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FOR 81

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Trees in Your Life[1]

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Most people realize that paper and lumber come from trees. If we stop to think about it, we see paper every day, in checkbooks, cereal boxes, shipping cartons, and toilet tissue, for example. Similarly, wood comes in all shapes and sizes, from construction lumber, plywood, paneling, and flooring to cooking spoons, violins, furniture, and baseball bats. But this is not the limit of the products we use from trees. We do not often include pecans, toothpaste, cork stoppers, cellophane tape, football helmets, activated carbon filters, and artificial vanilla in the list of forest products, but we should; they come from or have ingredients from trees. This publication explores how trees contribute to some of these products. (See Table 1).

Food Made by Trees

A host of fruits and nuts are harvested from the same trees year after year. These tree products typically come from tended orchards, managed to provide the juiciest oranges, the largest pecans, the tastiest coconuts, and the sweetest mangoes. In some cases, a hardy variety is used to provide a strong and resilient root system, while branches of varieties that produce more ideal fruit are grafted onto the main stem. Most of the citrus in Florida comes from branches grafted onto sour orange and lemon roots. This practice is used for many other fruits as well.

Table 1. Teachers can use this information to enhance the following Project Learning Tree activities. To find out more about Project Learning Tree in Florida, contact Florida PLT Central at 352-846-2329.

Activity 12	Tree Treasures*
Activity 13	We All Need Trees
Activity 15	A Few of My Favorite Things
Activity 16	Pass the Plants, Please
Activity 32	A Forest of Many Uses
Activity 51	Make your Own Paper
Activity 82	Resource-Go-Round
* In 2005 and earlier editions	

Only a few marketable food products come from wild, natural forests. Pine nuts, for example, are often collected from pinyon pine trees in the southwestern U.S. Conservation organizations help create local and international markets for certain rain forest fruits to

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increase the value of standing forests. If local communities can collect and sell enough tagua palm nuts (also called vegetable ivory) for buttons or Brazil nuts for candies, the forest might provide economic stability for the community.

Maple syrup is another tree-produced food. Although many different trees can be used to make “syrup,” the sugar maple tree yields the sweetest and best tasting syrup. The process begins in the early spring, when repeated cycles of sunny, warm days and frosty nights pressurize the woody core, or xylem tissue, of sugar maple trees in the northern U.S. The xylem carries slightly sweetened water containing nutrients and energy stores up to the branches. Because of this pressure, a tap drilled into the tree trunk will produce a steady drip of clear, watery sap. Collectors gather the sap from many trees and boil it down to concentrate the sugars into brown syrup. Once the weather warms, however, the sap loses its sweetness and pressure, and the maple syrup operation closes for the year.

Another sweetener, honey, is made by bees from the nectar of flowers. Some highly prized types of honey are made from nectar of tree flowers, such as orange, basswood, and tupelo. Tupelo honey is known by movie-goers as “Ulee's Gold.”

From Plants to Pulp to Paper

The fibers of many plants can be converted into paper. Specialty papers may include a percentage of cotton, banana leaves, kenaf, or hemp fibers. But the most popular source of paper is trees. In the southeastern U.S., pine trees can be harvested for pulpwood in only 15 years. Genetic improvements and carefully managed plantations may help trees grow even more quickly. Unlike other crops, trees can be harvested at any time of year providing a steady supply of wood to a nearby mill. If the pulp price is too low, the owner may decide to let the trees grow bigger and delay the harvest.

Paper is made from dried fibers that once formed the woody mass of a tree. These fibers are part of the xylem tissue that carries water up the tree and forms the structural component of wood. The walls of the cells in the xylem are composed of cellulose impregnated with lignin, a chemical glue that makes the cells stiff and waterproof. Different trees have slightly different chemical and physical properties of their wood fibers, and some of these features make them ideal for paper production. Hardwood trees tend to have short fibers and a type of lignin that dissolves more easily than softwood lignin, and their pulp tends to produce good writing paper. Eucalyptus trees are an unusual hardwood – they have very short, but stiff fibers that make strong paper with a smooth writing surface. Softwood trees like pines have long fibers that make a pulp that is very good for cardboard boxes and grocery bags. Paper mills pay attention to the type of trees they receive and may change their recipe for paper accordingly.

