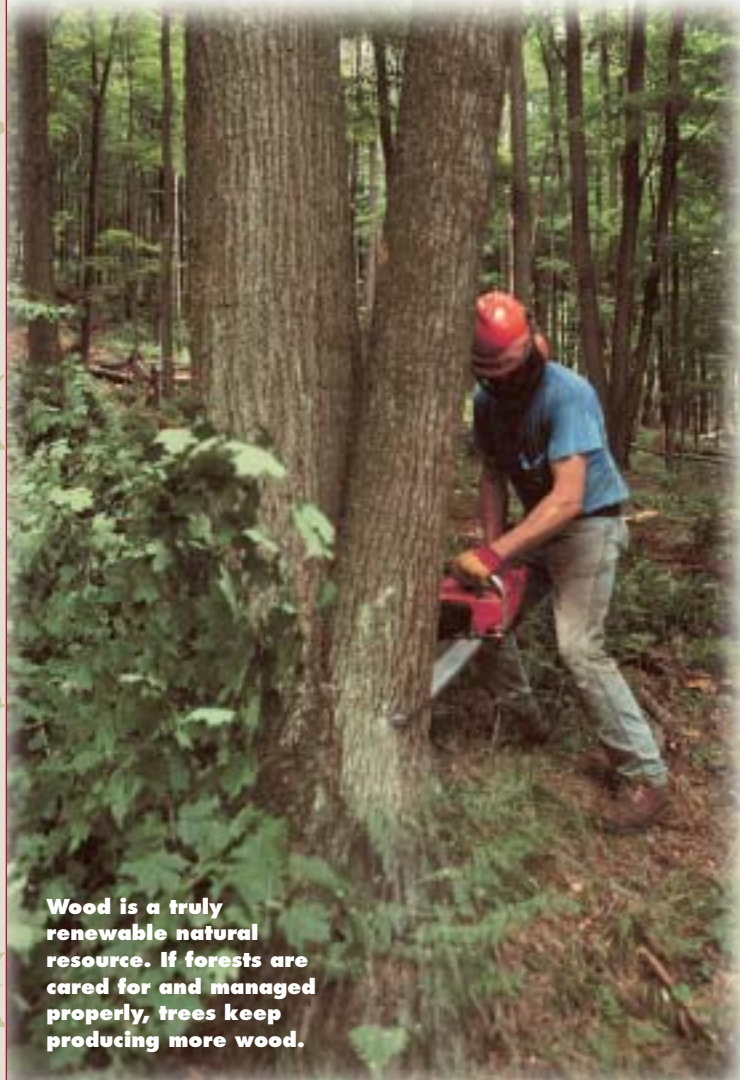
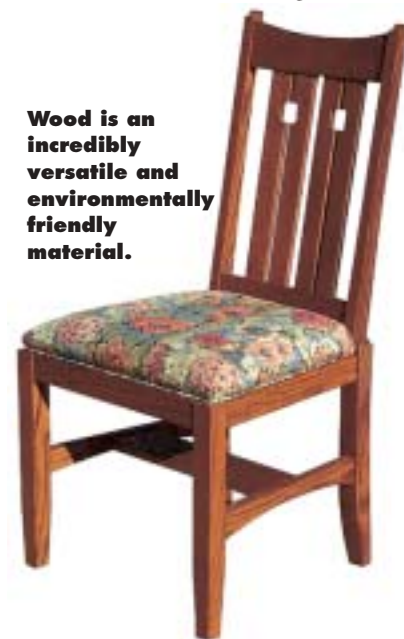
also relates to how the wood is cut from the tree and the tree's growth pattern. Yet, many of the products that are made from wood do not look like wood at all. We use numerous wood products without ever thinking of their connection to wood. Here are the ways we use the wood from Pennsylvania's trees.

LUMBER

Almost 70 percent of all the trees harvested in Pennsylvania are used to produce lumber. Lumber is simply pieces of wood, such as boards or beams, cut from trees. More than 700 sawmills across Pennsylvania produce lumber. Most of our state's lumber (about 95 percent) is from *hardwood* trees. Hardwood trees have broad flat leaves that drop every fall. They include red oak, sugar



Wood is an incredibly versatile and environmentally friendly material.



Wood is a truly renewable natural resource. If forests are cared for and managed properly, trees keep producing more wood.



Furniture is a major product of the wood industry. From elegant hardwood to economical softwood, wood furniture can be found in nearly every home or office.

maple, white ash, and black cherry. The lumber from hardwood trees becomes furniture, doors, baseball bats, toys, musical instruments, flooring, cabinetry, paneling, and many other items for which attractive appearance

Each American uses over 700 pounds of paper, in its various forms, every year!



and durability are important. Pennsylvania's hardwood lumber is known around the world for its quality and beauty. This valuable product is shipped to many countries in Europe and Asia.

