Forestry

Instructor Guide

10-3000-I

In cooperation with
Agricultural Education Department of Practical Arts and Vocational-Technical Education
College of Education and College of Agriculture, Food and Natural Resources
University of Missouri-Columbia

Agricultural Education Section Division of Vocational and Adult Education
Department of Elementary and Secondary Education, Jefferson City, Missouri

MISSOURI AGRICULTURAL EDUCATION

Course	Agricultural Science II
Unit	Forestry
Lesson	The Importance of Forest Resources
Estimated Time	Four 50-minute blocks

Student Outcome

Identify the important benefits from the Missouri forest industry and available careers in forestry.

Learning Objectives

1. Identify the benefits from Missouri forests.
2. Identify the career opportunities related to forestry in Missouri.
3. Describe what forestry assistance is available from agencies in Missouri.
4. Describe how the programs of the Forestry Division of the Missouri Department of Conservation help in the utilization of Missouri forest lands.
5. Identify the responsibilities and benefits of classifying land as Forest Crop Land.

Grade Level Expectations

SC/ES/3/A/09-11/a

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. *Forestry* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1986.
2. *Forestry Curriculum Enhancement.* University of Missouri-Columbia: Instructional Materials Laboratory, 2008.

Supplemental Information

1. Internet Sites
   - ❑ Flooding has Occurred Across the Forest. US Forest Service, Mark Twain National Forest. Accessed February 29, 2008, from http://www.fs.fed.us/r9/forests/marktwain/.
   - ❑ Forest Management Assistance for Missouri Landowners. Missouri Department of Conservation. Accessed May 28, 2008, from http://www.mdc.mo.gov/forest/products/mgmtasst.htm.
   - ❑ Missouri Forest Facts. Conservation Commission, Missouri Department of Conservation. Accessed February 29, 2008, from http://mdc.mo.gov/forest/IandE/forfacts.htm.
   - ❑ Missouri Forests – Their History, Values, and Management: Missouri Forests in the Past. Missouri Department of Conservation. Accessed May 28, 2008, from http://mdc.mo.gov/forest/IandE/forests/forest.htm.
   - ❑ Private Land Programs. Missouri Department of Conservation. Accessed May 28, 2008, from http://www.mdc.mo.gov/forest/products/private.htm.

2. Print
   - ❑ Holland, I.I., G.L. Rolfe, and D.A. Anderson (ed.). *Forests and Forestry.* 5th ed. Danville, IL: Interstate Publishers, 1997.
   - ❑ Stelzer, H.E. *Forestry Assistance for Landowners* (Guide G5999). Columbia: University of Missouri Extension, revised 2007. Accessed May 28, 2008, from http://extension.missouri.edu/explore/agguides/forestry/g05999.htm.

Interest Approach

Forests cover approximately 12.4 million acres out of Missouri's total of 44 million acres. Forest resources provide a highly diverse range of benefits ranging from recreation to providing jobs to a significant portion of the work force.

Communicate the Learning Objectives

1. Identify the benefits from Missouri forests.
2. Identify the career opportunities related to forestry in Missouri.
3. Describe what forestry assistance is available from agencies in Missouri.
4. Describe how the programs of the Forestry Division of the Missouri Department of Conservation help in the utilization of Missouri forest lands.
5. Identify the responsibilities and benefits of classifying land as Forest Crop Land.

Instructor Directions	Content Outline
Objective 1 *Ask students how they benefit personally from Missouri's forest lands. List their ideas on the board and discuss how these and other factors benefit the quality of life in Missouri.*	**Identify the benefits from Missouri forests.** Water and soil – Forests affect the quality and availability of water. 1. Forest canopy reduces speed of raindrops. 2. Decayed organic matter from forests protects soil from raindrops. 3. Runoff is reduced and more water is allowed to filter into the ground. 4. Water gradually finds its way into ground water and streams. 5. This also reduces sediment which can be carried off. Recreation – Forest lands provide recreational areas. 1. Much of the state's tourism and recreational activities occur in the forested areas of Missouri. 2. Recreation areas are often near attractive bodies of water. (Watersheds help keep water clean and provide aesthetic backdrops.) Wildlife habitat – Forests are complex communities of plants and animals. 1. Food and cover are provided for wildlife. 2. Important to the ecological balance of associated plants Other non-marketable benefits 1. Erosion control 2. Shade 3. Windbreaks

Instructor Directions	Content Outline
	Timber products – Missouri produces a variety of forest products. 1. Fine hardwoods a. Missouri leads the nation in the production of black walnuts – fine wood for veneer, cabinets, and gunstocks b. Many oak products – Flooring – Barrel staves – Railroad ties – Lumber – Furniture – Posts c. Other hardwood products – Hickory for most tool handles – Boxes and pallets – Pulpwood – Firewood: 1.7 million cords (enough to make a stack 4 feet by 3 feet wide from Kansas City to St. Louis) – Charcoal 2. Shortleaf pine a. Poles, pilling, posts b. Lumber c. Log buildings d. Pulpwood f. Furniture 3. Red cedar a. Novelties b. Closet lining c. Animal bedding d. Posts e. Furniture
Objective 2 *Discuss with the students all of the careers they can think of which are related to forestry. List them on the board.*	**Identify the career opportunities related to forestry in Missouri.** Forestry occupations – occupations concerned with developing, maintaining, cultivating, and protecting forests, forest tracts, and woodlands, as well as with harvesting their products 1. Professional forester 2. Forest nursery person

Instructor Directions	Content Outline
	3. Christmas tree farmer 4. Christmas tree grader 5. Seedling puller 6. Seedling sorter Forests conservation occupations – concerned with planting tree seedlings; pruning and thinning trees to improve quality of stand; locating and combating fires, insects, pests, and diseases harmful to trees; controlling erosion and leaching of forest soil 1. Fire warden 2. Forester aide 3. Smoke jumper 4. Fire lookout 5. Fire ranger 6. Forest worker 7. Forest firefighter 8. Tree planter Logging and related occupations – concerned with felling trees and cutting them into logs or products such as cordwood, shakes, firewood, and posts using chain saws, axes, wedges, and related tools 1. Felling-bucking supervisor (power saw supervisor, saw boss, timber supervisor) 2. Faller 3. Tree-shear operator 4. Bucker 5. Logger 6. Tree cutter 7. Chain saw operator 8. Log marker Log grading, scaling, sorting, rafting and related occupations 1. Log grader 2. Log scaler 3. Log sorter 4. Log marker Other forestry occupations 1. Logging supervisor 2. Woods boss

Instructor Directions	Content Outline
	3. Cruiser 4. Timber Stand Improvement Contractor 5. Forest surveyor Forest related occupations – based on using, processing, and/or marketing forest products 1. Wood machining occupations – concerned with shaping wooden parts or products by removing excess material from stock or objects, primarily by such means as cutting, boring, abrading, milling, and planning 2. Processing wood and wood products – concerned with producing wood particles (such as chips, sawdust, and powder) and conglomerates (such as plywood, particle board, and compressed-sawdust fuel logs), removing moisture from wood, and treating wood with preservatives 3. Woodlot owner 4. Sawmill owner or operator 5. Logging contractor 6. Lumber yard or store worker
Objective 3 *Discuss with students the agencies in your area which give assistance to land owners. List their suggestions on the board.*	**Describe what forestry assistance is available from agencies in Missouri.** County University Extension Center State Forester's Office – Missouri Department of Conservation 1. Forestry Division a. Tree planting b. Species selection c. Woodland management d. Fuelwood cutting e. Timber stand improvement f. Timber sales and tax treatment of these sales g. Harvesting and marketing h. Insect and disease detection i. Woodland wildlife management j. Utilization of timber products k. Marketing timber products l. Management plans m. Advice on cost-share payments for specific forestry practices such as T.S.I. and tree planting

Instructor Directions	Content Outline
	2. Forest Crop Land Program a. Landowners receive significant reduction in property taxes if they agree to follow an approved management plan for 25 years. b. Counties are reimbursed to offset revenue lost through this program. c. Timber tracts must be at least 20 acres in size. 3. George O. White State Forest Nursery – sells tree and shrub seedlings at a minimal cost 4. Wildlife Division – helps locate areas for food plots, brush cover, or ponds 5. Fisheries Division a. Advises on pond establishment and management b. Stocks farm ponds with fish Missouri Department of Natural Resources 1. Regulates standards for air, water, minerals, and energy 2. Administers state park system of Missouri 3. Restores original public land survey corners to ensure accurate location of property boundaries 4. Soil and water conservation programs 5. Forms soil and water conservation districts for watershed protection and proper land management Missouri Department of Agriculture 1. Licenses and regulates applicators of pesticides 2. Conducts surveys with assistance of other state and local agencies to locate and control spread of insect pests and plant diseases 3. Establishes preservative retention standards for treated timber products 4. Aids pecan and other nut growers, fish farmers, and produce growers in marketing their products School of Natural Resources – University of Missouri 1. Offers 4 year and graduate programs in fisheries and wildlife sciences; forestry; and parks, recreation, and tourism 2. Extension staff transfers information from faculty research programs to potential users

Instructor Directions	Content Outline
	3. Educational programs about renewable natural resources for landowners, industry, professionals, FFA, 4-H, and other youth organizations United States Department of Agriculture – U.S. Forest Service 1. Manages federal lands of the Mark Twain National Forest to promote timber, recreation, watershed protection, grazing, and wildlife 2. Research carried on at North Central Forest Experiment Station Missouri Soil and Water Districts Commission (SWDC) 1. Develops statewide programs of resource conservation 2. Offers cost-share incentives to owners of agricultural land to install erosion control projects and practices 3. Developing a soil and water conservation loan interest-share program Missouri Christmas Tree Producers Association 1. Non-profit organization of Christmas tree growers and technical persons to promote the Christmas tree industry in Missouri 2. Promotes production of high-quality Christmas trees 3. Encourages research related to Christmas tree production 4. Informs members regarding current research 5. Conducts educational meetings and tours of successful Christmas tree plantations Walnut Council International Office and Missouri Chapter of the Walnut Council – provides information regarding planting, growing, and tending of black walnut trees for nut, lumber, and veneer crops American Tree Farm System of the American Forest Foundation, and the Missouri Tree Farm Program of the Missouri Forest Products Association 1. Free woodland inspection to help develop a management plan 2. Provides woodland management information

Instructor Directions	Content Outline
	3. To qualify, woodlands must be privately owned, 10 or more acres; protected from fire, insects, disease, and grazing; and managed for production of timber and forest products. Missouri Forest Products Association 1. Provides services to sawmill owners, loggers, wood products manufacturers, and forest landowners 2. Provides information about markets, insurance, waste utilization, and legislation 3. Co-sponsors of the Missouri Tree Farm Program Missouri Consulting Foresters Association 1. Provides consultation on a fee basis 2. Woodland management plans 3. Timber appraisals 4. Forest and shade tree damage appraisals 5. Marketing timber 6. Reforestation 7. Marketing and sale supervision 8. Surveying and mapping
Objective 4 *Discuss with students the ways in which the programs of the Forestry Division of the Missouri Department of Conservation help Missourians fully utilize the benefits of Missouri forest lands.*	**Describe how the programs of the Forestry Division of the Missouri Department of Conservation help in the utilization of Missouri forest lands.** Fire control – The Forestry Division provides direct fire protection to 16,000,000 acres and, on the average, suppresses 3,500 fires annually. 1. Must maintain necessary manpower, equipment, and facilities 2. Significant responsibility in heavily timbered Ozarks Fire prevention 1. 99 percent of fires are man-made, either intentional or accidental. 2. Prevention activities a. Publicity (radio and television ads) b. Information and education – During high danger periods, telling public about fire precautionary measures – Publications about fire prevention 3. Law enforcement to capture and punish forest arsonists

Instructor Directions	Content Outline
	Insect and disease control 1. Damage to forests from insects and diseases is greater than from fire. 2. The Forestry Division employs entomologists (insect specialists) and pathologists (disease specialists) to train field foresters about the diagnosis and treatment of pest problems. State land management 1. Direct management a. 285,000 of state-owned Forestry Division land b. 100,000 acres of land of the Fisheries Division and Wildlife Division 2. Managed under multiple use concept a. To produce wood products b. To improve wildlife and fish habitats c. To provide recreation and high quality watersheds d. To preserve unique areas Urban and Community Forestry Program 1. Three major components a. Urban state forests b. Urban forest technical assistance c. Community forestry assistance 2. During an average year, about 100 community forest projects are planned around the state. George O. White State Forest Nursery 1. Located at Licking, Missouri 2. Objective – to provide tree seedlings for Missouri's private and public lands 3. Over 14,000 total seedling orders processed each year, with 11 million trees distributed (enough so every person living in the state could plant two trees 4. Special bundles of trees for a. Wildlife cover b. Windbreaks c. Conservation 5. Large part of the nursery devoted to shortleaf pine plantings 6. Yearly seedlings distributed to all fourth grade students for Arbor Day plantings

Instructor Directions	Content Outline
	Tree Improvement Program 1. Objective – selection and development in initial survival, growth, and production characteristics 2. Highest priority species – black walnuts and shortleaf pines 3. Pecans and cottonwoods next priority Forest products utilization 1. Direct assistance from the Forestry Division given to loggers, manufactures, and consumers 2. Provides assistance on utilizing wood residues a. Extends forest resources b. Helps reduce potential pollution sources Research and planning 1. Often conducted in cooperation with the University of Missouri School of Natural Resources 2. Oriented to solve specific problems and needs facing forestry statewide Information activities 1. Presentations to group 2. Written articles 3. Use of media 4. Distribution of pamphlets and brochures 5. Exhibits at fairs 6. Working with schools Private land management assistance 1. 85 percent of Missouri's forested acreage is owned by private individuals. 2. How foresters can help a. Recommend number and types of trees to plant b. Inventory of standing timber c. Develop management plans for cutting and forest improvements d. Give advice for woodland wildlife management e. Help select trees to harvest f. Advise owners about timber sales and assistance programs g. In an average year, foresters accomplish the following – Give assistance on thousands of acres

