

Title 7: Education K-12

Part 120: Mississippi Secondary Curriculum Frameworks in Career and Technical Education, Agriculture, Food, and Natural Resources, Forestry



## 2021 Forestry

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The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

# Table of Contents

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Acknowledgments.....	3
Standards.....	5
Preface.....	6
Mississippi Teacher Professional Resources .....	7
Executive Summary .....	8
Course Outlines.....	10
Professional Organizations .....	16
Using This Document .....	17
Unit 1: Exploring the World of Forestry.....	18
Unit 2: Leadership Development .....	19
Unit 3: Forest Safety .....	20
Unit 4: Tree Growth and Stand Development .....	21
Unit 5: Dendrology .....	22
Unit 6: Forest Traversing and Mapping.....	23
Unit 7: Legal Land Descriptions.....	24
Unit 8: Tree and Log Measurements .....	25
Unit 9: Introduction to Timber Cruising.....	26
Unit 10: Identifying Forests and Forest Products .....	27
Unit 11: Employability Skills/Leadership Development.....	28
Unit 12: Forest Management Practices .....	29
Unit 13: Advanced Timber Cruising.....	30
Unit 14: Timber Marketing.....	31
Unit 15: Timber Harvesting.....	32
Unit 16: Reforestation.....	33
Unit 17: Forest Fire Management .....	34
Unit 18: Forest Insects and Diseases .....	35
Student Competency Profile .....	36
Appendix A: Industry Standards.....	37

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# Standards

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Standards and alignment crosswalks are referenced in the appendices. Mississippi's CTE forestry curriculum is aligned to the following standards:

## **National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards**

The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in grades 9-12 and two-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. A complete copy of the standards can be accessed at [thecouncil.ffa.org/afnr/](http://thecouncil.ffa.org/afnr/). The National AFNR Career Cluster Content Standards are copyrighted to the National Council for Agricultural Education and are used by permission.

## **International Society for Technology in Education Standards (ISTE)**

Reprinted with permission from *ISTE Standards for Students* (2016). All rights reserved. Permission does not constitute an endorsement by ISTE.  
[iste.org](http://iste.org)

## **College- and Career-Ready Standards**

College- and career-readiness standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted Mississippi College and Career Ready Standards (MCCRS) to provide a consistent, clear understanding of what students are expected to learn and so teachers and parents know what they need to do to help them.  
[mde.k12.ms.us/mccrs](http://mde.k12.ms.us/mccrs)

## **Framework for 21st Century Learning**

In defining 21st-century learning, the Partnership for 21st Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, and technology skills; and life and career skills. *21 Framework Definitions* (2019).  
[battelleforkids.org/networks/p21/frameworks-resources](http://battelleforkids.org/networks/p21/frameworks-resources)

## Preface

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Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Strengthening Career and Technical Education for the 21st Century Act, 2019 (Perkins V); and Every Student Succeeds Act, 2015).

# Mississippi Teacher Professional Resources

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The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning

Program resources can be found at the RCU's website, [rcu.msstate.edu](http://rcu.msstate.edu).

Learning Management System: An Online Resource

Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, call the RCU at 662.325.2510.

# Executive Summary

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## **Pathway Description**

Forestry is a pathway in the agriculture, food, and natural resources career cluster. This program is designed for students who wish to enter occupations related to the field of forestry. The first-year topics include exploring the world of forestry, leadership/FFA activities, forest safety, tree growth and stand development, dendrology, forest surveying and mapping, legal land descriptions, tree and log measurements, and introduction to timber cruising. The second-year instruction focuses on identifying forests and forest products, employability skills/FFA activities, forest management practices, advanced timber cruising, timber marketing, timber harvesting, reforestation, forest fire management, and forest insects and diseases. Graduates may become employed at the entry level or pursue careers in forestry, agriculture, agribusiness, or natural resources education in postsecondary or higher education.

## **College, Career, and Certifications**

Competencies and suggested performance indicators in the forestry course have been correlated to the National AFNR Career Cluster Content Standards, which have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

## **Grade Level and Class Size Recommendations**

It is recommended that students enter this program as a ninth grader. Exceptions to this are a district-level decision based on class size, enrollment numbers, and student maturity. A maximum of 15 students is recommended for both classroom- and lab-based courses.

## **Student Prerequisites**

For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
  2. C or higher in high school-level math (last course taken or the instructor can specify the level of math instruction needed)
  3. Instructor approval and TABE reading score (eighth grade or higher)
- or**
1. TABE reading and math score (eighth grade or higher)
  2. Instructor approval
- or**
1. Instructor approval

## **Assessment**

The latest assessment blueprint for the curriculum can be found at [rcu.msstate.edu/curriculum/curriculumdownload](http://rcu.msstate.edu/curriculum/curriculumdownload).

## **Applied Academic Credit**

The latest academic credit information can be found at [mdek12.org/ese/approved-course-for-the-secondary-schools](http://mdek12.org/ese/approved-course-for-the-secondary-schools).



**Teacher Licensure**

The latest teacher licensure information can be found at [mdek12.org/oel/apply-for-an-educator-license](http://mdek12.org/oel/apply-for-an-educator-license).

**Professional Learning**

If you have specific questions about the content of any of training sessions provided, please contact the RCU at 662.325.2510.

# Course Outlines

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## **Option 1—Four 1-Carnegie Unit Courses**

This curriculum consists of four 1-credit courses, which should be completed in the following sequence:

- 1. Forestry Introduction—Course Code: 991502**
- 2. Forestry Surveying and Measurements—Course Code: 991503**
- 3. Forestry Cruising—Course Code: 991504**
- 4. Forestry Marketing—Course Code: 991505**

### **Course Description: Forestry Introduction**

Forestry Introduction provides the building blocks for knowledge and understanding in forestry. Students will cover topics such as the National FFA Organization, leadership skills, safety, and dendrology. Additionally, students will cover forest surveying and mapping techniques necessary for the next course offering.

### **Course Description: Forestry Surveying and Measurements**

Forestry Surveying and Measurements offers insight into the world of legal documents used in forestry. Students will be well versed in the use of legal land descriptions as well as how to perform tree and log calculations. Students will also be introduced to timber cruising activities.

### **Course Description: Forestry Cruising**

Forestry Cruising examines timber cruise practices more deeply. Students will also be exposed to employability skills and career opportunities in forestry. Additional topics include forest types, products, and management techniques.

### **Course Description: Forestry Marketing**

Forestry Marketing delivers information about timber harvesting, sales, and reforestation techniques. Additionally, students will be exposed to fire management and safety as well as common insect and disease problems encountered in forestry.