Pennsylvania also produces small quantities of *softwood* lumber. Softwood trees are those

that have needle leaves. Most needles stay green and attached to the tree year-round. Softwood trees include white pine and eastern hemlock. Softwood lumber is largely used for building construction, siding, and paneling.

PAPER

About 25 percent of all the trees harvested in Pennsylvania go into paper and paper products. There are several large paper mills in Pennsylvania. Paper is made almost entirely from wood pulp. When wood is ground up and broken down, either mechanically or chemically, two main things remain: *wood cells* (referred to as "fibers") and *lignin*. Wood pulp consists of individual wood fibers with the lignin removed. We use both hardwood and softwood trees for making wood pulp. The many uses of paper are mind-boggling. Books,



tissues, tickets, envelopes, boxes, bags, transfer papers, art supplies, hospital gowns, and newspapers, to name just a few, are all produced from wood.

HARDWOOD VENEER

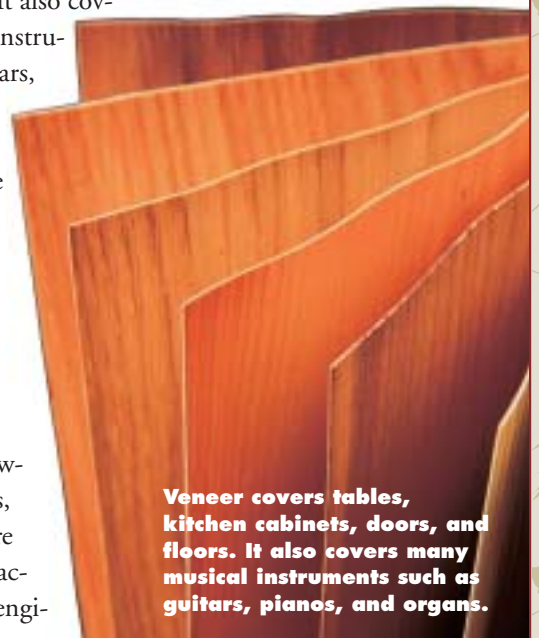
Hardwood veneer is a very thin layer of wood sliced or peeled from logs or pieces of lumber. It is usually made from the "highest quality" logs—those that have very few imperfections such as knots and decay. The purpose of veneer is to cover a less attractive or less valuable product with a more attractive wood. Veneer covers tables, kitchen cabinets, doors, and floors. It also covers many musical instruments such as guitars, pianos, and organs. Only about 2 percent of all the trees cut in Pennsylvania are made into veneer.

ENGINEERED WOOD PRODUCTS

Veneer, lumber, sawdust, wood strands, strips, and chips are used in the manufacture of numerous engi-

Veneer, lumber, sawdust, wood strands, strips, and chips are used in the manufacture of numerous engineered wood products from Pennsylvania's woods.

neered wood products from Pennsylvania's woods. Engineered wood products are usually a mixture of wood fibers or wood pieces mixed with glues. These products can be made with lower quality trees and sawmill scrap materials. They have many useful applications. Laminated veneer lumber, laminated



Veneer covers tables, kitchen cabinets, doors, and floors. It also covers many musical instruments such as guitars, pianos, and organs.

lumber, fiberboard, ceiling tiles, strand board, and particleboard are examples of engineered wood products.

WOOD CHEMICALS

Wood is also used to produce chemicals. Cellulose, hemicellulose, and lignin are the source of most of these chemicals. Wood chemicals become things like cosmetics, rayon cloth, cellulose sponges, photographic films, food additives, and fillers for many types of plastics. Wood chemicals and components are found in ice cream, salad dressing, shampoo, and toothpaste. Manufacturers often use cellulose gum made from wood to thicken and smooth foods and other items. While very little of Pennsylvania's wood actually ends up in these types of products (our hardwoods are more valuable when used as lumber), many of these wood chemical-using products are produced in the state.

Wood in ice cream?



Believe it or not, wood is a component of that creamy ice cream cone and many other products that "wood" surprise you, like cosmetics, rayon cloth, cellulose sponges, photographic films, food additives, salad dressing, shampoo, and toothpaste.

FIREWOOD

Wood is also useful as a fuel. Trees capture the sun's energy to produce sugars. These sugars are used to produce cellulose, hemicellulose, and lignin for growing wood. When wood is burned, energy is released as heat. Tens of thousands of homes in Pennsylvania heat with firewood. Wood fuel can also be used to generate electricity. Smaller and crooked trees that are not useful for lumber are the

best to use for firewood. Hardwoods burn longer and give off more heat per unit volume than softwoods.

INCREDIBLE WOOD

The next time you think about wood, think about all the important products you enjoy and use from it. Wood is beautiful to look at and fascinating to work with. Wood is an incredible material useful in thousands of ways, and it's a truly renewable natural resource.

Prepared by: Sanford S. Smith, natural resources and youth extension specialist, and Lee R. Stover, extension wood products specialist.