Instructor Directions	Content Outline
	– Make wildlife recommendations – Help to sell about 30 million board feet of timber (enough to make crossties to build a railroad from Kansas City to St. Louis)
Objective 5 *Discuss with students the benefits and responsibilities from becoming involved in the Forest Crop Land Program. List these benefits and responsibilities on the board.*	**Identify the responsibilities and benefits of classifying timber land as Forest Crop Land.** Benefits 1. Partial tax relief for 25 years 2. Intensified fire control through the aid of the Forestry Division 3. Continuing free forest management 4. Timber trespass assistance Responsibilities of landowners 1. Marked ownership boundaries 2. Reasonable efforts to prevent and extinguish wildfires 3. Land must be designated and devoted primarily to growing trees a. Lands cannot be grazed b. Buildings cannot be erected c. Must file for inspection to qualify
Application	Other activities: 1. Have a Farm Forester or a member of the Forestry Division come and speak to students about their programs. 2. Have a local tree farmer who is involved in the Forest Crop Land Program speak to the class. The local forester should be able to recommend an individual who belongs to this program.
Closure/Summary	Missouri has many acres of valuable timber providing income and jobs from timber and tourist industries as well as providing beauty to all. The Forestry Division of the Missouri Department of Conservation aids in developing the potential of this natural resource through its numerous programs.
Evaluation: Quiz	Answers: 1. a. Water and soil conservation and improvement b. Recreation c. Firewood d. Shade

Instructor Directions	Content Outline
	e. Windbreaks f. Timber products g. Wildlife habitat 2. 99 percent 3. Multiple use 4. Black walnuts, shortleaf pines 5. 85 percent 6. a. Partial tax relief for 25 years b. Intensified fire control through aid from the Forestry Division c. Continuing free forest management d. Timber trespass assistance

Course	Agricultural Science II
Unit	Forestry
Lesson	Identifying Missouri Trees
Estimated Time	Four 50-minute blocks

Student Outcome

Identify common Missouri trees.

Learning Objectives

1. Describe how to identify trees.
2. Identify the four major growing areas of trees in Missouri.
3. Identify some common trees of Missouri, their uses, and the areas in which they grow.

Grade Level Expectations

SC/LO/1/E/09-11/a SC/LO/1/E/09-11/b

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
   - ☐ PPt 1 – Arrangement of Leaves on the Stem and Types of Leaves
   - ☐ PPt 2 – Lobes and Catkins
   - ☐ PPt 3 – The Four Growing Areas of Missouri
2. Activity Sheet
   - ☐ AS 1 – Tree Identification Chart
3. *Forestry* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1986.
4. *Forestry Curriculum Enhancement.* University of Missouri-Columbia: Instructional Materials Laboratory, 2008.

Supplies & Equipment

- ❑ Pictures or samples of leaves, fruit, twigs, flowers, and bark

Supplemental Information

1. Internet Sites
   - ❑ Forestry. Missouri Department of Conservation. Accessed April 2, 2008, from http://mdc.mo.gov/forest/.
   - ❑ Missouri Forestry: Urban Trees. Missouri Department of Conservation. Accessed April 2, 2008, from http://mdc.mo.gov/forest/urban/urbantre/.
   - ❑ Missouri Trees and Shrubs. Missouri Department of Conservation. Accessed May 29, 2008, from http://www.mdc.mo.gov/forest/IandE/MOConservationTreesAndShrubs/.
2. Print
   - ❑ Holland, I.I., G.L. Rolfe, and D.A. Anderson (ed.). *Forests and Forestry.* 5th ed. Danville, IL: Interstate Publishers, 1997.

- Settergren, C., and R.E. McDermott. *Trees of Missouri* (Guide SB767). Columbia: University of Missouri Extension, reviewed 2000. Accessed May 27, 2008, from http://extension.missouri.edu/explore/specialb/sb0767.htm.
- Slusher, J.P., and G. Hoss. *Before You Order Tree Seedlings* (Guide G5006). Columbia: University of Missouri Extension, revised 2000. Accessed May 27, 2008, from http://extension.missouri.edu/explore/agguides/forestry/g05006.htm.

Interest Approach

There are over 180 species of native and commonly naturalized trees in Missouri. Identification and knowledge of some of these trees will be a valuable tool to the landowner when developing a forest management plan.

Communicate the Learning Objectives

1. Describe how to identify trees.
2. Identify the four major growing areas of trees in Missouri.
3. Identify some common trees of Missouri, their uses, and the areas in which they grow.

Instructor Directions	Content Outline
Objective 1 *Ask the students about their favorite trees. Ask them how they recognize those trees. Write their answers on the board. Summarize the importance of knowing which trees are productively valuable and how to identify them. Refer to PPt 1 and PPt 2.* ☐ PPt 1 – Arrangement of Leaves on the Stem and Types of Leaves ☐ PPt 2 – Lobes and Catkins	**Describe how to identify trees.** 1. Leaves a. Arrangement of leaves on stem – Opposite – Alternate – Whorled (few Missouri trees) b. Simple or compound – Simple: one leaf (oaks, maples, elms) – Compound: multiple leaflets (locust, walnuts) – Leaf margins: entire, lobed, toothed (serrated) 2. Flowers 3. Fruit a. Dry: acorns, pods b. Fleshy: persimmon, wild plum 4. Twigs a. Especially important when there are no leaves b. Examination of color and size c. Bud arrangement 5. Bark a. Ability to recognize range (old bark different from young bark) b. Some very distinctive barks – River birch: papery – Shagbark hickory: peeling – Sycamore: color
Objective 2 *Have students identify the four growing areas of Missouri and the characteristics of those areas. Pay particular attention to local areas. Refer to PPt 3.*	**Identify the four major growing areas of trees in Missouri.** 1. Areas – boundaries show major changes in growing conditions that should be considered in selecting species a. Areas: similar soils and climates

Instructor Directions	Content Outline
☐ PPt 3 – The Four Growing Areas of Missouri	b. Considering specific sites (conditions will vary within an area) 2. Areas a. Ozark Area (A) – High priority area for tree planting – Extensive commercial timber planting – Often little or no site preparation needed before planting openings b. River Border Area (B) – Good soil potential for planting high quality hardwood species – Site preparation necessary before planting – Mowing or light disking after planting – Herbicides may be necessary c. Southeast Lowlands Area (C) – Bootheel – Feasibility of planting certain species in overflow land in this area – Site preparation is essential – High priority area for windbreaks – Mowing or light disking after planting – Herbicides may be necessary – Low grasses beneficial – Cultivation or regular mowing of weedy sites until trees are established d. Northern and Western Prairie Areas (D) – Generally soils and climate conditions of these areas not as favorable – Site and species selection extremely important – Extra precautions needed against insect and disease outbreaks – Wildlife foods and cover plantings moderately successful and much needed
Objective 3 *The Student Reference includes 25 species of trees. It is not recommended that all species be included in this lesson. Choose 10 to 15 species of interest or importance in your area. Using the Student Reference and Trees of Missouri (from Extension) or*	**Identify some common trees of Missouri, their uses, and the areas in which they grow.** **Baldcypress** Leaves: Needle-like and delicate, arranged in two ranks in a feather-like fashion, loses needles in winter Flowers: Male – long drooping clusters Female – globe-shaped at end of branch Twigs: Light green at first, becoming reddish brown by winter

Instructor Directions	Content Outline
Missouri Trees and Shrubs (from MDC), discuss the characteristics, importance, and areas in which these species grow. Have students complete AS 1 using information about the trees. If possible, have samples of leaves, fruit, twigs, flowers, or bark from these species. A walking tour of a local woodland area may help develop the tree identification skills of students. AS 1 – Tree Identification Chart	Bark: Cinnamon brown; divided by long, loose, shreddy ridges Area: Area C General: Baldcypress occurs naturally on deep swamps that are usually flooded for long periods of time. Baldcypress has been successfully planted along lakes and watercourses in central Missouri and has been very successful. **Black Locust** Leaves: Alternate, compound, 9 to 19 oval leaflets, droop at nightfall Flowers: Large clusters; creamy white, fragrant blooms in late spring Fruit: Thin, flat pod containing 4 to 8 kidney-shaped seeds Twigs: Dull brown, slender, some spiny Bark: Brown with yellow or orange inner bark; inner bark containing poison named "robin" (capable of killing livestock when eaten in large quantities) Area: Found in areas A, B, and D General: Primary uses are for posts, erosion control, fuelwood, and, because it is a legume, soil improvement. Branches are armed with pairs of short, sharp spines. Because it spreads easily from root runners, it can become a nuisance. **Black Oak** Leaves: Alternate, simple, roughly egg-shaped; 5 to 7 bristle tipped lobes, dark green, shiny Flowers: Male and female flowers on same tree Male – hairy catkins 4 to 6 inches long Female – red on short, hairy stalks Fruit: Acorn 3/4 inch long, bowl shaped, scales forming loose fringe on rim Twigs: Moderately stout, dark brown to black, smooth when mature Bark: Dark, black, rough, deeply furrowed, blocky on older trees, orange inner bark Area: All areas

Instructor Directions	Content Outline
	General: Black oak is second only to white oak in the amount of net board foot volume of commercial forest area. Black oak is frequently found on dry, rocky ridges and upper slopes. In southern Missouri, black oak competes with and often crowds out shortleaf pines. The wood of black oak is used for flooring, crating, railroad ties, and rough local construction. **Black Walnut** Leaves: Alternate, compound, 13 to 25 leaflets, spear-shaped, long, pointed tip Flowers: Male – catkins 3 to 5 inches long Female – 3 to 5 on spikes Fruit: Large, globe-shaped nut in thick, leathery, rough, green husk; shell hard and bony, rounded; kernel sweet and edible Twigs: Stout, brownish Bark: Variable; almost black, dark chocolate brown inner bark Area: All areas; prefers deep, well-drained, nearly neutral soils General: This is one of the best known and the most valuable trees in our state. Since 1899, one-fifth to one-sixth of all black walnut lumber comes from Missouri forests. On an individual tree basis, black walnut is the most valuable commercial lumber species in the United States. Its wood is highly valued for gun stocks, veneer, and fine furniture. Nuts are also sold commercially and the shells are used as an abrasive. **Eastern Cottonwood** Leaves: Alternate, simple, long, pointed tip, broadly rounded base Flowers: Male and female flowers on separate trees Male – red catkins Female – green catkins Fruit: Long cluster of alternately arranged capsules, each capsule containing many seeds in a cottony mass Twigs: Moderately stout, light brown or tan, shiny

Instructor Directions	Content Outline
	Bark: Greenish yellow and smooth on young stems; thick, dark, and deeply furrowed on old trunks Area: All areas except south central portion of A General: The cottonwood is a large spreading tree found along streams throughout the state. It is sometimes used as an ornamental tree where large spaces exist because it grows rapidly and requires minimal care. Its leaves turn bright yellow in the fall. It is used for excelsior, crates, and barrel staves. It has also become popular as a source of wood pulp for paper. **Eastern Redcedar** Leaves: Scale-like or awl-shaped, opposite around a four-angled central stem, dark green Flowers: Male and female flowers on separate trees Male – cone-like with 4 to 6 scales Female – structure with fleshy scales Fruit: A bluish berry, about the size of a pea, with a white frost-like shade Twigs: Slender, four-angled, becoming reddish brown Bark: Tan to reddish brown, shreddy Area: All areas General: Eastern red cedar is one of the most versatile trees in Missouri. It is found in every county in the state on nearly all classes and conditions of soil. It seems to thrive on barren soils where few other trees are found. Its heartwood is red, durable, and aromatic and is used in cedar chests, closets, and novelty items. Its dense evergreen foliage makes it a valuable windbreak, screen, or hedge tree. The fruit is a favorite food of birds. **Flowering Dogwood** Leaves: Opposite, simple, 3 to 5 inches long, egg-shaped, pointed at both ends Flowers: Appear before the leaves in small flat-topped clusters, greenish white or yellow with four white petal bracts beneath, occasionally bracts are red or pink Fruit: Borne in clusters, egg shaped, bright scarlet Twigs: Slender, purple

Instructor Directions	Content Outline
	Bark: Reddish tan to dark brown; broken in square or round, blocky scales Area: All areas around or south of the Missouri River General: Missouri's "State Tree" is conspicuous in the early spring by its large, showy, white, petal-like bracts which give the appearance of large spreading flowers. The scarlet fruit is relished by birds, squirrels, and other animals. The Dogwood is a small tree commonly found in the understory of a woodland. It is found naturally south of the Missouri River but can be grown in selected sites. **Green Ash** Leaves: Opposite, compound, 7 to 9 spear-shaped leaflets Flowers: Male and female flowers on separate trees Male – wooly clusters Female – greenish red Fruit: Seeds with wings, paddle-shaped, narrow Twigs: Stout, velvety when mature Bark: Gray, the ridges crossing frequently to form a diamond pattern Area: All areas General: The green ash is often planted as a shade tree because it is rapid in growth. A bottomland species, its wood is used for many of the same purposes in the lumber industry as white ash. **Hackberry** Leaves: Alternate, simple, narrow egg-shaped, long points, often hooked in a sickle-like fashion Flowers: Male and female flowers on the same tree Male – green, borne in small clusters Female – green, borne singly Twigs: Slender, light brown, becoming gray at maturity (A very common disease of hackberry causes erratic twig growth called "witches broom.") Bark: Grayish, rough with warty projections Area: A, B, and D General: In rich bottomlands where hackberry is commonly found, it may grow 125 feet in height. Many people consider the hackberry a