**Forestry Introduction—Course Code: 991502**

<b>Unit</b>	<b>Unit Name</b>	<b>Hours</b>
1	Exploring the World of Forestry	7.5
2	Leadership Development	10
3	Forest Safety	20
4	Tree Growth and Stand Development	7.5
5	Dendrology	30
6	Forest Traversing and Mapping	37.5
<b>Total</b>		<b>112.5</b>

**Forestry Surveying and Measurements—Course Code: 991503**

<b>Unit</b>	<b>Unit Title</b>	<b>Hours</b>
7	Legal Land Descriptions	30
8	Tree and Log Measurements	37.5
9	Introduction to Timber Cruising	45
<b>Total</b>		<b>112.5</b>

**Forestry Cruising—Course Code: 991504**

<b>Unit</b>	<b>Unit Name</b>	<b>Hours</b>
10	Identifying Forests and Forest Products	7.5
11	Employability Skills and Leadership Development	7.5
12	Forest Management Practices	45
13	Advanced Timber Cruising	52.5
<b>Total</b>		<b>112.5</b>

**Forestry Marketing—Course Code: 991505**

<b>Unit</b>	<b>Unit Name</b>	<b>Hours</b>
14	Timber Marketing	15
15	Timber Harvesting	20
16	Reforestation	25
17	Forest Fire Management	25
18	Forest Insects and Diseases	22.5
<b>Total</b>		<b>107.5</b>

## Option 2—Two 2-Carnegie Unit Courses

This curriculum consists of two 2-credit courses, which should be completed in the following sequence:

1. **Forestry I—Course Code: 991500**
2. **Forestry II—Course Code: 991501**

### Course Description: Forestry I

Forestry I is designed to introduce students to the forestry industry and careers in Mississippi. The course provides instruction on careers and leadership, forest safety, tree growth and development, dendrology, surveying and mapping, and tree and log measurements. Emphasis is placed on the scientific and technical principles of modern forest management.

### Course Description: Forestry II

Forestry II is a continuation of Forestry I with additional emphasis on forest management, timber cruising, marketing and harvesting methods, reforestation, fire management, and forest pests. Emphasis is placed on scientific and technical principles.

### Forestry I—Course Code: 991500

Unit	Unit Name	Hours
1	Exploring the World of Forestry	7.5
2	Leadership Development	10
3	Forest Safety	20
4	Tree Growth and Stand Development	7.5
5	Dendrology	30
6	Forest Traversing and Mapping	37.5
7	Legal Land Descriptions	30
8	Tree and Log Measurements	37.5
9	Introduction to Timber Cruising	45
<b>Total</b>		<b>225</b>

**Forestry II—Course Code: 991501**

<b>Unit</b>	<b>Unit Name</b>	<b>Hours</b>
10	Identifying Forests and Forest Products	7.5
11	Employability Skills and Leadership Development	7.5
12	Forest Management Practices	45
13	Advanced Timber Cruising	52.5
14	Timber Marketing	15
15	Timber Harvesting	20
16	Reforestation	25
17	Forest Fire Management	25
18	Forest Insects and Diseases	22.5
<b>Total</b>		<b>220</b>

# Career Pathway Outlook

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## Overview

The agricultural and natural resources cluster covers a broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. Forestry covers establishments primarily engaged in the operation of timber tracts, tree farms, or forest nurseries; in the gathering of forest products; or in performing forestry services. Forestry and conservation workers measure and improve the quality of forests. Forest and conservation workers typically work for state and local governments or on privately owned forest lands or nurseries. Governments also employ forest and conservation workers on a contractual basis. According to the MSU College of Forest Resources, forestry is Mississippi's second largest commodity, behind poultry and eggs. Forestry in combination with forest products is even larger and employs a workforce of 69,000 individuals in Mississippi across four sectors: logging, solid wood products, pulp and paper, and wood furniture.

## Needs of the Future Workforce

Data for this synopsis were compiled from employment projections prepared by the U.S. Census Bureau, the U.S. Bureau of Labor Statistics (2019), and the Mississippi Department of Employment Security (2019).

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2016	Projected Jobs, 2026	Change (Number)	Change (Percent)	Average Hourly Earnings (2019)
Conservation Scientists	700	730	30	4.3	\$26.38
First-Line Supervisors of Farming, Fishing, and Forestry Workers	940	990	50	5.3	N/A
Foresters	190	200	10	5.3	\$28.80
Forest and Conservation Technicians	220	230	10	4.6	\$22.79
Forestry and Conservation Science Teachers, Postsecondary	40	50	10	25.0	N/A
Logging Equipment Operators	1,680	1,740	60	3.6	\$18.48

Source: Mississippi Department of Employment Security; [mdes.ms.gov](http://mdes.ms.gov) (2020).

## Perkins V Requirements and Academic Infusion

The forestry curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in fields related to agriculture and natural resources. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for forestry careers. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, the curriculum focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.

## **Transition to Postsecondary Education**

The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, [mccb.edu](http://mccb.edu).

## **Best Practices**

### *Innovative Instructional Technologies*

Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The forestry educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

### *Differentiated Instruction*

Students learn in a variety of ways, and numerous factors—students' background, emotional health, and circumstances, for example—create unique learners. By providing various teaching and assessment strategies, students with various learning preferences can have more opportunity to succeed.

### *CTE Student Organizations*

There are student organizations relevant to this curriculum. Teachers are encouraged to charter one of these organizations if one is not already available to students. The suggested organization for this course is the National FFA Organization. Contact information for this and other related organizations is listed under the Professional Organizations section of this document.

### *Cooperative Learning*

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the forestry curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. This curriculum provides opportunities for students to work together and help each other complete complex tasks, including field experiences that will allow and encourage collaboration with professionals currently in the forestry field.

### *Work-Based Learning*

Work-based learning is an extension of understanding competencies taught in the forestry classroom. This curriculum is designed in a way that necessitates active involvement by the students in the community around them and the global environment. These real-world connections and applications link to all types of students to knowledge, skills, and professional dispositions. Work-based learning should encompass ongoing and increasingly more complex involvement with local companies and forestry professionals. Thus, supervised collaboration and immersion into the forestry industry around the students are keys to students' success, knowledge, and skills development.

# Professional Organizations

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American Association for Agricultural Education (AAAE)

[aaaeonline.org](http://aaaeonline.org)

Association for Career and Technical Education (ACTE)

[acteonline.org](http://acteonline.org)

Mississippi ACTE

[mississippiacte.com](http://mississippiacte.com)

Mississippi FFA/ Mississippi Association of Vocational Agriculture Teachers (MAVAT)

[mississippiffa.org](http://mississippiffa.org)

National FFA Organization

[ffa.org](http://ffa.org)

National Association of Agricultural Educators (NAAE)

[naae.org](http://naae.org)



# Using This Document

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## **Suggested Time on Task**

This section indicates an estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80% of the time in the course. The remaining percentage of class time will include instruction in nontested material, review for end-of-course testing, and special projects.

## **Competencies and Suggested Objectives**

A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

## **Teacher Resources**

Teacher resources for this curriculum may be found in multiple places. Many program areas have teacher resource documents that accompany the curriculum and can be downloaded from the same site as the curriculum. The teacher resource document (TRD) contains references, lesson ideas, websites, teaching and assessment strategies, scenarios, skills to master, and other resources divided by unit. This document could be updated periodically by RCU staff. Please check the entire document, including the entries for each unit, regularly for new information. If you have something you would like to add or have a question about the document, call or email the RCU's instructional design specialist for your program. The teacher resource document can be downloaded at [rcu.msstate.edu/curriculum/curriculumdownload.aspx](http://rcu.msstate.edu/curriculum/curriculumdownload.aspx). All teachers should request to be added to the Canvas Resource Guide for their course. This is where all resources will be housed in the future, if they are not already. To be added to the guide, [send a Help Desk ticket to the RCU](#) by emailing [helpdesk@rcu.msstate.edu](mailto:helpdesk@rcu.msstate.edu).