Appreciation to Holgate Toys, OAKWORKS Inc., Paul Downs Cabinetmakers, and Pennsylvania House Furniture for their assistance with some of the photos used in this publication.

This publication was produced with support from the Pennsylvania Hardwoods Development Council, Pennsylvania Department of Agriculture.

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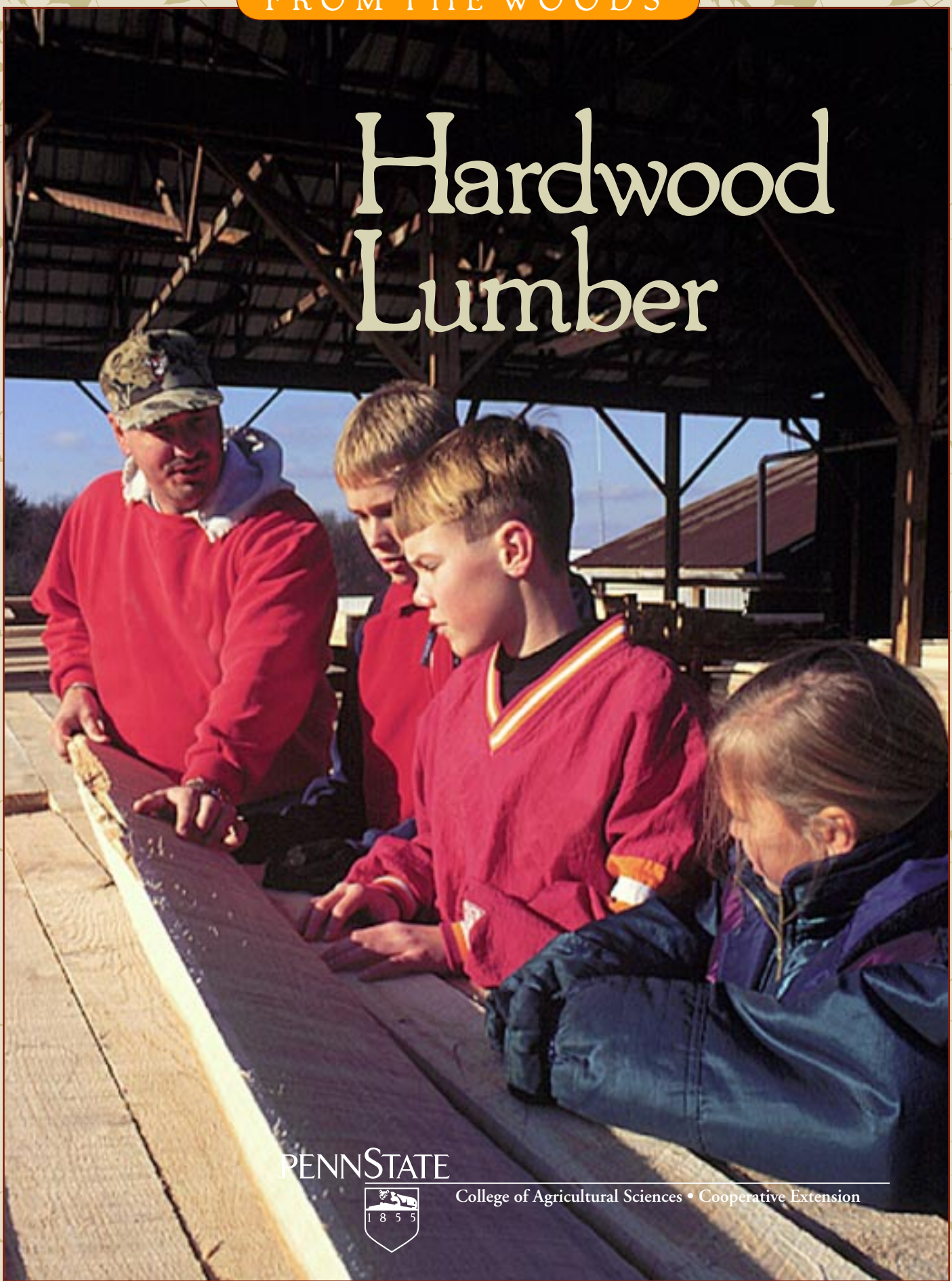


Wood is useful as a fuel for heating homes and generating electricity.



FROM THE WOODS

Hardwood Lumber



PENNSYLVANIA STATE UNIVERSITY
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AN EDUCATIONAL SERIES ABOUT FORESTRY FOR YOUTH

Pennsylvania is known for its beautiful and productive forests. More than 108 different kinds of trees (each one called a “species”) grow naturally here.

Forests provide many benefits and materials that we need. Forests are places to camp, hike, fish, and watch wildlife. Forests also provide us with the wood we use to make many different products.