Instructor Directions	Content Outline
	desirable shade tree. Insects may cause galls. The purple berrylike fruit is food for squirrels and birds. **Northern Red Oak** Leaves: Alternate, simple, 5 to 8 inches long Flowers: Male and female flowers on the same tree Male – 4 to 5 inches long; heavy, yellow catkins Female – 2 to 3 on short stems Fruit: An acorn 1 inch long, oblong, somewhat hairy at the cup end; cup end is saucer shaped, enclosing 1/4 to 1/3 of the nut Twigs: Slender, reddish-brown Bark: Dark brown or black, smooth on young trees, deeply furrowed on older trunks Area: All areas General: Northern red oak is a favorite wood for cross ties, rough lumber, flooring, and for certain types of barrels. The brilliant red color of its autumn leaves and the symmetrical form of the tree make the species a widely used shade tree where space is not limited. **Osage Orange (Hedge Apple)** Leaves: Alternate, simple, long pointed tip, dark green and lustrous Flowers: Male and female flowers born on separate trees Male – small, greenish cluster Female – globe-shaped, many-flowered head Fruit: A large globe-shaped, fleshy fruit resembling a rough, green orange; commonly called a hedge apple Twigs: Slender, orange-brown or tan in color Bark: Greenish, fissured when young with orange inner bark, shreddy, orange and brown when mature Area: D, B, parts of C and A General: In the past, Osage orange has been used as a "living fence." The dense, compact, thorny branches and short trunk provide an excellent barrier to livestock. The wood of this species has properties which are ideal for making archery bows. In addition, its hardiness and durability

Instructor Directions	Content Outline
	make this an excellent wood for fence posts and telephone pole insulator pins. **Pecan** Leaves: Alternate, compound, spear-like leaflets, lower leaflet hooks back toward the stem Flowers: Male – catkins in threes, 3 to 5 inches long Female flowers – in several flowered spikes on the tips of branches Fruit: In clusters of 3 to 12 oblong-shaped nuts in a thin husk, nut smooth with thin shell and sweet kernel Twigs: Stout, reddish-brown with large orange-brown lenticels Bark: Thick, light to dark reddish-brown, deeply furrowed to scaly on very old trees Area: B, D (southwestern), A (western) General: Pecan is a favorite nut, timber, and shade tree of Missouri. It occurs naturally in areas along certain large streams and rivers throughout the state. It is most common on well-drained loam soils not subject to prolonged overflow. It also occurs on certain heavy textured bottomland soils and some cool protected slopes. Although once used a great deal for flooring, the lack of adequate amounts of marketable pecan has prevented this use in recent years. **Persimmon** Leaves: Alternate, simple, oval-shaped, 4 to 6 inches long with pointed tips Flowers: Male and female flowers on separate trees Female flowers – solitary, yellow or creamy white, bell shaped Fruit: Large fleshy berry 1 to 1-1/2 inches in diameter, orange and wrinkled when ripe in autumn, edible but often astringent Twigs: Slender, brown becoming gray Bark: Dark, broken into thick blocks, with the inner block on young trees showing orange between blocks Area: A, B, D (mainly below Missouri River), and C

Instructor Directions	Content Outline
	General: The wood of the persimmon tree, closely related to the tropical ebony, is very hard and heavy. It is often used for golf club heads and in weaving shutters where a resistance to splitting is necessary. **Pin Oak** Leaves: Alternate, simple, broadly oval in outline with 5 to 7 narrow lobes, forked lobes Flowers: Male and female flowers on the same tree Male – hairy catkins 2 to 3 inches long Female – on short, hairy stalks; reddish Fruit: Acorn, small 1/2 inch long; often striped with dark lines; enclosed 1/3 of the way with thin saucer-shaped cups Twigs: Slender, green at first becoming red-brown Bark: Thin and smooth when young, shallowly fissured and rough when mature Area: Parts of A, B, C, and D General: The pin oak is a wetland tree, growing in the bottomlands and borders of swamps (but also occurring in poorly-drained soils and along draws in nearly every county of the state). Because it is one of the fastest growing oaks, it is used extensively as a windbreak and as an ornamental tree. Pin oak has a single, upright stem with numerous long, tough branches. The lower branches usually droop. It produces very knotty, low-grade lumber. Acorns are a favorite food of waterfowl. **Red Bud** Leaves: Alternate, simple, heart-shaped, dark green in summer, yellow in fall Flowers: Purplish-red clusters along the stem, appear before leaves in early spring Fruit: A legume; oblong, flattened, multi-seeded pod; reddish color Twigs: Slender, brown, turning darker with maturity Bark: Covered with small, dark, loose scales; underbark reddish-brown Area: All areas

Instructor Directions	Content Outline
	General: This understory tree is probably found in every county of our state. It is a small, flat-topped tree which grows in the shade of the larger oaks and hickories. This tree is valued for its beauty. The flowers and heart shaped leaves, as well as growth habits, make redbuds a desirable ornamental tree. **River Birch** Leaves: Alternate, simple, egg-shaped, 1-1/2 to 3 inches long, dark green and shiny Flowers: Male catkins – clustered 2 to 3 inches long Female catkins – short, 1/3 inch long Fruit: Cone-like in appearance, small winged seeds Twigs: Slender, dark red Bark: Thick and dark brown on old trunks, thin and papery on young trees, light pink to tan on outer surface Area: A (except south central), B (except extreme north), C, and D General: A medium-sized tree (rarely as tall as 8 feet or greater than 2 to 3 feet in diameter); more commonly found in clumps of several trunks. **Shagbark Hickory** Leaves: Alternate, compound, 5 leaflets, elliptical (broadest near pointed tip), dark yellowish-green crown turning rusty golden yellow in the fall Flowers: Male catkins – in threes, green, hairy Female flowers – on short spikes Fruit: 1 to 2-1/2 inches in diameter, nut in husk, nut flattened with 4 prominent ridges, pale tan in color, sweet kernel Twigs: Stout, reddish-brown Bark: Gray, smooth when young, shredding later into strips or shaggy plates, ends curving away from the tree Area: All areas except south central A General: The shagbark often becomes a nuisance around agricultural land since it is quick to invade open fields. The wood is heavy, strong, and flexible. It was once used for the spokes, hubs, and rims of

Instructor Directions	Content Outline
	wagon wheels. Its principal uses today are for handles for hammers, axes, picks, and hatchets. A great deal of this wood is also made into charcoal for barbecue grills. Nuts are excellent wildlife food. **Shortleaf Pine** Leaves: Needles in bundles of 2 or 3 on the same tree Flowers: Male and female flowers cone-like, borne on the same tree Fruit: A cone maturing in two seasons; egg shaped; individual scales, each with a minute prickle Twigs: Moderately stout, purple with white frost-like shade Bark: Rough and scaly at first, thick and divided into large cinnamon-red plates on old trees Area: A, planted in C and D (southwest area) General: The shortleaf pine is the only pine native to Missouri. It is an important timber species, used largely for lumber, paper-pulp, and treated posts. Scattered stands of shortleaf pine furnish valuable wildlife cover. In many cases, large areas may be seeded, under a forester's direction, more economically than they can be planted. **Silver (Soft) Maple** Leaves: Opposite, simple, deeply 5-lobed, pale green above, silvery white beneath Flowers: Yellow-green to reddish Fruit: 2 single-winged seeds with wings wide spreading, largest of the native maples Twigs: Orange-brown to red, have a disagreeable odor when bruised Bark: Smooth and gray on young trees, scaly or with long thin plates on older trees Area: All areas General: Silver maple is the fastest growing of all maples and produces a shade tree in relatively few years. Commercially, this species has great potential. In certain parts of the state, its importance has risen due to its use as a

Instructor Directions	Content Outline
	furniture wood. It is also used for windbreaks and streambank protection. **Sumac** Leaves: Alternate, spear-shaped, compound, 9 to 27 Flowers: Small and green in dense clusters at the tip of the branch Fruit: Dense clusters of globe-shaped berries covered with crimson hair Twigs: Stout Bark: Thin, gray Area: All areas except extreme northwest B and D General: Sumac is a shrub up to 6 feet in height. Its fruit ripens from June through August and is eaten by many birds, including wild turkey. **Sweetgum** Leaves: Alternate, simple, star-shaped with 5 pointed lobes, turns brilliant red and yellow in the fall Flowers: Male and female flowers on the same tree Male – hairy clusters, 2 to 3 inches long Female – clustered on swinging globe-shaped head Fruit: A round globe-shaped cluster of capsules, these ball-like capsules persisting on trees over winter Twigs: Moderately stout, greenish-yellow with corky lenticels Bark: Light gray on young trees; dark brown, fissured and rough on older trees Area: C General: Sweetgum is restricted in range to the lowlands of the bootheel and scattered occurrences in upland swamps. Sweetgum is an excellent lumber species. Nationally, it is second only to oak on the hardwood market. It is made into veneer, furniture, interior trim, and numerous other products. **Sycamore** Leaves: Alternate, simple, large with 3 to 5 main lobes, very coarsely toothed, yellow-green Flowers: Male and female flowers on the same tree Male – short-stalked dark red clusters

Instructor Directions	Content Outline
	Female – long-stalked, ball-like green and red clusters Fruit: A ball-like multiple of many seeds, brown when mature, clusters hanging on tree throughout winter Twigs: Moderately stout, green Bark: Dark brown; broken into small, rounded scales; smooth and white with large, loose, olive-green, red, or brown scales on older trees Area: All areas General: Sycamores are very tolerant of wet soil conditions and fluctuations in the ground water table. Sycamores make excellent den trees for squirrels, raccoons, and birds and provide food for beavers and squirrels. The wood is hard, tough, and almost impossible to split. Although used in butcher blocks, tobacco boxes, furniture, crates, and barrels, its use in construction is limited due to its warping tendency. **White Oak** Leaves: Alternate, simple, 4 to 9 inches long, somewhat wider toward the tip end of the leaf, 7 to 9 smooth-edged lobes Flowers: Male flowers – hairy catkins Female flowers – inconspicuous Fruit: 3/4 inch long acorn, short-stalked cup covered with warty scales enclosing about 1/4 of the nut's length Twigs: Slender, greenish red with white frost-like shade, becoming reddish brown as it matures Bark: Light, rough with long loose scales, becomes blocky when older Area: All areas General: White oak can be found under a diversity of environmental conditions. It often grows in almost pure stands on loamy, well-drained soils in protected coves on cool slopes. Probably the most important use in Missouri is the cooperage industry for making barrels for distilleries. Nuts of the white oak are a choice food for squirrels. Leaves turn a deep red in autumn and persist on the tree during early winter.

Instructor Directions	Content Outline
	Wild (American) Plum Leaves: Alternate, simple, oval in shape with long pointed tip Flowers: Clusters of several flowers, individual flowers about 1 inch in diameter, white Fruit: Globe-shaped, 1 inch diameter, red or orange colored, sweet and edible Twigs: Slender, dark reddish brown, smooth and shiny Bark: Thin; dark reddish brown; smooth when young; thin, dark plates when older Area: D (southwest), B, A (west), and C General: The wild American plum is a small tree commonly occurring in thickets throughout the state. It provides an excellent wildlife cover and erosion control when planted in the heads of washes in area D.
Application AS 1 – Tree Identification Chart	Answers to AS 1: Answers will vary. Other activities: 1. Visit woodland areas to identify trees. 2. Visit the state Nursery at Licking, Missouri, or local private nurseries 3. Have students make a collection of pressed leaves, twigs, bark, fruit, and flowers of local trees.
Closure/Summary	These are just a few of Missouri's numerous tree species. Being able to identify some of these common species is important to the tree farmer, who needs to know their potential uses and to know what species will grow best under given environmental conditions.
Evaluation: Quiz	Answers: Teachers should develop an answer key based on the trees which are selected for their evaluation.

Course	Agricultural Science II
Unit	Forestry
Lesson	Planting Trees
Estimated Time	Two 50-minute blocks

Student Outcome

Describe how to plant and care for seedlings.

Learning Objectives

1. Identify how to develop a tree planting plan.
2. Identify how many trees should be ordered, and where the trees can be ordered from.
3. Identify how to care for seedlings before planting.
4. Identify how to plant tree seedlings.
5. Identify how to care for seedlings after they have been planted.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
   - ☐ PPt 1 – Planting Forest Trees
   - ☐ PPt 2 – Center Hole Method Using a Grubbing Hoe
   - ☐ PPt 3 – Slit Method Using a Tree Planting Bar
2. Handout
   - ☐ HO 1 – Uses of Trees
3. *Forestry* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1986.
4. *Forestry Curriculum Enhancement.* University of Missouri-Columbia: Instructional Materials Laboratory, 2008.

Supplemental Information

1. Internet Sites
   - ❑ Arbor Day Foundation Website. Accessed April 11, 2008, from http://www.arborday.org/.
   - ❑ Planting Trees in Your Landscape. Virginia Cooperative Extension. Accessed April 11, 2008, from http://www.ext.vt.edu/pubs/envirohort/426-702/426-702.html.
   - ❑ Tree Planting: In Your Backyard. USDA Natural Resources Conservation Service. Accessed April 11, 2008, from http://www.nrcs.usda.gov/feature/backyard/TreePtg.html.
2. Print
   - ❑ Slusher, J.P., and G. Hoss. *Before You Order Tree Seedlings* (Guide G5006). Columbia: University of Missouri Extension, revised 2000. Accessed May 27, 2008, from http://extension.missouri.edu/explore/agguides/forestry/g05006.htm.