## **Perkins V Quality Indicators and Enrichment Material**

Many of the units include an enrichment section at the end. If the forestry program is currently using the Mississippi Career Planning and Assessment System (MS-CPAS) as a measure of accountability, the enrichment section of material will not be tested. If this is the case, it is suggested to use the enrichment material when needed or desired by the teacher and if time allows in the class. This material will greatly enhance the learning experiences for students. If, however, the forestry program is using a national certification or other measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be tested. It is the responsibility of the teacher to ensure all competencies for the selected assessment are covered throughout the year.

# Unit 1: Exploring the World of Forestry

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## Competencies and Suggested Objectives

1. Explain the importance of forestry. <sup>DOK1</sup>
  - a. Describe the elements of a forest community, including trees, plants, shrubs, soil, water, and animal life.
  - b. Describe the importance of trees and forests, including products, employment, climate, air quality, erosion, and recreation.
  - c. Describe the amount of forested land worldwide and in the United States, including acres of forestland and acres of commercial land within the local county or regional area.
  - d. Describe the history of forestry, including the importance of forestry to the South and to Mississippi.
  - e. Describe the importance of forests in the South, including growing season, timber inventory, and economic impact.
  - f. Describe resources considered in multiple-use forest management, including timber, soil, wildlife, recreation, and water.
2. Explain careers in the field of forestry. <sup>DOK1</sup>
  - a. Identify the careers available in the field of forestry.
  - b. Describe educational requirements, job opportunities, duties, and responsibilities for professional, technical, and forestry workers.

## Enrichment

### The Forest Community

Divide students into groups and assign one component of the forest community to each group to research, summarize, and prepare a fact sheet and present it to the class. Presentations will be scored based on the presentation rubric in the TRD.

### Forestry Career Paths

Assign each student a career within forestry to investigate and compare educational requirements, job opportunities, and duties and responsibilities. Students will develop a slideshow presentation to the class about their findings. Presentations will be scored based on the presentation rubric.

## Unit 2: Leadership Development

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### Competencies and Suggested Objectives

1. Explain the benefits of FFA participation. <sup>DOK 1</sup>
  - a. Identify FFA organizational activities that promote and recognize achievements in forestry, including career development events, personal development seminars, leadership conferences, national and international exchange programs, education experience with industry, and personal and community development programs.
  - b. Identify the benefits of FFA participation to an individual and to the forestry industry, including personal growth and development, exposure to the forestry industry environment, and multicultural experiences.
  - c. Identify opportunities for members in FFA, including personal development, personal recognition, career exploration, and self-expression.
2. Demonstrate group leadership skills and personal traits. <sup>DOK 2</sup>

• Communication	• Positive self-concept
• Considerate	• Problem-solving
• Cooperation	• Punctuality
• Dependability	• Rational thinking
• Effective listening	• Resilience
• Empathy	• Respect for others
• Enthusiasm	• Responsibility
• Getting along with others	• Responsible use of social media
• Good manners	• Safety conscious
• Honesty	• Self-motivated/determined
• Humility	• Setting priorities
• Interpersonal skills	• Teamwork
• Loyalty	• Trustworthy
• Open-minded	• Work ethic

### Enrichment

Select a local, county, or state FFA officer or alumni to discuss with students the benefits of the FFA. Students will be required to write a report discussing the various benefits following the speaker's presentation. Reports will be scored based on the written report rubric in the TRD.

## Unit 3: Forest Safety

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### Competencies and Suggested Objectives

1. Explain forest safety practices. <sup>DOK 1</sup>
  - a. Describe first aid and first aid equipment used in forestry work.
  - b. Describe job site safety practices, including hazard awareness, safety equipment, safety regulations, prevention of accidents, and appropriate use of personal technology.
  - c. Explain the impact of federal and state safety regulations (such as the Occupational Safety and Health Administration [OSHA]) on forestry operations.
2. Describe forest environmental hazards, including heat, cold, plants, insects, wildlife, and topographical hazards. <sup>DOK 2</sup>
  - a. Identify characteristics of forest insects and wildlife.
  - b. Explain signs and symptoms of exposure to insects and wildlife.
3. Demonstrate forest safety practices. <sup>DOK 2</sup>
  - a. Apply safety practices to environmental, wildlife, and topographical hazards.
  - b. Apply job site safety practices.
  - c. Discuss types and frequency of forest accidents.

### Enrichment

#### Safety is as Safety does

You have been hired to be the safety officer for a large forestry division. As safety officer, you are responsible for monitoring harvesting site safety practices. Using the safety checklist, monitor job site safety practices used in forestry. Make notes about good and bad practices as well as solutions for any problems identified. Safety officers (students) will be scored based on the safety checklist in the TRD.

#### Safety Regulations

Students will develop a poster that shows the various local, county, state, and federal regulations that impact forestry and forest harvesting in Mississippi. Students will be grouped into teams and scored based on the poster rubric in the TRD.

**Note:** Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.

**Note:** This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

## Unit 4: Tree Growth and Stand Development

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### Competencies and Suggested Objectives

1. Explain tree physiology. <sup>DOK2</sup>
  - a. Describe the main parts of a tree, including trunk, crown, and roots along with their functions.
  - b. Describe tree respiration and photosynthesis, including respiration, transfer of water, minerals, nutrients, and production of food.
  - c. Describe environmental and biological factors that affect tree growth, including temperature, moisture, light, air, soil, tolerance, and hardiness.
  - d. Describe the methods of tree reproduction, including sprouts, seeds, and suckers.
  - e. Identify characteristics of tree growth, including height and diameter growth.
2. Explain forest stand development. <sup>DOK2</sup>
  - a. Identify stands according to classifications, including age, size, and composition.
  - b. Identify trees according to crown classes, including dominant, codominant, intermediate, and suppressed.
3. Discuss advances in biotechnology for forestry applications, including grafting, tissue culture, varietals, and genetic improvement. <sup>DOK2</sup>
4. Discuss the carbon cycle in pine plantations. <sup>DOK1</sup>

### Enrichment

#### Tour Guide to the Trees

You are an urban forester for a local school district. You have been asked to teach a forestry seminar to local high school students. Take the class around and identify the factors that affect tree growth, methods of tree reproduction, and characteristics of tree growth forest stand classifications and crown classes using trees on your campus. You will guide the classroom discussion about the tree growth characteristics.

#### Biotechnology Activity

You have been asked to give a lecture to a group of educators (the class) about biotechnology. Research an application of biotechnology in forestry and summarize your findings for presentation to the educators (students). Use the presentation rubric in the TRD.

## Unit 5: Dendrology

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### Competencies and Suggested Objectives

1. Explain the tree classification system. <sup>DOK 2</sup>
  - a. Identify nomenclature and taxonomy terms.
  - b. Identify common names and/or binomial names of trees, including:
    - Loblolly pine—*Pinus taeda*
    - Longleaf pine—*Pinus palustris*
    - Shortleaf pine—*Pinus echinate*
    - Slash pine—*Pinus elliotti*
    - Bald cypress—*Taxodium distichum*
    - Eastern red cedar—*Juniperus virginiana*
    - White oak—*Quercus alba*
    - Southern red oak—*Quercus falcata*
    - Swamp chestnut oak—*Quercus michauxii*
    - Water oak—*Quercus nigra*
    - Cherrybark oak—*Quercus pagoda*
    - Southern live oak—*Quercus virginiana*
    - Mockernut hickory—*Carya tomentosa*
    - Yellow poplar—*Liriodendron tulipifera*
    - Red maple—*Acer rubrum cv.*
2. Identify trees by their characteristics. <sup>DOK 2</sup>
  - a. Describe identifying characteristics and uses of trees, including fruit, leaves, twigs, bark, and tree form.
  - b. Collect leaves, fruit, and/or bark samples of species found locally.