Forests that are well cared for can continuously provide the many benefits and materials

Hardwoods vs. softwoods

Hardwood trees have leaves that are broad, flat, and green in the summer (left). Softwood trees have leaves that are narrow, called needles, and most species stay green all year round (right).

Red oak (hardwood)



Hemlock (softwood)



we need. This is why forests are “renewable.”

For some of our needs, we remove trees from the forest. These trees go through many processes to produce paper,

chemicals, building products, and lumber. Lumber is simply logs (sections of tree trunks) cut into pieces, called boards.

HARDWOODS AND SOFTWOODS

The tree species of Pennsylvania can be placed into two categories.

Hardwood trees are easy to recognize because in the summer their leaves are broad, flat, and green, and in the fall the leaves change color and drop off. Over 85 percent of Pennsylvania’s trees are hardwoods, and many are valuable for making hardwood lumber.

Softwood trees have leaves that are narrow, called needles, and most species stay green all year round. Pennsylvania’s state tree, the eastern hemlock, is a softwood.

FROM THE FOREST

Trucks transport the logs harvested from the forest to the log yard at a sawmill. In the log yard, people and machines sort and stack logs by species, length, and quality.

Log preparation. Before it is sawn, a log is usually run through a debarker, which removes the bark. Debarking prevents wear and damage to the saw blade from soil or stones that might be stuck in or on the bark.

The sawmill also may use a metal detector to find old

By-products

Nothing is wasted in the lumber industry. Bark becomes landscaping mulch, and sawdust is used as animal bedding or for particleboard production.



Sawdust

Bark



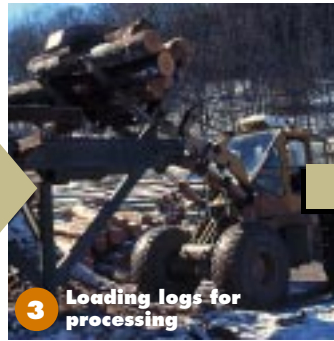
From forest to lumber ...



1 Transporting logs



2 Sawmill



3 Loading logs for processing



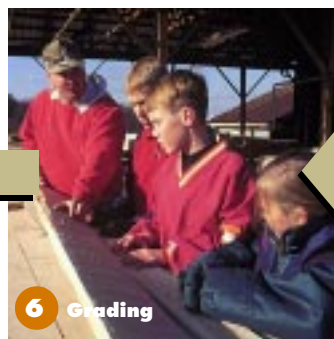
4 Debarking



8 Kiln-drying lumber



7 Air-drying lumber



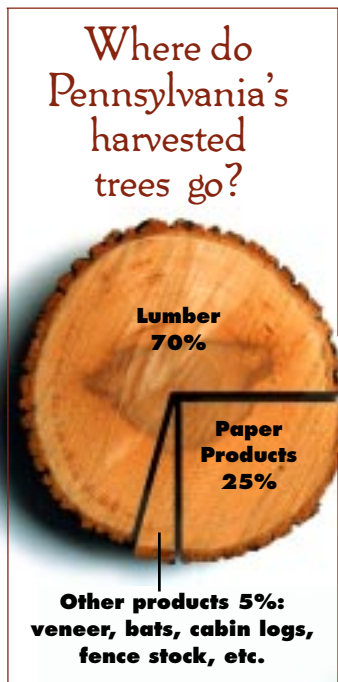
6 Grading



5 Sawing

nails, fencing, or other metal objects that were attached to the tree's trunk sometime during its growth. Undetected objects could seriously damage the saw blade or injure a sawmill worker during sawing.

Sawing. In the sawmill, a large saw cuts the curved sides, or "slabs," off the bare log to make four flat surfaces. Aided by lasers, computers, or just their eyes, the saw operators (called "sawyers") evaluate each log for the lumber desired. The sawyers vary the spacing of the cut in the log to create individual boards. Other saws square off edges and cut boards to length. Lumber is cut into standard thicknesses and different widths and lengths.



"By-products." The bark and other by-products, such as sawdust, slabs, or wood chips, were once considered "wood waste." Today, they are no longer waste. Bark becomes landscaping mulch. Sawdust is used as animal bedding or for particleboard (boards made from a mixture of sawdust and glues pressed together). Slabs and chips produce

paper, and any excess wood can become fuelwood.

Grading. Hardwood lumber is inspected and sorted for its appearance and beauty. This is called grading. Imperfections or "defects" like knots, splits, and decay may greatly reduce the value of hardwood lumber. The sawing process removes or cuts away some defects, but not all.



Drying lumber. After grading, lumber is often air-dried and/or dried in a lumber dry kiln. A lumber dry kiln is a large, low-temperature oven that dries the hardwood lumber over a period of several weeks. Kiln-dried wood is less likely to crack and twist out of shape.