- Slusher, J.P., and T. Robison. *How to Plant Forest Trees* (Guide G5008). Columbia: University of Missouri Extension, reviewed 1993. Accessed May 30, 2008, from http://extension.missouri.edu/xplor/agguides/forestry/g05008.htm.

Interest Approach

Seedlings planted for forest products are a long-term investment. They won't be harvested this year or even next year. The time before you realize a profit may be anywhere from 5 years (for some Christmas trees) to 25 years for hardwood species. Therefore, choosing good stock and starting that stock off on the right track is important.

Communicate the Learning Objectives

1. Identify how to develop a tree planting plan.
2. Identify how many trees should be ordered, and where the trees can be ordered from.
3. Identify how to care for seedlings before planting.
4. Identify how to plant tree seedlings.
5. Identify how to care for seedlings after they have been planted.

Instructor Directions	Content Outline
Objective 1 *Discuss with students the necessity of careful planning and list factors to be considered when selecting the species of trees to be planted. Refer to HO 1.* HO 1 – Uses of Trees	**Identify how to develop a tree planting plan.** Trees must be selected according to their intended uses. 1. Wood products 2. Wildlife 3. Windbreaks 4. Erosion control 5. Ornamental or shade Factors to consider in developing a planting plan. (Specific information on some individual species is given in Lesson 2.) 1. What trees grow well in the area? 2. What species will best fit the landowners needs? 3. What species will grow in the soil type? 4. What are the growth rates of selected species? 5. How many trees should be planted in the given area? 6. How much time and funds are available to be spent on tree planting and maintenance each year? 7. Financial returns needed on initial investment. 8. Consider how the factors listed above can be developed into a long-range forest management plan. Reasons for developing a long-range forest management plan 1. Basis for determining economical use of forest resources (enables timber grower to allocate time and finances to obtain maximum timber production and returns from forest land)

Instructor Directions	Content Outline
	2. Prevents spur-of-the-moment decisions (harvesting prematurely or too late depending on financial needs) 3. Allows scheduling and planning of management practices such as thinning, planting, cutting, fire, and pest protection, etc.
Objective 2 *Discuss with students how to figure the number of trees and where and how they can order trees. Have students complete an application for planting stock or a State Nursery application form. Refer to PPt 1.* ☐ PPt 1 – Planting Forest Trees	**Identify how many trees should be ordered, and where the trees can be ordered from.** Good tree stock is essential to successful planting. Choose the right species for your forest plan. (Refer to Lesson 2 for common Missouri trees, their use, and areas where they grow.) If planting a cleared area, calculate the spacing and number of trees needed. 1. Example – find the number of oaks needed for a 1/2 acre area. a. From tree spacing chart, oaks are spaced on 15′ x 15′ centers. b. From tree quantity chart, there are 194 trees/acre at 15′ x 15′ spacing. Where to obtain trees: 1. A list of private nurseries which carry seedling trees and shrubs can be obtained from an extension forester. 2. State Nursery is at Licking, Missouri a. Contact your country extension center or local vocational agriculture instructor for the following forms. – A list of seedlings available – Application form b. It is important to order early as the nursery provides seedlings on a first-come-first-serve basis.
Objective 3 *Discuss with students how to handle nursery stock on arrival or demonstrate with tree seedlings how they are handled.*	**Identify how to care for seedlings before planting.** Best success is obtained when seedlings are planted in the spring as soon as possible after arrival. (Always make sure packing material around roots is kept moist.)

Instructor Directions	Content Outline
	If planting must be delayed, use the following procedures. 1. To store trees for 1 week or less: a. Put bundles in cool shaded place. b. Separate bundles to avoid overheating and elevate the end slightly. c. Pour enough cold water into elevated end to keep roots moist. d. Do not store trees in water because roots may be damaged. e. Protect trees from severe freezing. 2. To store trees for more than a week: a. Method 1: Hold bundles in cold storage at 35° to 37° F. b. Method 2: Put trees in a "heeling-in" trench. – Dig trench in a shaded, protected place; adjust the depth to fit roots. (Avoid areas with high rodent populations.) – Cut bundle strings and spread trees. – Pour water on roots as trench is being refilled. – Water as often as necessary thereafter to keep soil moist (avoid overwatering). – A mulch placed on soil near tress will help hold moisture. 3. General guidelines: a. Never leave bundles exposed to sun and wind. b. During planting, take out a few seedlings at a time. c. Avoid damaging terminal buds and roots.
Objective 4 *Discuss with students how seedlings are planted. If possible allow students to plant forest seedlings on school grounds, in the school lab, or on their home farms. Refer to PPT 2 and PPt 3.* ☐ PPt 2 – Center Hole Method Using a Grubbing Hoe	**Identify how to plant tree seedlings.** Prepare the site well in advance. 1. Plowing 2. Disking 3. Herbicides 4. Scalping Keep seedling roots moist by placing them in a bucket 1/2 full of water or wet moss. Planting may be done by hand or by machine.

Instructor Directions	Content Outline
☐ PPt 3 – Slit Method Using a Tree Planting Bar	General rules for planting: 1. Plant seedling at the same level that it was in the nursery. 2. Make sure seedling is upright and roots not doubled over. (Trees with doubled roots grow more slowly.) 3. Pack the soil around the roots so tree will remain upright. 4. Plant only one tree per space. Procedures for planting: 1. Center hole method using a grubbing hoe a. Dig hole to fit root system of seedling. b. Set tree at same depth grown in nursery. c. Fill hole half full of soil and tamp well. d. Finish filling hole and tamp with feet. 2. Slit method using a tree planting bar a. Hold bar vertically and drive blade full length into soil. – Pull handle toward you 4 or 5 inches. – Make a similar thrust in opposite direction. b. Remove the planting bar and insert the seedling making sure the root is in normal position. c. Drive tree planting blade in at a 30° angle, 3 inches behind seedling. – Pull the bar toward you. – Push the bar forward to close the bottom and top slit. – Remove the bar and tamp with heel.
Objective 5 *Discuss with the students the general rules of ensuring success of seedlings after planting.*	**Identify how to care for seedlings after they have been planted.** 1. Protect trees from fire by plowing or disking fire breaks. 2. Keep livestock out of plantations. 3. Control weeds, particularly during the first 2 years. a. Light disking b. Chemicals c. Mowing d. Hoeing 4. Check for disease and insect problems.
Application	Other activities: 1. Develop a tree planting plan. 2. Have students order trees for their home or farm.

Instructor Directions	Content Outline
	3. Have students plant previously ordered trees on school grounds. 4. Invite your Department on Conservation Field Service Agent to explain tree ordering procedures to the class.
Closure/Summary	Seedlings planted today will be around for many years before they yield a return. It is very important, therefore, to have success. Success will depend on obtaining good seedling stock, properly storing that stock before planting, planting the stock correctly, and caring for the seedlings after planting.
Evaluation: Quiz	Answers: 1. a. Private nurseries b. State nursery at Licking, MO 2. Either hold bales in cold storage at 35° to 37° F or put trees in a heeling-in trench. 3. a. Plowing b. Disking c. Herbicides d. Scalping 4. a. Plant seedlings at the same level that they were in the nursery. b. Make sure seedlings are upright and roots are not doubled over. c. Pack the soil around the roots so the tree will stay upright. d. Plant only one tree per space. 5. – Hold planting bar vertically and drive blade full length into soil. Pull handle toward you 4 to 5 inches and then push it away from you. – Remove planting bar, insert seedling, and straighten roots in slit. – Drive tree planting blade in at a 30° angle, 3 inches behind seedling. Pull bar toward you, then push bar forward to close the bottom and top slit. Remove bar and fill in remaining hole. 6. Answers should include three of the following: Fire, livestock, weeds, disease, or insects

Uses of Trees

Tree or Shrub	Wood Products	Wildlife	Windbreaks	Erosion Control	Ornamental or Shade
Aromatic sumac		X		X	
Autumn olive		X	X	X	X
Baldcypress	X			X	X
Black locust	X (fence posts)			X	
Black walnut	X	X			
Cottonwood	X			X (strip mines, stream banks)	
Dogwood		X			X
European black alder		X	X	X	X
Green ash	X		X	X	X
Hackberry	X	X	X		X
Jack pine		X (cover)	X	X	
Lilac			X	X	X
Loblolly pine	X			X (Ozarks, strip mines)	
Ninebark			X		X
Northern red oak	X	X			X
Osage orange	X	X	X	X	
Pecan	X	X		X (strip mines)	X
Persimmon		X			
Pin oak		X	X		X
Redbud			X	X	X
Redcedar	X	X (cover)	X	X	X
River birch				X	X
Russian olive		X	X		
Scotch pine	X (Christmas tree)	X (cover)	X		X
Shortleaf pine	X			X (Ozarks)	
Silver maple	X				
Sweet gum	X		X (bootheel)		X
Sycamore	X			X (stream banks)	X
White mulberry		X			X
White pine	X		X		X
Wild plum		X		X	
Yellow poplar	X				X

Credit: *Before You Order Tree Seedlings,* University of Missouri Extension Guide G5006.

Course	Agricultural Science II
Unit	Forestry
Lesson	Forestry Tools and Equipment
Estimated Time	Four 50-minute blocks

Student Outcome

Describe the safe use of forest tools.

Learning Objectives

1. Identify some common tools used for pruning and planting.
2. Identify some common tools used for harvesting trees.
3. Describe how to use a chain saw safely.
4. Describe how to fell trees safely using a chain saw.
5. Describe how to limb trees safely using a chain saw.
6. Describe how to buck logs safely using a chain saw.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
   - ☐ PPt 1 – Tools for Pruning and Planting
   - ☐ PPt 2 – Using the Cant Hook
   - ☐ PPt 3 – Chain Saw Safety
   - ☐ PPt 4 – Safe Bucking Procedures
2. *Forestry* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1986.
3. *Forestry Curriculum Enhancement.* University of Missouri-Columbia: Instructional Materials Laboratory, 2008.

Supplies & Equipment

- ❑ Chain saw for demonstration of safe use

Supplemental Information

1. Internet Sites
   - ❑ Forestry equipment and supplies. Pacforest Supply Company. Accessed May 28, 2008, from http://pacforestsupply.com/.
2. Print
   - ❑ Baker, D.E., and B.E. Cutter. *Basic Chain Saw Safety and Use*. (Guide G1959). Columbia: University of Missouri Extension, reviewed 1998. Accessed May 30, 2008, from http://extension.missouri.edu/xplor/agguides/agengin/g01959.htm.

Interest Approach

Knowing the tools used in the forest industry is essential for occupational success. Even more important is to know the safe use and handling of these tools.

Communicate the Learning Objectives

1. Identify some common tools used for pruning and planting.
2. Identify some common tools used for harvesting trees.
3. Describe how to use a chain saw safely.
4. Describe how to fell trees safely using a chain saw.
5. Describe how to limb trees safely using a chain saw.
6. Describe how to buck logs safely using a chain saw.

Instructor Directions	Content Outline
Objective 1 *Discuss with students the common hand tools used in pruning and planting trees. Refer to PPt 1. Allow students to develop skills with these tools in a lab setting.* ☐ PPt 1 – Tools for Pruning and Planting	**Identify some common tools used for pruning and planting.** Pruning saw 1. Curved blade – maneuverable, light weight 2. Makes smooth cuts 3. Used for pruning hardwoods such as black walnuts Hand shears and pruners 1. Used to shape Christmas trees 2. Must be kept sharp to facilitate clean cuts Planting tools 1. Planting machine 2. Planting bar
Objective 2 *Discuss with students the uses of harvesting tools. Refer to PPt 2 when discussing the cant hook.* ☐ PPt 2 – Using the Cant Hook	**Identify some common tools used for harvesting trees.** Axe 1. Many tasks previously done by an axe are now done by chain saws. 2. Light single bit axe with a 2-1/2 to 3 pound head and 24 inch handle may still be useful. a. It can be useful in cutting small brush and limbs that interfere with felling. (Chain saw is unsafe for this.) b. Poll (back) of axe can be used to drive wood or plastic wedges. c. Blade can chop out chain saw if stuck in a cut. 3. Care and safety are important. a. Keep the blade sharp; a dull blade is unsafe (likely to glance off objects).

Instructor Directions	Content Outline
	b. Never use poll end to drive steel wedge. (Steel splinters break off and can be projected into eyes.) Wedges 1. Wedges keep the chain saw from being pinched in cut. 2. They are used to start tree falling in proper direction. 3. Never use steel wedges in chain saw cut. a. Wedge contact with chain will ruin the chain. b. Plastic, wood, or soft metal wedges should be used. Woodchopper's maul – splitting maul 1. This maul is used for hand splitting fuelwood. 2. It is the only tool needed for hand splitting short pieces of wood. Cant hook or peavey 1. Used to pry or roll logs. 2. Always roll logs away from user to avoid rolling logs on feet. 3. It is also used as a lever in lifting logs. 4. Pry logs away from stumps in felling. Chain saw 1. This is the most widely used, indispensable tool in today's logging operation (used in 90 percent of wood cutting jobs). 2. It accounts for the vast amount of accidents in logging operations. (It must be used safely.)
Objective 3 *Discuss with students the safe use of a chain saw. Refer to PPt 3. Using actual equipment, demonstrate how to use the chain saw safely.* ☐ PPt 3 – Chain Saw Safety	**Describe how to use a chain saw safely.** Danger associated with chain saws 1. Recent study found 50,000 people required hospital treatment from injuries associated with chain saws. 2. Operator can make careless mistakes. a. Reaching across saw b. Losing control of saw c. Loss of balance due to loss of footing (accounts for 1/6 of accidents) d. Kickback 3. Safety awareness can reduce the incidence of injury.