### Enrichment

#### Leaf Collection

Students are to collect, preserve, and display leaves and bark of a minimum of 40 local species. All specimens are to be identified by common and scientific name.

# Unit 6: Forest Traversing and Mapping

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<b>Competencies and Suggested Objectives</b>	
1. Explain concepts of forest traversing. <sup>DOK 2</sup>	<ol style="list-style-type: none"><li>a. Define terms, including bearings, acre, azimuths, chaining, boundary lines, angles, surveying, traversing, latitude, and longitude.</li><li>b. Describe the importance of surveying to forestry, including timber sales, land measurement, boundary marking, and mapping.</li><li>c. Identify characteristics of a forest survey, including use of compass, measuring distances, and mapping.</li><li>d. Identify surveying tools, including compass, chain (metal tape), plumb bob, and range pole.</li><li>e. Label parts of a compass, including magnetic needle, pivot point, housing, graduated degrees, and sighting mirror.</li><li>f. Identify and calculate compass measurements and symbols, including azimuths, bearings, and degrees.</li></ol>
2. Perform forestry surveying and mapping techniques. <sup>DOK 3</sup>	<ol style="list-style-type: none"><li>a. Determine the number of paces per chain using common pacing techniques.</li><li>b. Perform compass, pacing, and chaining skills, including completing a traverse of a selected area.</li><li>c. Describe and utilize new technologies for forest surveying and mapping to include Unmanned Aircraft Systems (UAS), Global Positioning Systems (GPS) and/or Geographic Information Systems (GIS), and remote sensing.</li></ol>
3. Calculate acreage of forest tracts. <sup>DOK 3</sup>	<ol style="list-style-type: none"><li>a. Determine acreage from new technologies, such as UAS, remote sensing, GPS/GIS, and/or Google Maps.</li><li>b. Determine acres from traditional methods such as a traverse or grid system.</li></ol>
<b>Enrichment</b>	
<u>Forest Surveying</u> Your company was hired to survey a forest for a landowner. Demonstrate the proper techniques for pacing, chaining, and traversing within your group. Also, demonstrate the various tools used in surveying. If available, demonstrate the use of GPS in surveying.	

# Unit 7: Legal Land Descriptions

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## **Competencies and Suggested Objectives**

1. Describe the United States Public Land Survey System. <sup>DOK 2</sup>
  - a. Explain and identify the principal meridians, baselines, and initial points used in Mississippi, including location of these lines on a map.
  - b. Define legal land description terms, including bearing, blaze, hack, contour, elevation, legend, plot, sea level, topographic map, and corner markers.
  - c. Explain reasons and importance for land location in forestry, including retrace, location, and layout of boundaries.
2. Identify information found on maps. <sup>DOK 2</sup>
  - a. Interpret information from and demonstrate use of ownership maps.
  - b. Interpret information from and demonstrate use of topographic maps.
  - c. Interpret information from and demonstrate use of GPS/GIS and/or internet map applications.
3. Apply principles of legal land description. <sup>DOK 2</sup>
  - a. Write, read, and locate parcels of land using legal land descriptions.
  - b. Observe the records of timber and land deeds located in the chancery clerk's office.

## **Enrichment**

### Map It Out

As a cartographer (mapmaker), you are required to label the principal meridians, baselines, and initial points on a map of Mississippi. Demonstrate your knowledge of map reading, interpretation, and labeling by completing the assignment for your employer.

### Courthouse Search

As a forester for your local timber company, you need to locate the legal description for a property you are attempting to purchase through a bidding process. Visit your local courthouse and obtain the legal land description for the property in question from the chancery clerk's office. After you have located the document, explain, discuss, and demonstrate how to write, read, and locate parcels of land using legal land descriptions.



# Unit 8: Tree and Log Measurements

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## Competencies and Suggested Objectives

1. Explain tree measurement techniques. <sup>DOK 2</sup>
  - a. Define terms, including board feet, basal area, cord, diameter at breast height (DBH), diameter, diameter inside bark (DIB), diameter outside bark (DOB), form class, 1000 board feet (MBF), merchantable height, sawlog, and sawtimber.
  - b. Identify tools used in taking tree measurements and associate them with their uses, including D-tape, tree stick, bark gauge, tree calipers, wedge prism, clinometer, and increment borer.
  - c. Classify DBH measurements into the correct diameter classes, including 1 and 2 in. classes.
  - d. Demonstrate the correct location of DBH measurements, including trees on level ground, slopes, leaning, forking, and deformed.
  - e. Identify merchantable height, including heights for sawtimber, (10-in. top for hardwood and 8-in. basic top for pine), pulpwood, and specialty products (i.e., pellets, poles, pilings, veneer, etc.).
  - f. Distinguish among the major log rules, including Doyle, Scribner, and International log rules.
  - g. Draw tally symbols, including dot-tally method.
2. Perform volume measurements of standing timber and sawlogs. <sup>DOK 3</sup>
  - a. Determine the volume of standing timber (board foot/cord volume), volume computation from DBH and height measurements and basal area.
  - b. Calculate the board foot of logs, including measuring length and DIB at small end of log to obtain volume and weight scaling of logs for volume.
  - c. Calculate the volume of standing timber using traditional methods and available technology.

## Enrichment

As owner of a forestry consulting firm, you were hired by a landowner to determine the volume of standing timber on their property using traditional methods and/or available technology. In addition to this information, you must measure and tally 10 pulpwood and 10 sawlog trees. From these 20 trees, determine the correct location of DBH measurements and include examples with the following scenarios: level ground, slopes, leaning, forking, and deformed. After these measurements have been taken, calculate the net volume of logs, including measuring length and DIB at small end of log to obtain volume and weight scaling of logs for volume. Return your findings in the form of a typed written proposal to be given to the landowner (instructor).

## Unit 9: Introduction to Timber Cruising

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### **Competencies and Suggested Objectives**

1. Describe procedures for cruising timber. <sup>DOK 2</sup>
  - a. Discuss terms associated with cruising, including basal area, board foot, bole, circumference, cord, cull, DBH, dendrometer, diameter, DIB, DOB, form class, hypsometer, MBF, merchantable height, sawlog, sawtimber, taper, and whorl.
  - b. Describe reasons for conducting a cruise, including management and procurement.
  - c. Describe factors that determine cruise intensity, including acreage, species, timber density, value, and purpose of cruise.
2. Perform a timber cruise. <sup>DOK 3</sup>
  - a. Describe cruising techniques.
  - b. Perform a cruise and volume calculation using traditional methods and/or available technology.

### **Enrichment**

#### Cruising Activity

As a forester for a local company, your assignment is to perform a 100% cruise on a plot of forest. Your performance will be evaluated using the timber cruise rubric in the TRD.