HARDWOOD LUMBER PRODUCTS

Many different products, including kitchen cabinets, flooring, household furniture, doors, window frames, decorative molding, pallets, and factory-made wooden buildings come from Pennsylvania's hardwood lumber. Many of these products are manufactured right here in Pennsylvania.

Pennsylvania also exports some logs and lumber to other states or countries for further manufacturing. Pennsylvania's hardwood lumber is among the finest in the world. It has beautiful



From furniture to flooring, there are thousands of hardwood lumber products.

texture and color. Hardwood lumber is just one of the many products we receive from renewable forests.

Prepared by Sanford Smith, natural resources and youth specialist; Roy Adams, former associate professor of wood products; and Anni Davenport, former extension assistant in forest resources.

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Appreciation to Spectra Wood, Thomas Timberland, and Deer Park Lumber Co. for providing facilities for on-site photography.

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THE BAT CONNECTION



Major league baseball bats are made from white ash lumber. This wood is shock-resistant, strong, and relatively light—perfect for slugging a homer.

FROM THE WOODS

Hardwood Veneer



PENNSTATE



College of Agricultural Sciences • Cooperative Extension

AN EDUCATIONAL SERIES ABOUT FORESTRY FOR YOUTH

Hardwood veneer is a very thin layer of wood sliced or peeled from a hardwood log. It is a unique and valuable forest product. It is usually made from the “highest quality” logs—those that have very few imperfections such as knots and decay. Hardwood veneer has many uses.

VENEER IS EVERYWHERE

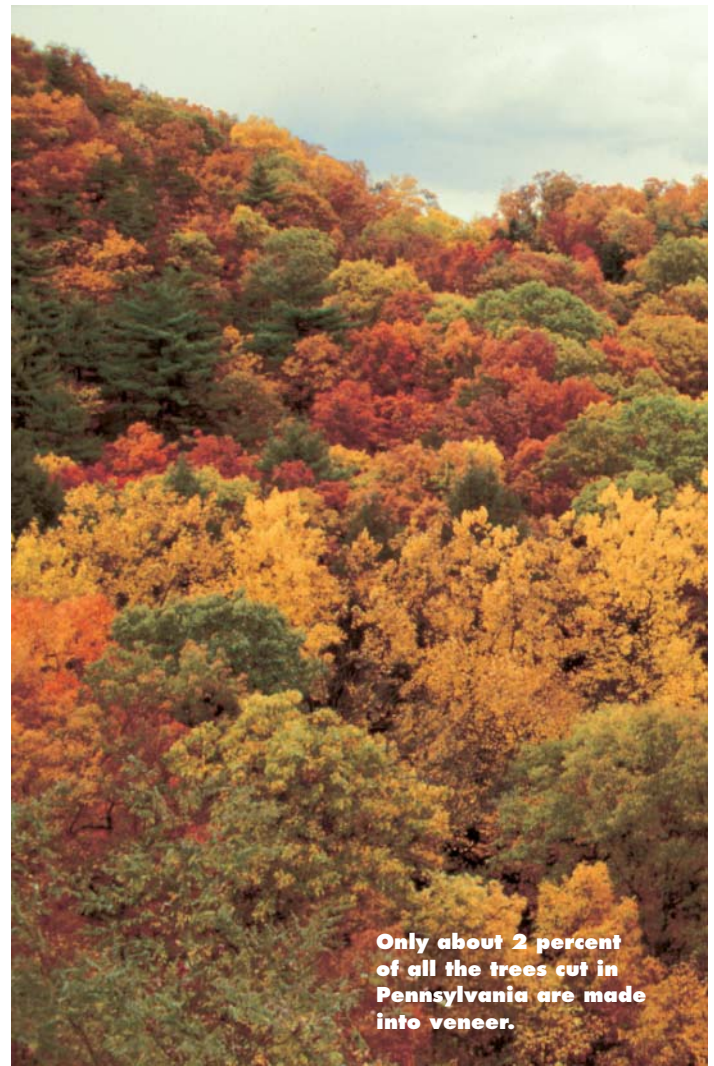
The purpose of veneer is to cover a less attractive or less valuable product with a more attractive surface. Veneer covers tables, kitchen cabinets, doors, and floors. It also covers many musical instruments such as guitars, pianos, and organs. Using veneer helps manufacturers keep down the cost of making wood products. This makes wood products more affordable. The standard thickness of hardwood veneer is 0.6 millimeters ($\frac{1}{42}$ of an inch). However, it may be cut thinner or thicker depending on its final use. For example, thin veneer wraps best over moldings and furniture, while

thicker veneer is more durable on plywood flooring.

The most common types of trees used for making attractive hardwood veneer are red oak, black cherry, black walnut, sugar maple, tulip poplar, and white ash. Only about 2 percent of all the trees cut in Pennsylvania are made into veneer. The rest are made into hardwood lumber (70 percent) or paper and other wood fiber products (25 percent).