Instructor Directions	Content Outline
	Safety preparation 1. Safety begins before saw operation begins. 2. Read and study owner's manual. 3. Outfit yourself with proper clothing and protective equipment. a. Clothing – Well fitted (free of dangling edges) – Long hair tied back – Additional protection – nylon mesh leg chaps or knee pads b. Hard hat – Provides protection – Must be properly fitted – Protects head from falling limbs c. Safety goggles or safety eyeglasses – Prevents injury from flying wood chips – Use safety eyeglasses with side shields d. Earmuffs or ear plugs (protect ears from harmful noise level) e. Non-slip gloves – Lightweight – Protect hands from abrasions and wood cuts f. Safety boots – Good gripping soles – High tops to protect ankles – Steel toes to protect feet 4. Prepare the saw a. Properly sharpened chain – Situations that indicate sharpening is needed • It tends to cut sideways • Cut shows fine powder instead of chips • Operator finds himself pressing down – Follow manual to sharpen chain b. Correct chain tension – Too loose – chain will derail – Too tight – chain will bind – Chain stretch usually occurs during first half hour of operation. – Follow the manufacturer's recommendations for the correct chain tension.

Instructor Directions	Content Outline
	c. Proper lubrication – Automatic oilers • Make sure oiler is properly adjusted • Check bar oil mechanism to make sure it is not plugged up. – If chain smokes while operating, there is not enough lubrication. d. Tool kit – Few extra cans of oil – Wrenches to fit all lugs and nuts on the saw – Screwdriver – Round file and guide for touching up chain – Flat file and depth gauge to file depth guides – Small brush to clean away sawdust and wood chips around gas cap and cooling fins – Extra spark plugs – Cleaning rags – Sharp axe (2-1/2 to 3 pound head, 24 inch handle) – Wood or plastic wedges – Supply of fuel in a UL listed safety can – First aid kit Safe operating techniques 1. Refueling and starting the engine a. Refueling – Use the manufacturer's recommended fuel mix. – Use a funnel or flexible nozzle to avoid spillage on engine. – Only refuel engine when it is cool. – If fuel spills, clean engine thoroughly. – Refuel with chain saw on ground and in area cleared of combustible material. – Never smoke while refueling. – Each time you refuel, check chain tension, nuts, bolts, and oil flow. b. Starting the engine – Saw should be started on a firm base, teeth free of obstacles. – With one foot placed on bracket to rear of unit, set starting controls. – Grip top handle of saw firmly with one hand.

Instructor Directions	Content Outline
	– Use other hand to pull rope. – Never "drop start" saw; this is an invitation to disaster. c. Cutting – While cutting always hold saw with both hands, thumb firmly locked around front handle. – Stand with feet well apart, body well-balanced. – Stand to the side of the saw while cutting (**never** behind it). – Keep clear of work. – Never cut above shoulder level. – Always be aware of helpers and bystanders while cutting. d. Avoiding kickback – Hold saw firmly. – Use a saw equipped with a chain brake or kickback guard. – Watch for twigs that can snag chain. – Don't let bar pinch in cut. – Saw with lower part of bar, never with tip. – Maintain high speed when entering a cut. – Keep chain sharp. – Never reach over shoulder height to cut.
Objective 4 *Discuss with students the general procedures for felling trees. Demonstrate or have an experienced person demonstrate tree felling at a local farm. Have students assist in judging direction of fall, clearing area, and developing a felling plan of safety.*	**Describe how to fell trees safely using a chain saw.** Consider the characteristics of the tree and direction of fall 1. Observe how it leans. 2. Notice if there is an uneven top. 3. Observe growth or breakage. 4. Determine wind direction. Clear the ground 1. Clear working space around the tree. 2. Use axe to cut away brush and saplings. Develop a felling safety plan in advance 1. Plan your escape route to side of fall at a 45° angle. 2. Plan a safe place to drop saw, allowing you an unhampered escape. 3. Clear trees and brush that might obstruct your escape route.

Instructor Directions	Content Outline
	Follow the felling procedure 1. Hold saw firmly in both hands; take a well-balanced stance. 2. Make cut close to base of tree, but high enough to avoid saw in ground. 3. Notch undercut at least 1/3 of the trunk diameter on the fall side of tree. (Make lower cut of notch first to avoid pinching saw.) 4. Make felling or back cut on the opposite side of the trunk 2 inches above and parallel to horizontal notch. a. Leaves wood fibers to act as a hinge b. Keeps tree from kicking back on stump 5. Guide saw into tree; do not force it. 6. Remove saw from tree and shut off. 7. Retreat along planned route. Use wedges 1. Used to make tree fall in the desired direction. 2. Always use two wedges rather than one. 3. Use wood or plastic wedges and drive with poll of axe or mallet. 4. Strike wedges squarely. (Careless blows may pop the wedge out, swinging the tree backwards.)
Objective 5 *Discuss with students the process of limbing felled trees. If possible, demonstrate limbing on trees. Have students involved in making decisions in the order of limbing.*	**Describe how to limb trees safely using a chain saw.** Limbing – branch removal from felled trees Limbing safely 1. Decide the order of limbs being cut, making sure taking the limb will not cause tree to roll on you. 2. Do not use tip (greatly increases chance of kickback). 3. Remove limbs on top side of trunk as far as possible. 4. When possible, saw from the uphill side. 5. Lesser branches should be removed. 6. Saw limbs on opposite side of trunk from where you are standing as much as possible. (Trunk is barrier between operator and saw.) 7. Avoid reaching with saw. (Move to limbs and have good stance before cutting.) 8. Exercise caution when removing lower branches. a. Cutting bottom branches as work progresses will be necessary.

Instructor Directions	Content Outline
	b. Key branches stabilizing tree should be left until last. c. It is difficult to determine if branch is supporting or not until saw weakens limb. d. Likelihood of tree rolling increases as more limbs are removed.
Objective 6 *Discuss with students the process of bucking. Refer to PPt 4. Demonstrate in lab setting or on a local farm.* ☐ PPt 4 – Safe Bucking Procedures	**Describe how to buck logs safely using a chain saw.** Bucking – cutting trunk into desired lengths 1. Generally less hazardous than felling or limbing 2. Safety skills still essential Special hazards 1. Log roll a. Work on the uphill side of logs b. Raise and chock trunk when possible 2. Kickback a. Avoid touching ground with tip of saw b. Avoid using the tip of the saw 3. Back strain – Do all manual lifting with back-and-strain saving techniques in mind. General procedure 1. When log is supported along entire length a. Cut from top b. Roll over and cut from opposite side until free c. Use care to avoid getting saw into ground 2. When log is supported from one end a. Cut 1/3 of diameter from one side (avoids pinching and splittering) b. Cut 2/3 of diameter from top, meeting first cut 3. When log is supported at both ends a. Make first cut from top 1/3 diameter b. Then cut 2/3 from underside, meeting first cut 4. Cutting firewood – laying on ground a. Make cuts on one side 3/4 of the way through log for each length b. Roll log over and cut through to first cut for each length c. A three-legged sawhorse is effective in steadying wood and making cuts easier and safer

Instructor Directions	Content Outline
Application	Other activities: 1. Plan a field trip to watch experts fell, limb, and buck trees.
Closure/Summary	Know the right tools for planting, pruning, and harvesting forest trees. Always use them with safety in mind as they are valuable to your success in the forest industry.
Evaluation: Quiz	Answers: 1. a. Pruning saw – hardwoods such as walnuts b. Hand shears and pruners – Christmas trees 2. a. Planting machine b. Planting bar 3. a. Axe – used for clearing small limbs and brush when felling; poll end used to drive wood or plastic wedges; can be used to chop out chain saw if stuck b. Wedges – used to keep chain saw from being pinched and to start tree falling in proper direction c. Woodchopper's maul – used for hand splitting wood d. Cant hook or peavey – used to pry or roll logs e. Log jack – supports logs above the ground for bucking 4. Well-fitting clothes; nylon mesh leg chaps; hard hat; safety goggles; earmuffs or earplugs; non-slip gloves; steel-toed ankle-high boots with good grip 5. a. Sharpness b. Chain tension c. Proper lubrication 6. Start saw on the ground away from obstacles. Stand at the rear of the unit with one foot placed on the bracket. Grip top of saw firmly with one hand. Use other hand to pull rope. 7. Always hold saw with both hands with thumbs firmly locked around front handle. Stand with feet well apart and body well-balanced. Stand to the side of the saw while cutting, never behind it. Keep clear of work and never cut above shoulder level. Always be aware of helpers and bystanders while cutting.

Instructor Directions	Content Outline
	8. Plan an escape route to either rear or side of the tree fall. Plan a safe place to drop chain saw which will allow you an unhampered escape. 9. Answers should include two of the following: a. Tree rolling – decide proper order of limbing; choose limbs that do not support the tree. b. Saw striking operator - saw limbs as much as possible on opposite sides of trunk so that the tree forms a barrier between the operator and the saw; stand at a 45° angle to limbs being cut; never reach for branches being cut; have a good, solid stance. c. Kickback – don't "nose saw". 10. a. When bucking a log which is supported along its entire length, cut from the top down, roll the log over, and cut through to the first cut. b. When bucking a log which is supported from one end, cut 1/3 of the way into the diameter from one side, and then cut 2/3 of the way down from the top to meet the first cut. c. When bucking a log which is supported at both ends, make the first cut from the top 1/3 of the way into the diameter. Then cut 2/3 of the way in from the underside, meeting the first cut. 11. Answers should include four of the following points: a. Hold saw firmly b. Use chain brake or kickback guard c. Watch for twigs which could snag chain d. Don't pinch bar e. Saw with lower part of bar, not the tip f. Maintain high speed when entering a cut g. Keep chain sharp h. Never reach over shoulder height to cut 12. F 13. F 14. T 15. T

Course	Agricultural Science II
Unit	Forestry
Lesson	Measuring Standing Timber and Logs
Estimated Time	Two 50-minute blocks

Student Outcome

Measure standing timber and logs by board-foot volume and cord volume.

Learning Objectives

1. Describe how to measure logs for fuelwood or pulpwood.
2. Describe how to measure logs for lumber.
3. Describe how to measure standing timber.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
   - ☐ PPt 1 – Measuring Diameter
   - ☐ PPt 2 – Measuring Tree Height
2. Handouts
   - HO 1 – Board Foot Volume of Trees by Diameter and Height Classes
   - HO 2 – International 1/4-Inch Log Rule Table
   - HO 3 – Cord Volume Table
   - HO 4 – Measuring Diameter at Breast Height and Merchantable Height
3. *Forestry* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1986.
4. *Forestry Curriculum Enhancement.* University of Missouri-Columbia: Instructional Materials Laboratory, 2008.

Supplemental Information

1. Internet Sites
   - ❑ Forest Landowner's Guide to the Measurement of Timber and Logs. Virginia Cooperative Extension. Accessed May 28, 2008, from http://www.ext.vt.edu/pubs/forestry/420-085/420-085.html.
   - ❑ Measuring Standing Trees: Determining Diameter, Merchantable Height, and Volume. Ohio State University Fact Sheet. Accessed May 28, 2008, from http://ohioline.osu.edu/for-fact/0035.html.
   - ❑ How to Measure Standing Timber. TimberQuote.com. Accessed May 28, 2008, from http://timberquote.com/education/howto/measure.

2. Print
   - ❑ Palmer, B., and J. McKee (ed.). *Forest Management for Missouri Landowners.* Jefferson City: Missouri Department of Conservation, revised 2003. Accessed June 4, 2008, from http://www.mdc.mo.gov/documents/forest/private/forest_manag.pdf.
   - ❑ Slusher, J.P. *How to Measure Trees and Logs* (Guide G5050). Columbia: University of Missouri Extension, reviewed 1993. Accessed June 4, 2008, from http://extension.missouri.edu/xplor/agguides/forestry/g05050.htm.

Interest Approach

It is important for producers to be able to determine the value of their produce. Part of that value is based on volume. Just as corn producers must know the number of bushels they produce and sell, tree farmers, foresters, and timber agribusiness personnel must know the volume of the wood products they buy or sell.

Communicate the Learning Objectives

1. Describe how to measure logs for fuelwood or pulpwood.
2. Describe how to measure logs for lumber.
3. Describe how to measure standing timber.

Instructor Directions	Content Outline
Objective 1 *Discuss with students how they would sell fuelwood or pulpwood. Explain what a standard cord is, and demonstrate how to use the formula.*	**Describe how to measure logs for fuelwood or pulpwood.** 1. Fuel wood and pulpwood are sold in cords. 2. Standard cord occupies 128 cubic feet. 3. Formula for determining number of cords: Number of Standard Cords = $\frac{\text{length (feet) x width (feet) x height (feet)}}{\text{128 cubic feet}}$ The number of standard cords in a stack of wood 4 feet x 4 feet x 8 feet = 1 cord Example: Is a level truck bed really equal to a half cord? Yes, if the dimensions were 4 feet x 8 feet x 2 feet = .5 cords. 4. A rick is not a standard measurement. (It is customarily 1/3 to 1/2 cord.) 5. Face cord – one row of wood 4 feet x 8 feet with lengths varying from 18 to 24 inches.
Objective 2 *Discuss with students how logs are measured for sawlogs and for lumber. Refer to HO 1 and 2.* HO 1 – Board Foot Volume of Trees by Diameter and Height Classes	**Describe how to measure logs for lumber.** 1. Logs for sawlogs and lumber are measured in board feet. (A board foot = 144 cubic inches.) 2. Scaling is the normal basis for estimating the number of board feet in a log. 3. By measuring the diameter and length, and then using a log rule, the number of board feet in a log may be estimated.