## Unit 10: Identifying Forests and Forest Products

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### Competencies and Suggested Objectives

1. Apply procedures to identify forest types. <sup>DOK 2</sup>
  - a. Define terms associated with forest types.
  - b. Distinguish between softwoods and hardwoods, including all characteristics of hardwoods and softwoods.
  - c. Identify forest regions of the United States on a map, including Pacific Coast, Rocky Mountains, Northern, Central Hardwood, Southern, and Tropical.
  - d. Identify the principal species associated with the forest regions of Mississippi, including oak-pine, oak-gum-cypress, oak-hickory, loblolly pine plantation, loblolly-shortleaf, and longleaf-slash.
2. Apply procedures to identify the physical properties of wood. <sup>DOK 2</sup>
  - a. Identify the physical properties of wood according to wood uses, including specific gravity, grain, strength, stiffness, bending, hardness, toughness, ability to be stained, and chemical properties.
  - b. Describe Mississippi wood products according to their importance to the state and local economies, including sawlogs, pulpwood products, poles and posts, veneer, furniture products, biofuels, biomass fuels, miscellaneous, and byproducts.
  - c. Describe the role of recycling in the forest products industry, including impact on forest management and harvesting practices.

### Enrichment

Divide students into groups and assign one component of the forest region to each group. The groups should research, summarize, and prepare a fact sheet to be presented to the class. Presentations will be scored based on the presentation rubric found in the TRD.

# Unit 11: Employability Skills and Leadership Development

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## Competencies and Suggested Objectives

1. Develop employability skills. <sup>DOK 1</sup>
  - a. Review group leadership skills and personal traits from Unit 2 (see associated list) and discuss how this affects employability.
  - b. Prepare a resume containing essential information, including personal information, education, and employment experience using correct grammar, spelling, and punctuation.
  - c. Complete job application forms using correct grammar, spelling, and punctuation.
  - d. Explain procedures for job interviews using correct job etiquette.
  - e. Demonstrate the role of an applicant in a job interview using correct interview procedures.
  - f. Explore job opportunities in forestry.
2. Identify FFA leadership activities associated with forestry. <sup>DOK 1</sup>
  - a. Identify FFA organizational activities that promote and recognize achievements in forestry, including personal development activities, seminars, leadership conferences, national and international exchange programs, education experience with industry, and personal and community development programs.
  - b. Identify the benefits of FFA participation to an individual and to the forestry industry, including personal growth and development, exposure to the forestry industry environment, and multicultural experiences.
  - c. Identify opportunities for members in the FFA organization, including personal development, personal recognition, travel, association with persons from other parts of the United States and abroad, career exploration, and self-expression.

## Unit 12: Forest Management Practices

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### Competencies and Suggested Objectives

1. Explain forest management practices. <sup>DOK 2</sup>
  - a. Define terms associated with forest management practices, including best management practices (BMPs) and streamside management zones (SMZs), age classifications, forest management, improvement cutting, selection cutting, timber stand improvement, stand types, and wildlife management.
  - b. Identify the role of forest management, including forest crops, management of stands, measurement of stands, goals and objectives of the landowner, and voluntary best management practices.
  - c. Describe forest management practices, including silviculture, reproduction, harvest cuttings, fertilization, and herbicide application.
  - d. Discuss the Sustainable Forestry Initiative (SFI), including BMPs and SMZs, and potential certifications in these areas.
  - e. Examine the impact of federal and state regulations on issues such as water quality and threatened and endangered species in forest operations.
2. Apply forest management practices. <sup>DOK 3</sup>
  - a. Describe the purposes of intermediate cutting in forest management, including maximizing growth, control spacing, and removal of undesirable trees.
  - b. Determine the type of intermediate cut, including precommercial, pulpwood, release, sanitation, and salvage.
  - c. Classify timber stand improvement (TSI) needs, including thinning overstocked stands, prescribed burning, fertilization, herbicide release, and sanitation and salvage cuts.

### Enrichment

Conduct a field trip to evaluate forest management practices, including BMPs and SMZs. Have students record their observations in their journal/notebook. While there, divide students into groups and assign a tract to each group to formulate a forest management plan and present the plan to the class. Use the presentation rubric found in the TRD.

## Unit 13: Advanced Timber Cruising

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<b>Competencies and Suggested Objectives</b>
1. Describe the different types of sampling techniques used in measuring standing timber, including line plot, strip, and prism cruising. <sup>DOK 2</sup>
2. Plan and conduct a timber cruise. <sup>DOK 3</sup> <ol style="list-style-type: none"><li>Prepare cruise layouts, including drawing of a diagram describing a 10% sample systematic grid.</li><li>Conduct timber cruises and determine tract volume and values, including 10%, 20%, and 100% samples.</li><li>Discuss and perform point sampling.</li></ol>
<b>Enrichment</b>
<u>Cruise Types</u> <p>A local landowner wants to know which cruise method is best for calculating his profits. Conduct a field exercise to participate in timber cruising. You and your crew (each group) will conduct a cruise of a given tract of timber. You will calculate the board footage on the tract and compare their findings to the groups. Each group will be given one of the following cruise types: fixed radius plot, point sampling, strip cruise, or 100%. Use timber cruise rubric in TRD.</p>

# Unit 14: Timber Marketing

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## Competencies and Suggested Objectives

1. Explain timber marketing procedures. <sup>DOK 2</sup>
  - a. Define terms associated with timber marketing, including harvesting compliance, management prescriptions, grantee, and grantor.
  - b. Describe marketing practices for selling at the highest return, including marking, cruising, determining the value of timber, and selling the timber for the highest price.
  - c. Identify potential markets, financial opportunities, and effects of supply and demand of the following: pulp paper mills, post mills, sawmills, specialty markets, export markets, and firewood sales.
  - d. Describe how to determine the highest value of a timber stand, including preparing a prospectus and a timber sale contract.
2. Describe conditions of sale and harvesting of timber. <sup>DOK 2</sup>
  - a. Describe legal documents used in the sale and harvesting of timber, including the prospectus, timber sale contract, timber deed, and harvesting contract.
  - b. Describe desirable postharvest land conditions which may be specified in a harvesting contract.
  - c. Describe logistics of transporting timber to markets, including proximity to the mill and its effect upon the price received by the producer.

## Enrichment

### Let's Make A Deal

You are a forester for a large paper company. You have been tasked with cruising a large tract of land. In this process, you must prepare the legal documents used in the sale and harvesting of this tract (i.e., prospectus, timber sale contract, timber deed, and harvesting contract). Within this set of documents, the landowner has requested a postharvest land condition line be placed in the harvest contract which will describe the conditions of the property at close of harvest. Also, your company requires you to provide information about logistics and transportation and their effects on timber prices. These reports will be presented to the head forester (instructor) and will be evaluated by the report rubric from the TRD.

# Unit 15: Timber Harvesting

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## Competencies and Suggested Objectives

1. Explain timber harvesting procedures. <sup>DOK 2</sup>
  - a. Define terms associated with timber harvesting, including harvesting layout, BMPs and SMZs, felling, topping, bunching, skidding, merchandising, loading areas and hauling.
  - b. Describe the methods of harvesting timber, including selection, seed tree, shelterwood, clear-cut, and row thinning.
  - c. Identify the products of harvesting, including pulpwood, sawlogs, and specialty wood products.
2. Develop a timber harvesting plan. <sup>DOK 3</sup>
  - a. Identify types of harvesting equipment, including chainsaws, cutoff saws, delimeter, flail delimeter, fellerbunchers, prehaulers, skidders, whole tree chippers, loaders, and hauling vehicles.
  - b. Observe timber harvesting operations, including total harvest, intermediate harvesting, and forest management practices.
  - c. Describe desirable postharvesting land conditions, including condition of nonmerchantable timber, dead trees, treetops, soil cover, and damage caused by logging equipment.
  - d. Develop a simple harvesting plan for a given tract of timber.