A FASCINATING PROCESS

Veneer production begins with the harvest of trees in the forest. There, tree trunks are cut into logs and separated into two piles: logs for sawing into lumber (called sawlogs), and logs for chipping to make wood fiber products such as paper. The sawlogs are sent to sawmills where workers separate logs that may qualify as veneer quality from the other logs. Veneer log buyers come to the sawmill and look at these logs. They decide which logs meet the quality criteria



Only about 2 percent of all the trees cut in Pennsylvania are made into veneer.

and negotiate purchases. These logs are worth much more than other logs, and competition between buyers can be keen. Once sold, truckers take the logs to a veneer plant.

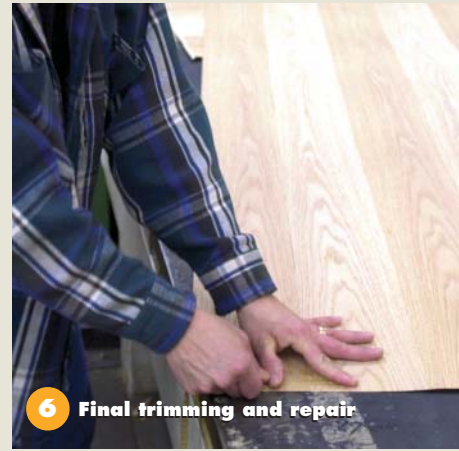
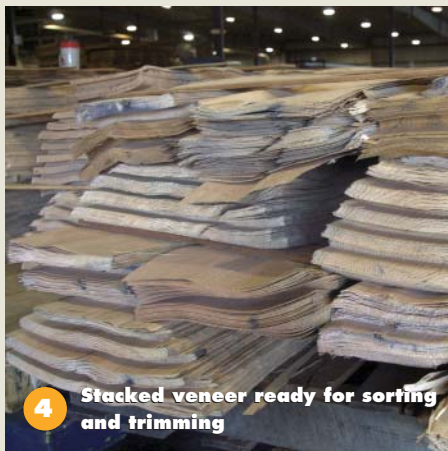
At the veneer plant, a *debarker* removes the bark from the logs. A metal detector then scans the logs to check for pieces of metal, like fence wire, nails, and bullets. Metal must be removed from logs because it will damage the expensive veneer cutting machinery. A worker then loads the logs into a high-humidity steam chamber or into a hot water vat.

The logs “cook” there for approximately 48 hours. The exact cooking schedule is different for each species of wood. Overcooking changes the color of the log, while undercooking results in rough or uneven cutting of the veneer. Mill workers, aided by computers, adjust the temperature and cooking time until the wood cells are softened. This makes it possible to slice veneer from the log. After the cooking process, the logs move to a “slicing” or “peeling” area. The *slicing* method, the most commonly used in Pennsylva-



The purpose of veneer is to cover a less attractive or less valuable product, such as particle board.

The step-by-step process of making veneer



nia, involves moving a log across a knife to produce individual slices of veneer. Sliced veneer has a more attractive grain pattern and is generally used on valuable furniture and cabinetry.

The *peeling* method uses a rotary lathe, where the log turns against a knife and veneer peels off the log. This process is like unrolling toilet paper. The thin veneer comes

off the log in a continuous sheet. It is called *rotary* cut veneer.

Initially, both sliced and peeled veneer are high in moisture. They

need to be dried to prevent splitting, twisting, and cracking. A stainless steel screen carries the veneer through a large dryer. The temperature,

The most common types of trees used for making attractive hardwood veneer are red oak, black cherry, black walnut, sugar maple, tulip poplar, and white ash



humidity level, and speed of the dryer determine how tender and flat the veneer is after drying. Once dried, clippers trim the edges and any splits from the ends of the veneer pieces.

A NATURAL PRODUCT

Sliced veneer is often edge-glued and spliced together to make larger sheets. Plywood, door, and furniture companies use these *spliced faces* to cover other materials and make the final product more attractive. Rotary cut or peeled veneer is often made into plywood. Plywood is made of several

Not all wood is cut out to be veneer



Veneer is usually made from the "highest quality" logs. Defects and imperfections such as knots and decay (above) make veneer unusable.

sheets of glued veneer pressed or laminated together. Plywood made from peeled softwood veneer is

often covered with sliced hardwood veneer to make it more attractive. Rotary cut veneer may also cover kitchen cabinets, vanities, curved windows, and chairs.

Because veneer is so popular, there are many kinds of *artificial veneer*. Artificial veneer is anything that attempts to look like real wood veneer but is not. Examples of artificial veneer can be found on desks where a pressed board or plywood product has a picture of veneer glued on it and then covered with a layer of plastic or vinyl. Other products may have a veneer pattern actually molded into the pressed wood itself. These treatments increase the value of the product, but they are not as valuable as a real hardwood veneer finish.

Hardwood veneer is all-natural. It is made from the highest quality logs cut in the forest. It is a beautiful and useful forest product.