Instructor Directions	Content Outline
HO 2 – International 1/4-Inch Log Rule Table	a. Diameter measurement – Measure small end of log inside bark. – If log is not perfectly round, take two measurements at right angles to each other and use the average diameter. b. Length – Measure length in even feet (10, 12, 14, 16, etc.). – If the log is in between an even number of feet, measure to the smaller even number. c. Log rule – Used to estimate board foot volume from the diameter and length measurements of logs. – Over 50 log rules in the United States. – International 1/4-Inch and Doyle are common log rules. Example: A log which is 15.5 feet long and has a D.I.B. of 18 inches = 200 board feet using the International Log Rule.
Objective 3 *Discuss and demonstrate procedures for measuring standing timber with the students. After this demonstration, have students practice measuring trees in the school yard. Refer to HO 1, 3, and 4 and PPt 1 and 2.* *Note: The discussion below refers to the example of a cruising stick in the Student Reference. Other cruising sticks may have different scales, formulas, and instructions.* HO 1 – Board Foot Volume of Trees by Diameter and Height Classes HO 3 – Cord Volume Table	**Describe how to measure standing timber.** Timber is often sold on a stumpage basis (selling timber from standing trees). The tree's diameter at breast height (d.b.h.) and the merchantable height are used to determine board foot or cord volume. 1. Measuring diameter at breast height (d.b.h.) a. Breast height is 4-1/2 feet above ground on the high side of the base of the tree b. Cruising stick is used to find a quick estimate of tree height and diameter c. Hold cruising stick 25 inches from eye against tree at breast height. d. Line up zero end with the outside edge of the tree. e. Without moving head and using only one eye, read figure nearest where line of sight crosses stick and edge of tree. f. Number indicates breast height diameter in inches.

Instructor Directions	Content Outline
HO 4 – Measuring Diameter at Breast Height and Merchantable Height PPt 1 – Measuring Diameter PPt 2 – Measuring Tree Height	2. Measuring merchantable (usable) height a. Use cruising stick b. Measure from stump (12 inches from ground) to point on tree beyond which merchantable logs cannot be cut. – Sawlogs – diameter 8 inch top, inside the bark – Can occur lower on tree if tree is forked or deformed c. Measuring height – Pace out 50 feet from tree to a point free of obstructions and level with tree. – Look at tree and decide at what point last cut will be made (merchantable height). – Hold stick <u>vertically</u> 25 inches from eye. – Move stick up and down until lower end is even with line of sight of stump height. – <u>Without moving head</u>, shift your eyes upward to the point where you decide the last cut will be made. – Point where line of sight passes the stick amounts to a reading in terms of 16 foot logs. (Make sure stick is held vertically and not tilted backward or forward.) Computing volume of standing trees 1. Diameter at breast height (d.b.h.) and merchantable height are used to compute tree volume. 2. Board foot volume table a. Read diameter breast height (d.b.h.) down left column b. Read merchantable height across top row c. Point of intersection = board foot volume of tree 3. The cord volume table is read the same way as the one above but results in estimation of cordwood volume.
Application	Other activities: 1. Have students break into teams and measure trees on school grounds to determine stacks of cordwood or logs. 2. Have students measure the tallest tree at their home or farm.

Instructor Directions	Content Outline
Closure/Summary	Whether measuring trees or logs for sawlogs or cordwood, a fast estimation of the volumes of wood products may be obtained by finding the diameter, the length, and using the appropriate log rule or volume table.
Evaluation: Quiz	Answers: 1. a 2. 65 board feet 3. 4-1/2 4. 279 board feet 5. 12 6. 25 7. a 8. d

Board Foot Volume of Trees* by Diameter and Height Classes

International Rule – Form Class 76

D.B.H. (inches)	Number of 16-Foot Logs in Trees						
	1/2	1	1-1/2	2	2-1/2	3	3-1/2
	. . . . . volume in board feet						
10	21	34	44	55			
12	30	52	68	85	98		
14	42	74	99	124	143	162	
16	59	100	134	169	198	226	246
18	74	129	175	221	259	297	325
20	92	162	220	279	328	377	413
22	112	198	271	344	406	467	514
24	133	237	326	415	491	567	622
26	158	284	392	500	592	684	755
28	187	331	458	585	696	806	888
30	220	381	529	677	805	933	1,029
32	254	435	606	776	926	1,077	1,192
34	291	493	687	881	1,054	1,227	1,359
36	333	559	782	1,006	1,205	1,404	1,557
38	374	624	874	1,125	1,354	1,582	1,754
40	415	693	974	1,256	1,510	1,764	1,962

*For estimating board feet in standing trees.

Credit: *How to Measure Trees and Logs,* University of Missouri Extension Guide G5050.

International 1/4-Inch Log Rule Table

Diameter of Log Small Ends, Inside Bark (inches)	Length of Logs (feet)				
	8	10	12	14	16
	board feet				
6	10	10	15	15	20
7	10	15	20	25	30
8	15	20	25	35	40
9	20	30	35	45	50
10	30	35	45	55	65
11	35	45	55	70	80
12	45	55	70	85	95
13	55	70	85	100	115
14	65	80	100	115	135
15	75	95	115	135	160
16	85	110	130	155	180
17	95	125	150	180	205
18	110	140	170	200	230
19	125	155	190	225	260
20	135	175	210	250	290
21	155	195	235	280	320
22	170	215	260	305	355
23	185	235	285	335	390
24	205	255	310	370	425
25	220	280	340	400	460
26	240	305	370	435	500
27	260	330	400	470	540
28	280	365	430	505	585
29	305	385	465	545	630
30	325	410	495	585	675

Credit: *How to Measure Trees and Logs,* University of Missouri Extension Guide G5050.

Cord Volume Table

D.B.H. (inches)	Height in Number of 8-Foot Bolts					
	1	**2**	**3**	**4**	**5**	**6**
	. . . . . volume in cords – unpeeled					
6	.02	.03	.04	.06	—	—
8	.03	.05	.07	.09	.12	.14
10	.05	.07	.10	.13	.17	.20
12	.07	.10	.14	.18	.22	.27
14	.10	.13	.18	.23	.29	.35
16	.12	.17	.22	.29	.36	.44
18	—	.20	.27	.35	.44	.53
20	—	.25	.32	.42	.52	.63

Taken from Technical Note 202, Lake States Forest Experiment Station, University Farm, St. Paul, Minnesota, 1943. Volume is stem volume above 1 foot stump in standard unpeeled cords (standard cord is 4′ x 4′ x 8′). Height is number of usable 8-foot bolts to a variable top diameter, not less than 4 inches inside the bark.

Measuring Diameter at Breast Height and Merchantable Height

Measuring Diameter at Breast Height (d.b.h.)

Diameter measurements of standing timber are made at breast height, which is 4-1/2 feet above the ground, because this is above the swell of the base of most trees.

The two most frequently used instruments to measure tree diameter are the diameter tape and the cruising stick. The diameter tape shows tree diameter by measuring circumference. It is based on the fact that circumference of a circle is equal to the circle's diameter multiplied by 3.14. Consequently, each division on the tape is 3.14 inches apart with each division representing 1 inch in the tree's diameter. The diameter tape is wrapped around the tree at breast height, and the diameter is read directly from the tape.

The cruising stick does not measure as accurately as the diameter tape but is much faster. It is based on a system of similar triangles (identical angles but different side lengths) to determine the distances on the stick which correspond to each inch in diameter.

To use the cruising stick, hold it horizontally 25 inches from your eye (about arm's reach for the average person) against the tree at breast height (4-1/2 feet above the ground). Be sure you have the "diameter measurement" side (front) of the stick toward you and not the log scaling side (back). Line up the zero end with the outside of the tree. Then without moving your head, and using only one eye, look at the other side of the tree and read the figure nearest to where your line of sight crossed the stick and the edge of the tree. That number is the estimate of the tree's diameter at breast height. <u>It is important to move your eye instead of your head, or your reading will not be correct.</u> If the tree is not round, take another reading at a right angle to the first, and average the two readings.

Measuring Merchantable (Usable) Height

Individual tree height normally is measured from a 6-inch stump to a point on the stem beyond which salable sawlogs or other products cannot be cut. For sawlogs (16-foot log) the merchantable height is usually measured to a top diameter of not less than 8 inches. Cordwood (short logs – called "bolts") may be figured to about a 4-inch diameter. It is important to note that the merchantable top may occur at a point lower on the trunk than previously mentioned if merchantability is limited by forking, larger branches, or deformity.

To measure height, use that portion of the front of your cruising stick marked off as "number of 16-foot logs."

1. Starting with your heel at the base of the tree, pace out a distance of 50 feet. Pace toward an opening which will allow you to see the tree you are measuring. Do not pace up or down hill any more than necessary, but try to stay as nearly on the same level as the base of the tree as possible.
2. Decide where the last cut will be made when the tree is cut into logs (merchantable height of the tree).
3. Hold the stick 25 inches from your eye (arm's length for the average person), but in a vertical position. Be sure the side of the stick with the "number of 16-foot logs" is toward you.
4. Move the stick up or down until the lower end is even with your line of sight to the stump height (12 inches above ground) on the tree.
5. Without moving your head, shift your vision upward to the point which you decided was the last cut of the tree. The point where your line of sight passes the stick amounts to a reading in terms of 16-foot logs. Be sure the stick is in a vertical position and not tilted forward or backward. Make your reading to the nearest half-log.

If it is necessary to go farther than 50 feet for a clear view of the tree, you may pace twice the distance and then double the reading obtained from the stick. After a little practice in timber cruising, you will find that you do not need to measure the merchantable heights of all trees. Foresters usually measure a few during a day of cruising just to "check their eye," but most of the height estimating is done by eye rather than by measurement when tallying saw timber.

Course	Agricultural Science II
Unit	Forestry
Lesson	Timber Stand Improvement (TSI) Principles
Estimated Time	Two 50-minute blocks

Student Outcome

Analyze how timber stand improvement (TSI) can improve forest production.

Learning Objectives

1. Describe timber stand improvement (TSI).
2. Identify practices involved in TSI.
3. Identify how sprouts are selected in preparing a site for natural reproduction.
4. Identify how trees are removed when practicing thinning and release.

Grade Level Expectations

SC/EC/1/A/09-11/a SC/EC/1/A/09-11/b SC/EC/1/B/09-11/b

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. Handout
   - HO 1 – Tree Spacing by Diameter
2. *Forestry* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1986.
3. *Forestry Curriculum Enhancement.* University of Missouri-Columbia: Instructional Materials Laboratory, 2008.

Supplemental Information

1. Internet Sites
   - ❑ Are You Interested in Making $1000 per Hour, in Your Woods? Krecik Forestry Consulting Services. Accessed May 28, 2008, from http://krecik.com/forestry/TSI.htm.
   - ❑ Moving Toward Sustainable Forestry: Strategies for Forest Landowners. Virginia Cooperative Extension. Accessed May 28, 2008, from http://www.ext.vt.edu/pubs/forestry/420-144/ch3.html.
2. Print
   - ❑ Kurtz, W.B., and Carol B. Trokey. *Determining the Profitability of Timber Stand Improvement Investments* (Guide G5151). Columbia: University of Missouri Extension, reviewed 1993. Accessed June 4, 2008, from http://extension.missouri.edu/xplor/agguides/forestry/g05151.htm.
   - ❑ Palmer, B., and J. McKee (ed.). *Forest Management for Missouri Landowners.* Jefferson City: Missouri Department of Conservation, revised 2003. Accessed June 4, 2008, from http://www.mdc.mo.gov/documents/forest/private/forest_manag.pdf.

- Slusher, J.P., H.E. Garrett, C. Solomon, and I.L. Sander. *Increase Woodland Products Through Timber Stand Improvement* (Guide G5150). Columbia: University of Missouri Extension, reviewed 1993. Accessed June 4, 2008, from http://extension.missouri.edu/xplor/agguides/forestry/g05150.htm.

Interest Approach

The average Missouri woodland contains about 20 percent cull trees and produces at less than one-third of its potential. Through the practices of timber stand improvement, woodlands can more effectively reach their potential.

Communicate the Learning Objectives

1. Describe timber stand improvement (TSI).
2. Identify practices involved in TSI
3. Identify how sprouts are selected in preparing a site for natural reproduction.
4. Identify how trees are removed when practicing thinning and release.

Instructor Directions	Content Outline
Objective 1 *Ask students to discuss what timber stand improvement is.*	**Describe timber stand improvement (TSI).** TSI denotes management practices that improve the vigor, productivity, and quality of stands of trees. TSI programs may improve the following resources. 1. Value of timber products 2. Water 3. Recreation 4. Forage 5. Wildlife 6. Natural beauty In most cases, more than one woodland use will benefit from a TSI practice.
Objective 2 *Discuss with students the five practices involved in TSI. Let the students give their ideas. List these practices on the board. Or visit a woodlot and have students suggest what TSI principles might be applied.*	**Identify practices involved in TSI.** Site preparation for natural reproduction in understocked stands 1. Preparing site allows a. Natural reseeding b. Resprouting of desirable species 2. May involve interplanting seedling stock a. Fully using the available growing space b. Improvement of the type of trees found in the stand Thinning 1. Thinning – cutting trees from a young stand, thus improving growth of remaining trees

Instructor Directions	Content Outline
	2. Trees compete for a. Light (most important) b. Soil moisture c. Nutrients 3. Spacing a. Varies depending on the species, purpose of management, and quality of the site b. Spacing for trees of various diameters at breast height (d.b.h.) Release 1. Cut or remove undesirable trees to encourage fast growth and better quality of desirable trees. 2. Different types of trees may be removed. a. Cull trees – Rotten – Diseased – Fire scarred – "Wolf trees" b. Trees of inferior species which interfere with selected desirable trees 3. Goals may conflict and therefore must be well established. a. If plans include hunting – removing all cull trees may be removing wildlife habitat. b. Removing "wolf" or trees of non-commercial species may remove habitat and interfere with esthetic value. Pruning 1. Removing limbs from trees to produce knot-free lumber. 2. Pruning can improve lumber grades by 60 percent. 3. Pruning can be expensive; prune only selected hardwoods with high return value. 4. Pruning principles include the following. a. Don't remove too much leaf surface of young trees. (At least two-thirds of food-producing leaf surface should be left.) b. Trees should be pruned before they reach 8 inches in diameter. c. Limbs being removed should be less than 2 inches in diameter.