## Enrichment

### Methods of Harvesting Research

As an upstart logging company, you are in search of the best harvesting methods. Research and prepare a report on methods of harvesting timber, including selection, seed tree, shelterwood, clear-cut, and mechanical. The written report rubric in the TRD can be used to evaluate the report describing the methods of harvesting timber

### Harvesting Plan

Based on the methods you researched above, select a harvesting method and develop a harvesting plan for a tract of land for which you are bidding. The plan will be presented to the landowner (instructor) for evaluation using the presentation and/or report rubric in the TRD.



# Unit 16: Reforestation

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## Competencies and Suggested Objectives

1. Explain reforestation practices. <sup>DOK 2</sup>
  - a. Define reforestation terms, including planting tools and site preparation.
  - b. Identify the sources of tree seedlings.
  - c. Describe the methods of handling seedlings, including planting as soon as possible and keeping in cold storage.
  - d. Describe the methods of planting, including direct seeding, hand planting, and machine planting.
  - e. Describe the different types of site preparation, including roll chop, shearing, burning, chemical, piling, and bedding.
  - f. Describe the types of reforestation, including artificial and natural means.
  - g. Describe the economics of reforestation.
  - h. Identify federal and state reforestation programs available locally.
2. Perform reforestation practices. <sup>DOK 2</sup>
  - a. Plant seedlings, including using all available methods.
  - b. Perform a compliance check, including carrying out a standard Mississippi Forestry Commission compliance check.
  - c. Calculate number of seedlings per acre and associated costs needed for reforestation.

## Enrichment

### Reforestation

Divide the class into groups and have them use the internet or a textbook to research all available federal and state reforestation cost-share programs available to landowners. Have students summarize their findings into fact sheets and distribute to the class.

### Seedling Activity

You are a crew foreman on a reforestation job. Demonstrate to your crew (fellow class members) seedling planting techniques. After the project is completed, demonstrate procedures for conducting a compliance check to evaluate the planting efforts.

# Unit 17: Forest Fire Management

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<b>Competencies and Suggested Objectives</b>
<ol style="list-style-type: none"><li>1. Explain forest fire management practices. <sup>DOK 2</sup><ol style="list-style-type: none"><li>a. Define the terms associated with forest fires, including types of fires, fire behavior, fuels, controls, and weather conditions.</li><li>b. Identify the elements of the fire triangle, including heat, fuel, and oxygen.</li><li>c. Identify the classes of fires, including ground, surface, and crown.</li><li>d. Identify the methods of attack, including direct and indirect.</li><li>e. Identify firefighting tools according to their uses, including rakes, swatters, cutting tools, backpack sprayer, drip torch, fire plows, and new technology (i.e., UAS).</li></ol></li></ol>
<ol style="list-style-type: none"><li>2. Apply forest fire management techniques. <sup>DOK 3</sup><ol style="list-style-type: none"><li>a. Develop a prescribed burning plan that details fire lanes, weather conditions, wind speed and direction, timber type, fuel conditions, manpower, and procedures for obtaining permission to burn.</li><li>b. Explain the significance of a certified burn manager on the site of all prescribed burns.</li><li>c. Develop a forest fire prevention plan that details fire lanes, section roads, prescribed burning, and emergency notification procedures.</li></ol></li></ol>
<b>Enrichment</b>
<p>As a county forester, you have been asked to develop a prescribed burning plan for your service area. Create a report discussing the common elements of a prescribed burn plan to present to the county supervisors (instructor and class). In your presentation, be prepared to demonstrate the use of firefighting tools and procedures. Use written report rubric in TRD.</p>

# Unit 18: Forest Insects and Diseases

## Competencies and Suggested Objectives

1. Identify and discuss forest insects and diseases. <sup>DOK 2</sup>
  - a. Define the terms associated with forest insects and diseases, including wood damage, leaf eaters, wood eaters, epidemic, predator, habitat, diseases, and signs of damage.
  - b. Identify the following common insects that affect the forestry industry:
    - Southern pine beetle
    - Ips engraver beetle
    - Black turpentine beetle
    - Nantucket pine tip moth
    - Fall web worm
    - Forest tent caterpillar
    - Pales weevil
    - Locust leafminer
    - Bag worm
    - Gypsy moth
  - c. Identify the following common diseases that affect the forestry industry:
    - Brown spot needle blight
    - Cedar apple gall rust
    - Needle cast
    - Heart rot
    - Oak leaf wilt
    - Verticillium wilt
    - Annosus root rot
    - Fusiform rust
    - Black knot fungus
    - Mistletoe
  - d. Identify insect and disease damage and match the damage observed to the origin.
  - e. Identify symptoms of insect or disease damage for the following: leaf eaters, wood eaters, sap eaters, phloem eaters, cone borers, root feeders, and terminal feeders.
2. Discuss control methods of forest insects and diseases. <sup>DOK 2</sup>
  - a. Describe the various methods used to control insects and diseases, including direct control and indirect control.
  - b. Identify the reasons for identifying insect and disease damage, including prevention of epidemics and loss of timber volume.
  - c. Describe aerial forest detection procedures, including UAS technology, for insect and disease problems.

## Enrichment

Collect photos of various timber insects, diseases, and associated damage. Include scientific names, common names, development stages, and control methods for each.

# Student Competency Profile

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Student's Name: \_\_\_\_\_

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

<b>Unit 1: Exploring the World of Forestry</b>		
	1.	Explain the importance of forestry.
	2.	Explain careers in the field of forestry.
<b>Unit 2: Leadership Development</b>		
	1.	Explain the benefits of FFA participation.
	2.	Demonstrate group leadership skills and personal traits.
<b>Unit 3: Forest Safety</b>		
	1.	Explain forest safety practices.
	2.	Describe forest environmental hazards.
	3.	Demonstrate forest safety practices.
<b>Unit 4: Tree Growth and Stand Development</b>		
	1.	Explain tree physiology.
	2.	Explain forest stand development.
	3.	Discuss advances in biotechnology for forestry applications.
	4.	Discuss the carbon cycle in pine plantations.
<b>Unit 5: Dendrology</b>		
	1.	Explain the tree classification system.
	2.	Identify trees by their characteristics.
<b>Unit 6: Forest Traversing and Mapping</b>		
	1.	Explain concepts of forest traversing.
	2.	Perform forestry surveying and mapping techniques.
	3.	Calculate acreage of forest tracts.
<b>Unit 7: Legal Land Descriptions</b>		
	1.	Describe the United States Public Land Survey System.
	2.	Identify information found on maps.
	3.	Apply principles of legal land description.

<b>Unit 8: Tree and Log Measurements</b>		
	1.	Explain tree measurement techniques.
	2.	Perform volume measurements of standing timber and sawlogs.
<b>Unit 9: Introduction to Timber Cruising</b>		
	1.	Describe procedures for cruising timber.
	2.	Perform a timber cruise.
<b>Unit 10: Identifying Forests and Forest Products</b>		
	1.	Apply procedures to identify forest types.
	2.	Apply procedures to identify the physical properties of wood.
<b>Unit 11: Employability Skills and Leadership Development</b>		
	1.	Develop employability skills.
	2.	Identify FFA leadership activities associated with forestry.
<b>Unit 12: Forest Management Practices</b>		
	1.	Explain forest management practices.
	2.	Apply forest management practices.
<b>Unit 13: Advanced Timber Cruising</b>		
	1.	Describe the different types of sampling techniques used in measuring standing timber.
	2.	Plan and conduct a timber cruise.
<b>Unit 14: Timber Marketing</b>		
	1.	Explain timber marketing procedures.
	2.	Describe conditions of sale and harvesting of timber.
<b>Unit 15: Timber Harvesting</b>		
	1.	Explain timber harvesting procedures.
	2.	Develop a timber harvesting plan.
<b>Unit 16: Reforestation</b>		
	1.	Explain reforestation practices.
	2.	Perform reforestation practices.
<b>Unit 17: Forest Fire Management</b>		
	1.	Explain forest fire management practices.
	2.	Apply forest fire management techniques.
<b>Unit 18: Forest Insects and Diseases</b>		
	1.	Identify and discuss forest insects and diseases.
	2.	Discuss control methods of forest insects and diseases.