For paper-making, the valuable part of the tree is the main stem, so the branches and leaves are left in the forest to enrich the soil. The bark is chipped off and may be burned at the mill to generate electricity or sold for mulch. The wood is sliced into silver-dollar size chips and cooked with chemicals under pressure to dissolve the lignin and separate the xylem tissue into individual fibers. The most common chemicals in the pulping process are sodium hydroxide and sodium sulfide, in a procedure called the *kraft* process. The pulping chemicals are recovered by washing the pulp and are used to dissolve the next batch of chips. The pulp goes through several additional processes: beating to increase fiber flexibility and bonding strength, and bleaching to brighten and whiten the pulp. Other chemicals are added to improve the paper printability and opacity. A residue of lignin and oleoresins is collected at the bottom of the pulping digester as spent black liquor to be separated and processed into other items or burned as fuel for the paper plant.

If recycled paper is used to make paper, a propeller-like machine mechanically separates moistened paper fibers. Sodium hydroxide aids in ink removal, and the pulp is screened and washed.

A slurry of wood fibers and water is spread in a thin sheet onto a continuously moving screen of the paper machine. The screen races through dryers and compressors until the water is squeezed out or evaporated; in this process the fibers bond together to form paper. As the paper is spooled onto giant rolls it may receive another treatment of clay or starch to

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give it an appropriate surface. From there it will be cut into sheets or processed into other products.

Paper thickness is determined from the amount of pulp fiber spread onto the screen. Cardboard is made from unbleached pulp that is thicker than writing paper. When one piece of cardboard is crimped and glued to two flat pieces, it becomes corrugated paper for boxes. Thick paper can be saturated with resins to create laminates for countertops, flooring, and wall coverings. Cereal boxes are made from a thin paperboard of pulp that has been bleached so those bright, bold, printed colors look their best.

The Magic of Cellulose

Cellulose, the molecule that gives flexibility and strength to redwoods and kudzu alike, can be dissolved out of the wood fibers and converted into many products. Rayon and Tencel®, for example, are fabrics woven from strands of spun wood cellulose. Chemical additives help purify the pulp, dissolve the fibers, and increase the viscosity of the molasses-like solution. When forced through a showerhead-like nozzle called a spinneret, thin strands of cellulose filament are formed. After hardening in a chemical bath, the strands are twisted into yarn, washed clean of chemicals, bleached, and dried. The yarn is woven into a fabric known for its silk-like qualities.

By adding other chemicals to the pulp or purified cellulose a huge variety of products can be created, like cellophane tape, cellulose sponges, cellophane windows in envelopes and pasta boxes, and photographic film. A hardened version of cellulose can be molded into “plastic” items, like toothbrush handles, steering wheels, combs, piano keys, ping pong balls, eyeglass frames, and football helmets. With the addition of nitrates, cellulose can even be used to make explosives!

Cellulose is a long polymer made from thousands of molecules of the sugar glucose. Starch is also a long chain of glucose molecules but connected together in a way that is easily digested by people. When cellulose is processed and purified, it can be used in foods much like starch, though our digestive systems can not break those connecting bonds to utilize the energy stored in glucose.

Cellulose gum is a common food additive used to make some low-fat salad dressings thicker, some cough syrups smoother, and some ice cream creamier. It is also in toothpaste, hot chocolate mix, and some ready-to-spread frostings. Cellulose makes other things thick, as well, like paint and shampoo. Cellulose is also used to keep powdered foods from clumping together. It is in many brands of grated Parmesan cheese to keep it coming out of the container holes.

Resins and Naval Stores

One of Florida's first natural resources to be harvested and processed was the oleoresin (also called gum and pitch) that oozed out of long diagonal cuts in pine trees. Initially, the crude gum was cooked to make tar for shipbuilding. Later, the sticky gum was distilled to make turpentine and rosin.

Oleoresin is not sap. It is produced by special resin canals that run the length and breadth of the tree. When a tree is wounded, these ducts exude a sticky resin that helps protect the tree from insects and disease and enables the tree to recover. Because this sticky gum clogs up the wound, tappers must re-injure the tree regularly to keep collecting oleoresin. The chemicals in pine tree resin can be distilled into a treasure chest of other chemicals.