Prepared by: Robert S. Hansen, Extension Forester, Bradford County, Sanford S. Smith, natural resources and youth extension specialist; and Lee R. Stover, wood products extension specialist, Penn State School of Forest Resources.

Appreciation to Lee Cummings, Oak Hill Veneer, and International Timber and Veneer (ITV) for their assistance in the production of this publication. This publication was produced with support from the Pennsylvania Hardwoods Development Council, Pennsylvania Department of Agriculture.

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Veneer increases the amount of usable material from each high quality log and makes attractive wood products more affordable.

FROM THE WOODS

Paper!



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AN EDUCATIONAL SERIES ABOUT FORESTRY FOR YOUTH

Paper! It's everywhere. It's all around us. You are looking at paper right now. No other manufactured material is so widely available, versatile, and so important to our everyday existence. We read books. We print out Web pages and computer files. We dry our hands on paper towels. We wrap gifts. We take notes. These are just a few of the ways we use paper. You may have heard that paper comes from trees, but that's just part of the story.

HISTORICAL WRAP

The ancient Egyptians developed a paperlike substance nearly 4,000 years ago.

By weaving together the reeds of papyrus plants into mats, and then pounding them, they produced a thin, tough sheet for writing on.

This product was called *papyrus*, and our English word "paper" has its origin in that Egyptian name. Before papyrus, people used clay tablets, stones, wooden boards, cloths, animal skins,

wood fibers

When a piece of paper is torn, you can see tiny wood fibers along the ripped edge.

metal tablets, and even leaves to write on.

The Chinese invented the first true paper about 2,000 years ago. Their paper was made from a watery paste of ground-up mulberry bark, hemp, and cloth rags. They pressed this paste to remove the water, then sun-dried the resulting mat of compacted fibers to make a sheet



Hand-copied text on cloth rag paper from a 15th century Italian manuscript

of paper. It wasn't until an invading army captured a Chinese paper mill 600 years later that the papermaking process was carried west to the Middle East, Africa, and Europe.

For many years throughout the Western world, paper was only made from discarded rags and clothing. Cotton and linen fibers produced a fine, strong paper, and the use of other plant fibers for papermaking was forgotten during the Dark Ages. However, paper was always in scarce supply due to the constant shortage of used cloth. The first paper mill in America, established outside of Philadelphia, Pennsylvania, in 1680, also used old rags to produce paper. By 1802, there were nearly 200 such mills in the United States.

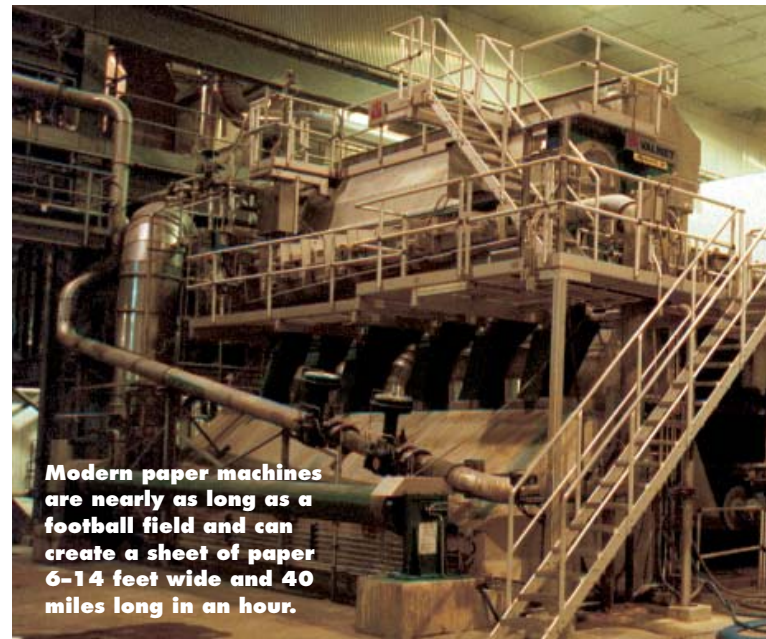
During the mid-1800s, European papermakers rediscovered the use of tree

fibers for papermaking. Also during this time, various types of machinery and processes were developed in Europe and America for grinding or chemically breaking down wood and producing paper.

Wood was in abundant supply, and the use of wood rather than rags made it much cheaper and easier to make paper. This was the beginning

of the mass-produced paper industry, an industry that played an important part

and linen fibers (for printing things like money and maps). But what exactly is wood pulp? When wood is broken down, either mechanically or chemically, two main things are left: *fibers* (composed mostly of two kinds of cellulose) and *lignin*. The fibers are actually the remains of the tree's cells. They are small, about 1/8 of an inch in length and 1/150 of an inch in width (about 1/10 the thickness of a human hair). When a piece of paper is torn, you can see tiny wood fibers along the ripped edge. Lignin is the glue, or cement, that held the fibers in place in the wood. Wood pulp is nothing more than a huge



Modern paper machines are nearly as long as a football field and can create a sheet of paper 6-14 feet wide and 40 miles long in an hour.

in the development of our country and the world, and still does!