## Appendix A: Industry Standards

**AGRICULTURE, FOOD, AND NATURAL RESOURCES (AFNR) PATHWAY  
CONTENT STANDARDS AND PERFORMANCE ELEMENTS**

	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9
AFNR										
AGRIBUSINESS SYSTEMS									X	X
ANIMAL SYSTEMS		X								
BIOTECHNOLOGY					X		X	X		X
ENVIRONMENTAL SERVICE SYSTEMS		X		X	X		X	X	X	X
NATURAL RESOURCE SYSTEMS		X		X	X	X	X	X	X	X
PLANT SYSTEMS					X	X				
POWER, STRUCTURAL, AND TECHNICAL SYSTEMS								X	X	X
	Units	Unit 10	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16	Unit 17	Unit 18
AFNR										
AGRIBUSINESS SYSTEMS				X		X				
ANIMAL SYSTEMS										
BIOTECHNOLOGY										X
ENVIRONMENTAL SERVICE SYSTEMS		X		X	X	X	X	X	X	X
NATURAL RESOURCE SYSTEMS		X		X	X	X	X	X	X	X
PLANT SYSTEMS								X		X
POWER, STRUCTURAL, AND TECHNICAL SYSTEMS							X	X		

**Agriculture, Food, and Natural Resources (AFNR) Pathway  
Content Standards and Performance Elements**

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**AGRIBUSINESS SYSTEMS**

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of agribusiness systems.

**ABS.01. Apply management planning principles in AFNR businesses.**

ABS.01.01. Apply micro- and macroeconomic principles to plan and manage inputs and outputs in an AFNR business.

ABS.01.02. Read, interpret, evaluate, and write statements of purpose to guide business goals, objectives, and resource allocation.

ABS.01.03. Devise and apply management skills to organize and run an AFNR business in an efficient, legal, and ethical manner.

ABS.01.04. Evaluate, develop, and implement procedures used to recruit, train, and retain productive human resources for AFNR businesses.

**ABS.02. Use record keeping to accomplish AFNR business objectives, manage budgets and comply with laws and regulations.**

ABS.02.01. Apply fundamental accounting principles, systems, tools and applicable laws and regulations to record, track and audit AFNR business transactions (e.g., accounts, debits, credits, assets, liabilities, equity, etc.).

ABS.02.02. Assemble, interpret, and analyze financial information and reports to monitor AFNR business performance and support decision-making (e.g., income statements, balance sheets, cash-flow analysis, inventory reports, break-even analysis, return on investment, taxes, etc.).

**ABS.03. Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.**

ABS.03.01. Develop, assess, and manage cash budgets to achieve AFNR business goals.

ABS.03.02. Analyze credit needs and manage credit budgets to achieve AFNR business goals.

**ABS.04. Develop a business plan for an AFNR business.**

ABS.04.01. Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.

ABS.04.02. Develop production and operational plans for an AFNR business.

ABS.04.03. Identify and apply strategies to manage or mitigate risk.

**ABS.05. Use sales and marketing principles to accomplish AFNR business objectives.**

ABS.05.01. Analyze the role of markets, trade, competition, and price in relation to an AFNR business sales and marketing plans.

ABS.05.02. Assess and apply sales principles and skills to accomplish AFNR business objectives.

ABS.05.03. Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.

**ANIMAL SYSTEMS**

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and practices to the production and management of animals

**AS.01. Analyze historic and current trends impacting the animal systems industry.**

AS.01.01. Evaluate the development and implications of animal origin, domestication and distribution on production practices and the environment.

AS.01.02. Assess and select animal production methods for use in animal systems based upon their effectiveness and impacts.

AS.01.03. Analyze and apply laws and sustainable practices to animal agriculture from a global perspective.

**AS.02. Utilize best-practice protocols based upon animal behaviors for animal husbandry and welfare.**

AS.02.01. Demonstrate management techniques that ensure animal welfare.

AS.02.02. Analyze procedures to ensure that animal products are safe for consumption (e.g., use in food system, etc.).

**AS.03. Design and provide proper animal nutrition to achieve desired outcomes for performance, development, reproduction, and/or economic production.**

AS.03.01. Analyze the nutritional needs of animals.

AS.03.02. Analyze feed rations and assess if they meet the nutritional needs of animals.

AS.03.03. Utilize industry tools to make animal nutrition decisions.

**AS.04. Apply principles of animal reproduction to achieve desired outcomes for performance, development, and/or economic production.**

AS.04.01. Evaluate animals for breeding readiness and soundness.

AS.04.02. Apply scientific principles to select and care for breeding animals.

AS.04.03. Apply scientific principles to breed animals.

**AS.05. Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health.**

AS.05.01. Design animal housing, equipment, and handling facilities for the major systems of animal production.

AS.05.02. Comply with government regulations and safety standards for facilities used in animal production.

**AS.06. Classify, evaluate, and select animals based on anatomical and physiological characteristics.**

AS.06.01. Classify animals according to taxonomic classification systems and use (e.g. agricultural, companion, etc.).

AS.06.02. Apply principles of comparative anatomy and physiology to uses within various animal systems.

AS.06.03. Select and train animals for specific purposes and maximum performance based on anatomy and physiology.

**AS.07. Apply principles of effective animal health care.**

AS.07.01. Design programs to prevent animal diseases, parasites and other disorders and ensure animal welfare.

AS.07.02. Analyze biosecurity measures utilized to protect the welfare of animals on a local, state, national, and global level.

**AS.08. Analyze environmental factors associated with animal production.**



- AS.08.01. Design and implement methods to reduce the effects of animal production on the environment.
- AS.08.02. Evaluate the effects of environmental conditions on animals and create plans to ensure favorable environments for animals.

## **BIOTECHNOLOGY**

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to biotechnology in agriculture.

### **BS.01. NCAE Standard: Assess factors that have influenced the evolution of biotechnology in agriculture (e.g., historical events, societal trends, ethical and legal implications, etc.).**

- BS.01.01. Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).
- BS.01.02. Evaluate the scope and implications of regulatory agencies on applications of biotechnology in agriculture and protection of public interests (e.g., health, safety, environmental issues, etc.).
- BS.01.03. Analyze the relationship and implications of bioethics, laws, and public perceptions on applications of biotechnology in agriculture (e.g., ethical, legal, social, cultural issues).

### **BS.02. NCAE Standard: Demonstrate proficiency by safely applying appropriate laboratory skills to complete tasks in a biotechnology research and development environment (e.g., standard operating procedures, record keeping, aseptic technique, equipment maintenance, etc.).**

- BS.02.01. Read, document, evaluate and secure accurate laboratory records of experimental protocols, observations, and results.
- BS.02.02. Implement standard operating procedures for the proper maintenance, use and sterilization of equipment in a laboratory.
- BS.02.03. Apply standard operating procedures for the safe handling of biological and chemical materials in a laboratory.
- BS.02.04. Safely manage and dispose of biological materials, chemicals and wastes according to standard operating procedures.
- BS.02.05. Examine and perform scientific procedures using microbes, DNA, RNA, and proteins in a laboratory.