The days of gum tappers are largely gone from Florida, but pine trees are still tapped in other countries. In Florida, these substances are extracted during the papermaking process. When pulp is cooked, turpentine is released from the wood chips and condensed in a distillery above the vats. The waste liquid from the pulp, mostly dissolved lignin and oleoresins, is called black liquor. The black liquor is processed to remove the lignin and concentrate the foamy soaps, which are skimmed off and acidified to produce *tall oil*. The tall oil is then separated into pitch, rosin, and fatty acids. The term tall oil comes from the Swedish word *tallolja,* meaning, “pine oil.” Each of these substances has a variety of uses.

- Turpentine, the first byproduct of the pulping process, has many uses in addition to a solvent. It can be processed into two basic chemicals: alpha-pinene (which is used to make pine-scented disinfectants as well as the insecticides toxaphene and strobane) and

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beta-pinene, which is used to make many fragrances and flavors such as lemon, lime, mint, and lilac.

- Black liquor is used in drilling muds and animal food pellets. Torula yeast, a nutritional food additive, can be grown on black liquor.
- Lignin can be used to control and trap the air blown into concrete mix, or processed into artificial vanilla, called vanillin.
- Pitch is often burned in the paper mill or distillery as a fuel, which increases the energy efficiency of the plant. It is also used in adhesives, coatings, and sealants. Pitch contains phytosterols that have pharmaceutical uses.
- Rosin is used for adhesives, coatings, inks, paints, varnishes, tackifiers, plasticizers, emulsifiers, and hundreds of other industrial applications. It is the substance that helps make Band-Aids™ stick to your skin, gives a baseball player a better grip on the ball or bat, helps the fiddler's bow pull on the strings to make a rich sound, and enables printing ink to stick to paper. Rosin is also added to rubber and chewing gum.
- Tall oil fatty acids are used in a variety of manufacturing industries, including printing ink, fabric softeners, detergents, soaps, cleaners, lubricants, plasticizers, and asphalt emulsifiers. A new use for tall oil is to produce stanol esters as a margarine substitute that lowers cholesterol.

Products from Special Trees

Many trees produce chemicals to fend off insect attacks that can be converted by enterprising chemists into marketable drugs. Willow twigs, for example, were chewed by native people to relieve toothaches. The leaves and bark contain salicin, a compound similar to synthetic aspirin.

A few other trees are making important contributions to the medical community. A drug used in cancer treatment, Taxol®, was first manufactured from the bark of Pacific yew. It too is now available synthetically. Extracts of saw palmetto berries improve prostate function.

Chicle, the boiled gum of sapodilla trees, has been used for many years as the foundation for chewing gum, although trees on every continent have served this purpose for over 2000 years. Gum manufacturers combine sugar, glycerin, and flavoring with the raw material to make soft yet resilient chewing gum.

One of the most useful substances still harvested today from trees is the latex from rubber trees. Each rubber tree can produce commercial quality latex for about 20 years. A spiral groove is cut into the bark and a collection cup is mounted at the bottom of the cut. A thin strip of bark is shaved from the groove every other day to keep the sap flowing from specialized lactifer tissues in the bark. The latex is cooked and processed, then molded into products like tires, boots, gloves, and rubber ducks.

The bark of the cork oak tree is a renewable source of light, airy cork. Cork is still harvested by stripping the bark from these Mediterranean trees every nine years. The many uses for cork is threatening the sustainability of this resource, and pushing some bottlers to use non-cork stoppers.

Summary

From baseball bats to bicycle tires, shampoo to Parmesan cheese, a vast array of commonly used products have a tree in their list of ingredients. In some cases, like rayon fabric and coconut milk, trees provide the main or only ingredient. In many of our processed foods, like ice cream and salad dressing, trees provide a few minor ingredients that enhance the quality or attractiveness of the food. And unless we talk to a chemical engineer, we will probably never know the extent to which chemicals derived from wood products are used in manufacturing as dispersing, stabilizing, lubricating, and plasticizing agents.

Many of these tree-derived chemicals compete in the industrial marketplace with petroleum-based hydrocarbons. As petroleum resources become scarce, there will be a growing interest in using renewable trees to maintain our comfortable lifestyle. Many of our southern forests, including pine plantations, will play a key role in producing these important ingredients.