Instructor Directions	Content Outline
	– Reduces wound size – Assists proper closing – Lessens the impact of entry of diseases and insects d. Make pruning cuts close to, but not into, the limb collar of the tree. – Make a smooth cut. – Use sharpened hand saw. Vine removal 1. Vines may do considerable damage to trees (especially young trees). 2. Retain some vines if they provide wildlife food or fall color. 3. Remove vines carefully. a. Cut as low to the ground as possible. b. Immediately treat the vine stump with herbicides.
Objective 3 *Discuss with students how sprouts are selected and how undesirable sprouts are removed. An alternate method is to visit a woodlot area and find examples of sprouts for removal.*	**Identify how sprouts are selected in preparing a site for natural reproduction.** Importance of sprout selection 1. Many Missouri hardwoods species sprout heavily from stumps of cut trees. 2. Sprouts grow rapidly into multi-stemmed clumps. 3. Sprouts can be used economically. Kinds of sprouts 1. Seedling sprouts a. Originate from several seedlings b. As good as seedling tree if cut to one stem 2. Tree stump sprouts a. Originate from older trees b. Less desirable than seedling sprouts c. Can develop into good quality trees depending on – Size of stump – Point of origin of sprout Managing sprouts 1. Best managed before 20 years of age – permits better selection from the standpoint of

Instructor Directions	Content Outline
	a. Attachment b. Size of parent stump c. Lessens danger from decay 2. General principles for sprouts 20 years old or less than 3 inches in diameter a. Favor the lower sprout; cut high sprouts. b. Preserve sprout from small stump rather than large stump. c. Remove attached sprout with a flush smooth cut. d. Cut well separated surplus sprouts at any convenient height. 3. General principles of treating sprouts over 20 years old or more than 3 inches in diameter a. Companion sprouts joined at base with a V-shaped crotch should not be cut (difficult to cut without leaving a large wound). b. Companion sprouts with a low U-shaped crotch between them or entirely separated can be removed.
Objective 4 *Ask students to discuss methods of removing trees from competition. List methods on the board and let students give their ideas. Refer to HO 1.* HO 1 – Tree Spacing by Diameter	**Identify how trees are removed when practicing thinning and release.** Thinning – cutting trees from a stand to increase the rate of growth and improve the form of remaining trees Release – removing or deadening undesirable older overtopping growth and quality of young, desirable trees Methods for removing trees when using the TSI practice of thinning or release 1. Timber sale (improvement harvest) a. A great amount of TSI can be accomplished where merchantable trees which are too closely spaced are thinned and sold. b. Some culled trees may be used for firewood. 2. Mechanical methods of removing undesirable trees a. Cutting b. Girdling c. Brush hogging (rarely used) 3. Chemical control a. Often more economical than felling b. More certain of killing trees than girdling c. Controlled resprouting

Instructor Directions	Content Outline
	d. Possible injury to other crops by silvicides and herbicides – Chemicals must be applied with caution. – Always read the label and use the chemical according to label recommendations. e. Methods of applying chemicals – Frilling or mechanical injection • Cuts are made into bark completely around tree. • Suitable chemical is applied to fresh cuts • Mechanical injectors apply chemical at the time they make the cuts. • Hard to kill species (such as ash, maple, or persimmon) must have a continuous cut well into sapwood. – Basal Spraying • This method is used effectively on trees less than 4 inches in diameter. • Spray chemical mixture on lower 12 inches of the trunk, wetting bark thoroughly.
Application	Other activities: 1. Visit a woodland where TSI principles have been used. 2. Assign students as individuals or in teams, to make up a TSI plan for a given woodlot. 3. Have a local TSI contest involving a 2-acre site.
Closure/Summary	You can increase the financial return from a stand of Missouri forest land by improving tree quality and woodland composition. Timber stand improvement (TSI) includes a broad range of practices: site preparation, thinning, release, pruning, and vine removal. Free technical service is available to help you with your TSI plan through local district foresters of the Missouri Department of Conservation.
Evaluation: Quiz	Answers: 1. a. Value of timber products b. Water c. Recreation d. Forage e. Wildlife f. Natural beauty

Instructor Directions	Content Outline
	2. a. Site preparation for natural reproduction in understocked stands b. Thinning – cutting trees from young stand to improve growth of remaining trees c. Release – cutting or removing undesirable older overtopping growth to encourage fast growth of desirable trees d. Pruning – removing limbs from trees to produce knot-free lumber e. Vine removal – cutting vines as close to the ground as possible 3. 20 years, 3 inches 4. a. Timber sale b. Cutting c. Brush hogging d. Girdling e. Chemical control

Tree Spacing by Diameter

Tree Diameter (inches)	Spacing Range (feet)	Tree Diameter (inches)	Spacing Range (feet)
2	4.6 – 6.5	9	14.3 – 18.7
3	6.1 – 8.2	10	15.6 – 20.4
4	7.6 – 9.9	11	17.0 – 22.1
5	9.0 – 11.6	12	18.1 – 23.8
6	10.3 – 13.4	13	19.4 – 25.6
7	11.6 – 15.0	14	20.8 – 27.2
8	13.0 – 17.0	15	21.9 – 29.0

Certain species or management purposes may require other spacing. In any thinning, the tallest desirable trees are usually favored.

Source: *Even-Aged Silviculture for Upland Central Hardwoods,* by B.A. Roach and S.F. Gingrich, Agriculture Handbook 355. Upper Darby, PA: USDA, Forest Service, Northeastern Forest Experiment Station, 1968.

Course	Agricultural Science II
Unit	Forestry
Lesson	Growing and Marketing Christmas Trees
Estimated Time	Two 50-minute blocks

Student Outcome

Identify the factors to consider in growing and marketing Christmas trees.

Learning Objectives

1. Identify considerations before growing Christmas trees.
2. Identify the busy times of the year for growing Christmas trees.
3. Identify some common methods of marketing Christmas trees.
4. Identify some species used for Christmas trees.
5. Identify the cultural requirements for Christmas trees.
6. Describe how to shape Christmas trees.

Grade Level Expectations

SC/LO/2/B/09-11/c

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
   - ☐ PPt 1 – Christmas Tree Shaping
   - ☐ PPt 2 – Shearing Christmas Trees
2. *Forestry* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1986.
3. *Forestry Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2008.

Supplemental Information

1. Internet Sites
   - ❑ Christmas Tree Marketing. University of Maine Cooperative Extension. Accessed May 28, 2008, from http://www.umext.maine.edu/onlinepubs/htmpubs/7009.htm
   - ❑ Growing Christmas Trees in Michigan. Michigan State University Extension. Accessed May 28, 2008, from http://www.for.msu.edu/extension/ExtDocs/xmastree.htm.
2. Print
   - ❑ Dwyer, J.P., W.B. Kurtz, and R.L. Plain. *Maintaining Woodland Tax Records* (Guide G740). Columbia: University of Missouri Extension, revised 1993. Accessed June 4, 2008, from http://extension.missouri.edu/xplor/agguides/agecon/g00740.htm.
   - ❑ Godsey, L.D. *Agroforestry in Action: Tax Considerations for the Establishment of Agroforestry Practices.* Columbia: Center for Agroforestry, 2007. Accessed June 4, 2008, from http://www.centerforagroforestry.org/pubs/agrotaxcons.pdf.

Interest Approach

Christmas trees can be grown on suitable sites in all parts of Missouri, and Christmas tree production can be a profitable enterprise. A 6-foot Christmas tree wholesales for $6 to $8. If 600 trees are produced per acre, the total gross income from 1 acre would be $3,600–$4,800.

Communicate the Learning Objectives

1. Identify considerations before growing Christmas trees.
2. Identify the busy times of the year for growing Christmas trees.
3. Identify some common methods of marketing Christmas trees.
4. Identify some species used for Christmas trees.
5. Identify the cultural requirements for Christmas trees.
6. Describe how to shape Christmas trees.

Instructor Directions	Content Outline
Objective 1 *Discuss with students some considerations to make before growing Christmas trees. List all of the considerations students think of on the board.*	**Identify considerations before growing Christmas trees.** 1. Plantation production of Christmas trees is a young and dynamic business in Missouri. (New equipment, methods, and problems continue to evolve.) 2. The long term investment in Christmas trees will not be realized for 5 to 7 years. 3. The seasonal nature of the work and whether or not the grower can spare the time required. 4. If labor is available for planting, weed control, pruning, shearing, and harvest. 5. Where and how large the potential markets are. 6. Which species and varieties are best. 7. If the planting site is suitable for Christmas tree species. 8. It is essential to keep accurate records for tax management.
Objective 2 *Discuss with students the busy times of the year for growing Christmas trees. Write their answers on the board.*	**Identify the busy times of the year for growing Christmas trees.** 1. Planting season – March until mid-April for most of Missouri 2. Pruning and shearing – June to mid-July 3. Harvest – late fall through December 4. Sales a. Develop a sales program at least 1 year prior to first harvest (for a new grower). b. Harvesting and marketing procedures must be firmly set by August, regardless of how trees are sold.

Instructor Directions	Content Outline
Objective 3 *Discuss with students the various marketing options available in the Christmas tree industry. Discuss the advantages and disadvantages of both.*	**Identify some common methods of marketing Christmas trees.** Factors influencing where and how Christmas trees are marketed 1. Grower's sales personality 2. Personnel available 3. Quality of the crop 4. Size of harvest 5. Location relative to population Methods of marketing 1. Growers retail trees directly to consumer. a. Highest per tree profits b. Very demanding on time c. Success hinges on – Improved services – Adequate parking – Location (near population center) – Quality trees – Good display – Prompt and courteous sales d. Common method – "choose and cut" – Customer selection, cutting, and carrying tree from plantation – Often pays same or nearly same price as at retailer's 2. Growers wholesale their trees. a. Trees harvested by grower b. Sold to organizations operating retail lots c. Lower returns per tree for grower and less risk than "choose and cut" 3. Grower sells stands of trees. a. Selling wholesale lots of trees standing in the plantation b. "Stumping sale" c. Cutting and transportation usually done by the buyer d. Lowest gross return to grower of the three methods, but less risk and reduced cost due to no harvest or transport

Instructor Directions	Content Outline
	Factors affecting success (regarding of method) 1. Quality – Annually there is an abundance of trees, but quality trees are always in shortage. 2. Maintaining consistent production a. Must supply an established market yearly b. Must balance size classes of trees – Plantings must provide both the number of trees needed by customers each year as well as the size classes they desire. (Since the trees will not all grow at the same rate or respond equally to shearing, each acre planted will not be totally removed during the first year of harvest.)
Objective 4 *Discuss with students the two common Christmas tree species. Refer them to the Student Reference for species descriptions. Get students' ideas on the pros and cons of each species. List them on the board.*	**Identify some species used for Christmas trees.** Scotch pine 1. Leading Christmas tree nationally 2. Excellent for a Missouri Christmas tree species 3. Marketable size in 5 to 10 years Eastern white pine 1. Straight, symmetrical, high quality tree 2. Poor survival rate first year after planting 3. Salable size 6 to 10 years after planting 4. More difficult to shear properly 5. More susceptible to deer damage Other species sometimes used for Christmas trees in Missouri 1. Jack pine 2. Douglas fur 3. Blue spruce 4. White spruce 5. Red cedar 6. Red pine Seedlings may be obtained from the State Forestry Nursery at Licking, Missouri, and other private sources. (See Lesson 3 for information on ordering.)
Objective 5 *Discuss the cultural requirements of Christmas trees with students. List students' answers on board*	**Identify the cultural requirements for Christmas trees.** Soil requirements 1. Use lands with soil types from sand to silty clays. 2. Avoid constantly wet or flooded areas.

Instructor Directions	Content Outline
and guide them to elaborate on the specific needs of Christmas trees.	3. Avoid high fertility. a. High fertility increases weed problems. b. Christmas tree species perform adequately at relatively low nutrient levels. Site preparation 1. Create open ground 30 to 40 feet from tree borders. 2. Convert open ground from brushy land. a. Clear area of vines, brush, stumps. b. Possibly rip cleared ground with subsoil plow (removing hardwood root systems). c. Chemically treat sprouts. d. Converting such areas is costly. 3. Convert open ground from land covered with sparse, shallow rooted grasses. a. Contour plow bands about 3 feet wide. b. Disk 3 foot bands. c. An alternative to plowing is to use a post-emergent herbicide. 4. Site preparation should be done about 1 year ahead of planting. Spacing 1. Christmas tree spacing ranges from 5 feet x 9 feet to 6 feet x 10 feet. 2. Leave ample space at ends of rows for turning mowers and other equipment. Control of competing vegetation 1. Mow rows routinely. a. More light and nutrients b. Less fire hazard c. Less rodent damage d. Easier control of sprouts e. Better working conditions 2. Control vegetation near trees. a. Removal by hand b. Chemical control 3. Do not plow after planting. (Shallow disking in rows can be useful.)