### **BS.03. NCAE Standard: Demonstrate the application of biotechnology to solve problems in Agriculture, Food and Natural Resources (AFNR) systems (e.g., bioengineering, food processing, waste management, horticulture, forestry, livestock, crops, etc.).**

- BS.03.01. Apply biotechnology principles, techniques, and processes to create transgenic species through genetic engineering.
- BS.03.02. Apply biotechnology principles, techniques, and processes to enhance the production of food through the use of microorganisms and enzymes.
- BS.03.03. Apply biotechnology principles, techniques, and processes to protect the environment and maximize use of natural resources (e.g., biomass, bioprospecting, industrial biotechnology, etc.).

- BS.03.04. Apply biotechnology principles, techniques, and processes to enhance plant and animal care and production (e.g., selective breeding, pharmaceuticals and biodiversity, etc.).
- BS.03.05. Apply biotechnology principles, techniques, and processes to produce biofuels (e.g., fermentation, transesterification, methanogenesis, etc.).
- BS.03.06. Apply biotechnology principles, techniques, and processes to improve waste management (e.g., genetically modified organisms, bioremediation, etc.).

## **ENVIRONMENTAL SERVICE SYSTEMS**

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of environmental service systems.

### **ESS.01. Use analytical procedures and instruments to manage environmental service systems.**

ESS.01.01. Analyze and interpret laboratory and field samples in environmental service systems.

### **ESS.02. Evaluate the impact of public policies and regulations on environmental service system operations.**

ESS.02.01. Interpret and evaluate the impact of laws, agencies, policies, and practices affecting environmental service systems.

### **ESS.03. Develop proposed solutions to environmental issues, problems, and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry, and ecology.**

ESS.03.01. Apply meteorology principles to environmental service systems.

ESS.03.02. Apply soil science and hydrology principles to environmental service systems.

ESS.03.03. Apply chemistry principles to environmental service systems.

ESS.03.04. Apply microbiology principles to environmental service systems.

ESS.03.05. Apply ecology principles to environmental service systems.

### **ESS.04. Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management, and energy conservation).**

ESS.04.01. Use pollution control measures to maintain a safe facility environment.

ESS.04.02. Manage safe disposal of all categories of solid waste in environmental service systems.

ESS.04.03. Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.

ESS.04.04. Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.

### **ESS.05. Use tools, equipment, machinery, and technology common to tasks in environmental service systems.**

ESS.05.01. Use technological and mathematical tools to map land, facilities, and infrastructure for environmental service systems.

ESS.05.02. Perform assessments of environmental conditions using equipment, machinery, and technology.

## **NATURAL RESOURCE SYSTEMS**

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of natural resources.

### **NRS.01. Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.**

NRS.01.01. Apply methods of classification to examine natural resource availability and ecosystem functions in a particular region.

NRS.01.02. Classify different types of natural resources to enable protection, conservation, enhancement, and management in a particular geographical region.

NRS.01.03 Apply ecological concepts and principles to atmospheric natural resource systems.

NRS.01.04 Apply ecological concepts and principles to aquatic natural resource systems.

NRS.01.05 Apply ecological concepts and principles to terrestrial natural resource systems.

NRS.01.06 Apply ecological concepts and principles to living organisms in natural resource systems.

### **NRS.02.01 Analyze the interrelationships between natural resources and humans.**

NRS.02.01. Examine and interpret the purpose, enforcement, impact and effectiveness of laws and agencies related to natural resource management, protection, enhancement, and improvement (e.g., water regulations, game laws, historic preservation laws, environmental policy, etc.).

NRS.02.02. Assess the impact of human activities on the availability of natural resources.

NRS.02.03. Analyze how modern perceptions of natural resource management, protection, enhancement, and improvement change and develop over time.

NRS.02.04. Examine and explain how economics affects the use of natural resources.

NRS.02.05. Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.

### **NRS.03. Develop plans to ensure sustainable production and processing of natural resources.**

NRS.03.01. Sustainability produce, harvest, process and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

NRS.03.02. Demonstrate cartographic skills, tools, and technologies to aid in developing, implementing, and evaluating natural resource management plans.

### **NRS.04. Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.**

- NRS.04.01. Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.
- NRS.04.02. Diagnose plant and wildlife diseases and follow protocol to prevent their spread.
- NRS.04.03. Prevent or manage introduction of ecologically harmful species in a particular region.
- NRS.04.04. Manage fires in natural resource systems.

## **PLANT SYSTEMS**

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the production and management of plants.

### **PS.01. Develop and implement a crop management plan for a given production goal that accounts for environmental factors.**

- PS.01.01. Determine the influence of environmental factors on plant growth.
- PS.01.02. Prepare and manage growing media for use in plant systems.
- PS.01.03. Develop and implement a fertilization plan for specific plants or crops.

### **PS.02. Apply principles of classification, plant anatomy, and plant physiology to plant production and management.**

- PS.02.01. Classify plants according to taxonomic systems.
- PS.02.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
- PS.02.03. Apply knowledge of plant physiology and energy conversion to plant systems.

### **PS.03. Propagate, culture, and harvest plants and plant products based on current industry standards.**

- PS.03.01. Demonstrate plant propagation techniques in plant system activities.
- PS.03.02. Develop and implement a management plan for plant production.
- PS.03.03. Develop and implement a plan for integrated pest management for plant production.
- PS.03.04. Apply principles and practices of sustainable agriculture to plant production.
- PS.03.05. Harvest, handle, and store crops according to current industry standards.

### **PS.04. Apply principles of design in plant systems to enhance an environment (e.g. floral, forest landscape, and farm).**

- PS.04.01. Evaluating, identifying, and preparing plants to enhance an environment.

## **POWER, STRUCTURAL AND TECHNICAL SYSTEMS**

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of power, structural, and technical systems.

### **PST.01. Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.**

- PST.01.01. Apply physical science laws and engineering principles to assess and select energy sources for AFNR power, structural and technical systems.
- PST.01.02. Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.
- PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
- PST.02. Operate and maintain AFNR mechanical equipment and power systems.**
  - PST.02.01. Perform preventative maintenance and scheduled service to maintain equipment, machinery and power units used in AFNR settings.
  - PST.02.02. Operate machinery and equipment while observing all safety precautions in AFNR settings.
- PST.03. Service and repair AFNR mechanical equipment and power systems.**
  - PST.03.01. Troubleshoot, service and repair components of internal combustion engines using manufacturers' guidelines.
  - PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.
  - PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment, and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).
- PST.04. Plan, build and maintain AFNR structures.**
  - PST.04.01. Create sketches and plans for AFNR structures.
  - PST.04.02. Determine structural requirements, specifications and estimate costs for AFNR structures.
  - PST.04.03. Follow architectural and mechanical plans to construct and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).
  - PST.04.04. Apply electrical wiring principles in AFNR structures.
- PST.05. Use control, monitoring, geospatial and other technologies in AFNR power structural and technical systems.**
  - PST.05.01. Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.
  - PST.05.02. Prepare and/or use electrical drawings to design, install, and troubleshoot electronic control systems in AFNR settings.
  - PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.