SIMPLY PULP

Today, almost all paper is made from wood pulp; however, some specialty papers are still produced using cotton

quantity of individual wood fibers with the lignin removed. The natural color of wood pulp ranges from dark brown to light gray.

Before wood pulp is produced from a tree, several steps must be taken. First, trees are cut and transported to a paper



Naturally dark brown wood pulp (right) is useful for making paper bags and boxes. After bleaching and softening (left) pulp produces higher grades of paper and other products.

mill. Most of the trees used for papermaking in Pennsylvania are smaller trees that have little potential for making lumber. At the mill, the bark is removed from the trees.

fibers. However, chemical methods are more widely used and are more energy-efficient. The chemical methods involve cooking wood chips in large tanks. These tanks, called *digesters*, are similar to pressure cookers. Various chemicals, called the *cooking liquor*, help break down wood chips into a mushy mass of fibers. Regardless of the method used to produce pulp, it is always washed and screened (to remove impurities) before it becomes paper.

Wood pulp is also made from chipped sawmill waste wood or from used paper. The recycling process for used paper is similar to making “virgin” pulp



Lastly, the fibers are either mechanically or chemically extracted from the wood and then separated from the lignin.

In the mechanical method, grindstones tear wood fibers apart in water, or the trees are chipped up into small pieces first and then ground down to

directly from wood. In recycling, the wood fibers in the paper must be separated again or “repulped” in water. It is also necessary to remove the chemicals, such as adhesives and ink, on used paper. The recycling process shortens the length of the individual fibers,

Here’s how paper is made...



1 Pulpwood yard stores the raw material



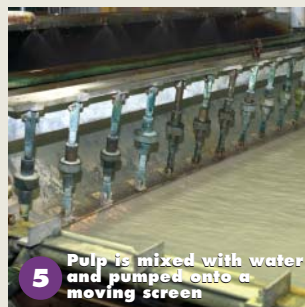
2 Pulpwood is debarked and chipped



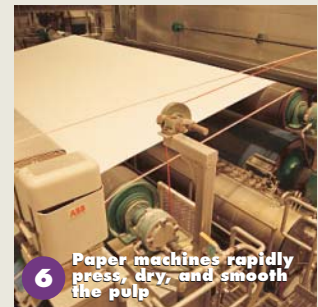
3 Wood chips are cooked in a digester and broken down into pulp



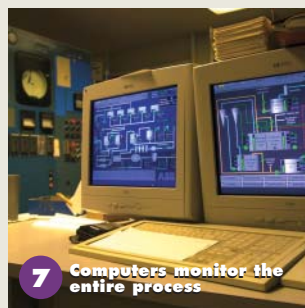
4 Pulp is washed, bleached, and softened



5 Pulp is mixed with water and pumped onto a moving screen



6 Paper machines rapidly press, dry, and smooth the pulp



7 Computers monitor the entire process



8 Paper machines produce large rolls of paper



9 Rolls of various weights and colors are stored in warehouses



10 Sheets of paper are shipped to buyers



Paper products are all around us, including your favorite comic books and magazines, newspapers, boxes, office paper, envelopes, paper towels, toilet paper, packaging, gift wrap, and so much more.

so wood fibers can only be recycled several times before they are too short for making paper. That's why it is necessary to mix new pulp with recycled pulp to make paper products.

MODERN PAPERMAKING

The papermaking process begins by washing, bleaching (to whiten or "brighten" if necessary), and beating (to soften) wood pulp. Starches, colors, and other chemicals added at this early stage create different types of paper. After mixing the pulp and chemicals with water, this "slush" moves into large papermaking machines. Here, the slush is pumped evenly onto a fast-moving (58 feet per second), fine-meshed screen. As water drains off,

the slush moves along on the screen and then through a series of heated cylinders to press, dry, and smooth it, ensuring uniform thickness. Rolls of paper are the finished product. They are

It's easy to recycle paper and it makes good sense!



usually rewound and cut into smaller rolls or packs, then shipped to printers and manufacturing plants to become products. There are thousands of different paper products—everything from coffee filters to facial tissues and magazines. Throughout the papermaking process, tests ensure paper quality. If a roll of paper does not meet quality standards for the desired finished product, it is recycled back into the process.

That's the whole story of papermaking. Paper is material that's similar to the air we breathe. It's all around us, we use it continuously, and we yet we never think about it! Can you imagine a world without paper?

Prepared by Sanford S. Smith, natural resources and youth extension specialist; James C. Finley, associate professor of forestry; and Lee R. Stover, wood products extension specialist, Penn State School of Forest Resources.

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