Instructor Directions	Content Outline

	Other protection problems
	1. Livestock must be kept out.
	2. Deer populations must be controlled.
	3. Rodents often girdle trees.
	  a. Use recommended rodenticides **according to the labels**. (Often you must have special licensing for use.)
	  b. Tree wrap guards may be used.
	4. Insects and disease can injure trees.
	  a. Tip moths
	  b. Sawflies
	  c. Mites
	  d. Needlecast disease
	5. Fire is the number one hazard.
	  a. Design access roads and borders as fire breaks.
	  b. Mow routinely
	6. Hail
	7. Winter injury
	8. Drought

Objective 6
 	
Examine Christmas trees in the school lab or at a local Christmas tree farm and discuss with students the method of shaping Christmas trees. Refer to PPt 1 and PPt 2.
 	
☐ PPt 1 – Christmas Tree Shaping
 	
☐ PPt 2 – Shearing Christmas Trees
	Describe how to shape Christmas trees.
	
	Ideal tree shape – a cone 2/3 as wide as it is high
	Example: A 6-foot tree should have a 4-foot circular base.
	
	Tools
	1. Shearing knife used most commonly
	2. Hedge shears with 8- to 10- inch blades (used for overall shaping)
	3. Anvil type hand pruners (used for making internal cuts or thinning whorls of limbs)
	
	When to shape
	1. Begin when trees are 2 to 3 feet tall.
	2. Trees should be shaped every year thereafter.
	3. Pine shaping should be done early in the growing season. (June 1 to July 15)
	
	Objectives of shaping
	1. Control height growth
	  a. Cut terminal leader back to 12 to 14 inches.
	  b. Make terminal leader cut at a 45° angle.

Instructor Directions	Content Outline
	2. Eliminate extra leaders. a. Leave the best leader that is straight, and remove the others. b. This is especially important during the first shearing. 3. Remove or conceal branch deformities. a. Remove crooked, crossed, or otherwise deformed branches while young. b. "Tree trainers" (manufactured commercially) or tape which will disintegrate within 1 or 2 years can hold unruly branches in position until they assume better growth habits. 4. Develop uniform taper and density. a. After leader and terminal whorl are shaped, work around each tree and shear lateral limbs as necessary to bring the tree to the desired form and taper. b. Confine shearing to current year's growth.
Application	Other activities: 1. Visit a Christmas tree farm in your area. 2. Demonstrate shearing or have students practice shearing on trees brought into the school lab.
Closure/Summary	Growing Christmas trees can be a profitable enterprise, but many considerations go into the decision to grow trees. Understanding considerations such as delayed returns, marketing potential, site suitability, labor needs, species, and cultural requirements are important before becoming a Christmas tree grower.
Evaluation: Quiz	Answers: 1. a. Long term investment b. Seasonal nature of work c. Labor needs d. Size and location of potential markets e. Best species and varieties f. Planting site should be suitable for Christmas trees g. Producing Christmas trees is a new industry in Missouri. 2. Answers should include any two of the following: Planting season from March until mid-April; pruning and shearing from June to mid-July; harvest in late fall; sales in December

Instructor Directions	Content Outline
	3. a. Grower retails trees directly to consumers. (This gives the highest returns to grower but is the most time consuming.) b. Growers wholesale their trees. (Trees are harvested by growers but sold to organizations operating retail sales.) c. Grower sells stand of trees – "stumping sale." (Wholesale lots of trees are sold while standing in plantation.) 4. a. Scotch pine – reaches marketable size in 5 to 10 years; grows well in Missouri b. Eastern white pine – straight, symmetrical, high-quality tree 5. Fire – mow routinely; design access roads and borders as fire breaks 6. a. Mowing b. Removal by hand c. Chemical control 7. 6 feet 8. a. Control height b. Eliminate extra leaders c. Remove or conceal branch deformities d. Develop uniform taper and density

Course	Agricultural Science II
Unit	Forestry
Lesson	Producing Walnut Timber
Estimated Time	Two 50-minute blocks

Student Outcome

Describe the principles of walnut production.

Learning Objectives

1. Distinguish why walnut trees should be grown in Missouri.
2. Identify what TSI practices are beneficial in walnut production.
3. Identify if walnut trees should be planted and if so, how they are planted.
4. Identify some common defects that lower the value of walnut timber and how they can be prevented.
5. Describe how to sell timber.

Grade Level Expectations

SC/LO/2/B/09-11/c SC/EC/1/A/09-11/a SC/EC/1/A/09-11/b

SC/EC/1/B/09-11/b

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. *Forestry* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1986.
2. *Forestry Curriculum Enhancement.* University of Missouri-Columbia: Instructional Materials Laboratory, 2008.

Supplemental Information

1. Internet Sites
   - ❑ Walnut Varieties for Home Production. The Natural Food Hub. Accessed May 28, 2008, from http://www.naturalhub.com/grow_nut_cultivars_walnut.htm.
   - ❑ Walnuts for Timber Production. The Walnut Tree Company. Accessed May 28, 2008, from http://www.walnuttrees.co.uk/timber_home.htm.
2. Print
   - ❑ Holland, I.I., G.L. Rolfe, and D.A. Anderson (ed.). *Forests and Forestry.* 5th ed. Danville, IL: Interstate Publishers, 1997.
   - ❑ Schlesinger, R.C., and D.T. Funk. *Manager's Handbook for Black Walnut.* St. Paul, MN: USDA Forest Service, North Central Forest Experiment Station, 1977.

Interest Approach

Missouri is one of the leading states for walnut production. It has many good sites for walnut production. Using proper principles, walnut production can be a highly profitable enterprise.

Communicate the Learning Objectives

1. Distinguish why walnut trees should be grown in Missouri.
2. Identify what TSI practices are beneficial in walnut production.
3. Identify if walnut trees should be planted and if so, how they are planted.
4. Identify some common defects that lower the value of walnut timber and how they can be prevented.
5. Describe how to sell timber.

Instructor Directions	Content Outline
Objective 1 *Discuss with students the reasons why an individual might consider producing walnuts in Missouri. Write their ideas on the board.*	**Distinguish why walnut trees should be grown in Missouri.** Missouri is a leading state in walnut production. 1. Many Missouri soils are ideal for walnut production. 2. Many established stands exist throughout the farmlands of Missouri, ready to have their potential tapped. 3. Walnuts have a higher return per board foot than any other North American timber. 4. Marketable quantities can be grown in a small area. (One truckload and occasionally one tree makes a salable volume.) 5. While growing to salable size, walnuts produce a nut crop which is valuable for home and commercial use. 6. Even trees grown from seed, or seedling walnuts which are properly maintained, can produce a timber crop within the lifetime of the grower. 7. Walnut trees add to a farm's capital value and make it a more attractive place to live.
Objective 2 *Discuss with students the TSI (timber stand improvement) principles that they feel would be beneficial to walnut production. List their ideas on the board.*	**Identify what TSI practices are beneficial in walnut production.** 1. Because of the high value of walnuts per board foot, all practices of TSI are beneficial and essential to profitable timber production. 2. Particular attention should be paid to pruning. a. Be careful not to tear long strips of bark down the tree. To prevent this, double-cut the heavier limbs. That is, cut the heavy limbs off a foot or so from the trunk with the first cut then remove the

Instructor Directions	Content Outline
	remaining stubs at the limb collar with the second cut. b. Pruning is best done during the dormant season, in winter or early spring, to reduce the incidence of disease and insects. c. Continue to prune until at least a 9-foot clear stem has been developed. 3. Also protect trees from the following conditions: a. Fire – Plow a firelane around timber where it adjoins highways, railroads, and grasslands. b. Pasturing – Grazing by livestock compacts soil and retards growth, while browsing damages young trees. c. Fencing – Keep these high value trees free of metal. Do not use walnuts as fenceposts.
Objective 3 *Discuss with the students the pros and cons of planting walnuts. List their ideas on the board. Explain the procedure for planting walnuts from seeds and by using tree seedlings.*	**Identify if walnut trees should be planted and if so, how they are planted.** 1. Planting a stand of walnuts is an excellent long term "time certificate" to be withdrawn many years down the road. 2. Planting in existing stands is important in order to replace trees which are harvested and to fully utilize forested areas. 3. It is important to plant walnuts only on good ground. a. Walnuts grow best in deep, well-drained fertile soil. b. Soils and growing conditions on north and east slopes are preferred. c. Sandy loam, loam, or silty loam textured soils are best, although silty clay loams can also be well suited. d. Areas with tight subsoils are poor locations. e. Good drainage is important. 4. Good places around the farm to grow walnuts: a. Replacement plantings in existing stands (need at least 1/3 acre opening) b. Unused ground along lanes c. Isolated areas too small to farm d. Stream terraces e. Walnuts can be interplanted with the following species, many of which also provide valuable timber.

Instructor Directions	Content Outline
	– White ash – Red oak – White oak – Sugar maple f. Many landowners are planting walnut rows with spacings wide enough to grow crops or forages between the trees (multi-cropping). 5. Walnuts should be planted in variable spacing schemes. 6. Plant walnut seedlings (For recommended procedures for ordering and planting seedlings, refer to Lesson 3.)
Objective 4 *Discuss with students the defects which lower the quality of walnut timber. Ask students what forest practices might prevent these defects. List their ideas on the board.*	**Identify some common defects that lower the value of walnut timber and how they can be prevented.** 1. Size a. Highest value is in trees 20 inches or larger in diameter. b. To be salable in markets, a tree should contain a log which is at least 8.5 feet in length. 2. Insect damage – Prevent anything that might wound the trunk, including fire damage, pasturing, and careless logging. 3. Crooked logs – Prevent by removing competition which causes walnuts to grow out of shape. 4. Dote or rot – Dote works down from the top of the tree and may extend the full length. Dead and dying branches in tree top, butt scars, other large wounds, and large rotten stubs on trunk often indicate dote. Sell trees as soon as practical. Don't sacrifice other good trees just to make a quick sale. 5. Cat faced knots – These concealed knots are generally more damaging to lumber than a knot from a sound live limb. Prevent them by pruning walnut limbs when small. 6. Lightning cracks – Sell tree immediately following lightning damage. 7. Splits – Prevent by properly felling trees.
Objective 5 *Discuss with students the ways in which walnut timber is sold. Ask students if any have sold timber*	**Describe how to sell timber.** 1. "Lump sum sale" or a price for all the trees to be sold is most common for walnuts. a. Least trouble for seller

Instructor Directions	Content Outline
from their farm or woodlot and what procedures they followed.	– Seller does not have to check measurements. – Receives money before trees have been harvested – Encourages buyer to make maximum use of trees b. Seller must mark trees to be sold. c. Often the buyer will bid more conservatively in this arrangement. 2. Walnuts should be sold by bid. The bid notice should include: a. Seller's name, address, and telephone number b. Location of trees (legal description and directions from nearest town) c. Number of trees to be sold, average diameter, and how they are marked d. Any special sale instructions (cleanup requirements, special periods of time that logging is to be excluded to prevent crop damage, etc.) e. Latest date bids will be accepted (A minimum of one month should be allowed after mailing the bid notice for buyers to examine the sale area.) f. Definite date, time, and place bids will be opened g. Seller has the right to refuse a bid but should not accept verbal or late bids 3. All sales of timber should be covered by a contract. a. Not a sign of distrust but a good business practice b. Can be prepared by a lawyer or with help of a forester (Standard contract forms can be obtained from foresters.) c. No contract covers all circumstances but there are certain basic things it should include. – Names and addresses of buyers and sellers – An accurate legal description of the location of the timber – The number of trees marked and how they are marked – The amount of the purchase price and how it is to be paid – Expiration date of the contract – Other responsibilities of the buyer such as preventing fire, preventing excessive damage

Instructor Directions	Content Outline
	to young timber, and leaving roads, fields, and fences in good repair – Other responsibilities of the seller such as guaranteeing to the buyer the right to sell the timber and granting a right of way and entry into the land for the purpose of harvesting trees d. Two copies signed by both parties should be made (one going to the buyer and one to the seller). 4. It is important to check periodically during the harvest to ensure that the terms of the contract are being met. a. No unmarked trees were cut. b. Fences, roads, and culverts were repaired to be in as good or better condition than before the sale. c. There is no excessive or abnormal damage to the sale area. d. Full payment has been received.
Application	Other activities: 1. Visit a local black walnut farm.
Closure/Summary	Walnuts have the highest return per board foot of any Missouri tree. Using good timber stand improvement practices, careful planting practices, and proper marketing techniques can make walnut production a profitable agricultural enterprise. Free technical assistance is available from foresters from the Missouri Department of Conservation and Extension.
Evaluation: Quiz	Answers: 1. Answers should include at least five of the following points: – Many Missouri soils are ideal for walnuts. – Many established stands already exist. – Walnuts have a higher return per board foot than any other North American timber. – Marketable quantities can be grown in small areas. – While growing to salable size, walnuts produce nut crops. – Walnuts which are properly grown can produce a salable crop within the lifetime of growers.

Instructor Directions	Content Outline
	– Walnuts add to the capital value of a farm and add to its beauty. 2. Pruning 3. a. Replacement plantings in existing stands b. Unused ground along lanes c. Isolated areas too small to farm d. Stream terraces 4. 20 5. a. Names and addresses of buyers and sellers b. Accurate legal description of the location of timber c. Number of trees marked and how they are marked d. The purchase price and how it is to be paid e. Expiration date of contract f. Other responsibilities of the buyer and seller