



This course was developed in 2022 by the Pacific Education Institute (PEI) with funding from Career Connect Washington and primary participation from teachers representing Vashon School District, Grays Harbor College, Spokane Community College, Manulife Forest Management, and OSPI's Associate Director of Secondary Science. This working document will be periodically updated while working with CTE teachers across Washington to provide local resources and relevant materials and opportunities to engage youth in learning about forest management in Washington State.

Advanced Forest Management		
Course Title: Advanced Forest Management		Total Framework Hours: 180 hours
Suggested CIP Code: 030510	Exploratory X Preparatory	Date Last Modified: 1/19/2023
Career Cluster: Agriculture, Food and Natural Resources		Cluster Pathway: Natural Resource Systems
Course Summary: This course framework applies scientific and forestry principles, as well as technical writing and communication skills, to the management of Washington's forests. The course builds upon topics covered in the complementary Forestry Practices course to focus on safety, well-being, and ethics; evaluation of forest management practices; timber cruising and valuation; diseases, insects, and pathogens; timber stand management and silviculture; fire ecology and management; mapping and land measurement; forest practice law and agencies; and career planning. Students will complete a Supervised Agricultural Experience (SAE) in a local forest as part of the course.		
Requested Course Equivalency: 1 credit of science OR English language arts (technical writing focus)		Total Number of Units: 9
Course Resources: Forest Practices Illustrated (Department of Natural Resources); online folder to be shared with teacher		

Unit 1: Safety, Well-Being, and Ethics	Total Learning Hours for Unit: 10
Unit Summary: This unit will highlight the skills necessary to work safely and effectively on a restoration work crew.	
Competencies:	
<ol style="list-style-type: none"> 1. Understand the safe and proper use of tools for manual and chemical restoration practices (including cleaning, maintenance, and storage). 2. Engage in field safe field work procedures (ex: pacing, adequate food, water, sleep, and use of personal protective equipment, road rights-of-way). 	

3. Work on a crew successfully and safely (includes skills in listening, following directions, keeping other crew members safe).
4. Understand and adhere to community partner safety protocols.
5. Understand basic first aid relevant to restoration ecology.
6. Practice Leave No Trace and low ecological impact practices.
7. Practice basic navigation skills.

Performance Assessments: *These can be locally developed or use the suggested assessments below.*

Assessments will be formal and informal, written, verbal and practical. Students can:

- Perform field work safely and properly (ex: pacing, adequate food, water, sleep, use of personal protective equipment, safety while working in road rights-of-way).
- Adhere to safe crew practices (includes skills in listening, following directions, keeping other crew members safe).
- Demonstrate safe and proper hand tool use for manual and chemical restoration practices.
- Adhere to the community partner's safety plans and protocols.
- Use Leave No Trace and low ecological impact practices in the field.
- Lead or assist in first aid skill role play activities.
- Demonstrate how to track locations using a compass, map, and GPS.
- Read a weather report and make safety decisions based on forecast.
- Lead or assist a group discussion to create shared group norms for communication and safety.
- Record and update tool inventory sheets.
- Assist community partner to ensure that tools are cleaned, maintained, and stored properly.
- Facilitate a pre- or post-safety meeting for onsite restoration crew work.
- Complete an OSHA job hazard assessment form.
- Review and discuss herbicide labels for required PPE, application limits, and public notifications.
- Demonstrate familiarity with a Satellite phone.

Related to Supervised Agricultural Experience (SAE):

- Create a safety plan that includes protocols to be used for on-site restoration work.
- Include examples of relevant hazard and safety signage that should be used in restoration work, as seen in public areas (ex: planting areas, road signs, snags).

Leadership Alignment: Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed for all students.

Suggested skills include:

- 3.B.3 Assume shared responsibility for collaborative work, and value the individual contributions made by each team member
- 7.A.1 Adapt to varied roles, job responsibilities, schedules and contexts

- 4.B.1 Use information

Industry Standards and Competencies

Agriculture, Food, and Natural Resources (AFNR) Standards: Natural Resource Science (NRS)

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

- NRS.03.02. Demonstrate cartographic skills, tools and technologies to aid in developing, implementing and evaluating natural resource management plans.
- NRS.03.02.01.a. Summarize how to use maps and technologies to identify directions and land features, calculate actual distance and determine the elevations of points.
- NRS.03.02.01.b. Apply cartographic skills and tools and technologies (e.g., land surveys, geographic coordinate systems, etc.) to locate natural resources.

AFNR Cluster Skills

- CS.03. Examine and summarize the importance of health, safety, and environmental management systems in AFNR workplaces.

CRP Strand (Career Ready Practices)

- CRP.09.03. Demonstrate behaviors that contribute to a positive morale and culture in the workplace and community.

Unit 2: Evaluation of Forest Management Practices	Total Learning Hours for Unit: 25
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Unit Summary: In this unit, students will utilize their tree and plant identification skills to collect, analyze, and use data in a technical report. Students will also increase their competence with commonly used technical forest management and planning technology.

Competencies:

1. Collect primary data to analyze and describe forest types, trees, and vegetation.
2. Create relational databases using forestry data.
3. Use climate projections to project potential impact on native timber species.
4. Use apps to mine forestry data.
5. Decide which data sets are pertinent to study and availability of those data sets.
6. Plan, write, revise, and use proper documentation of sources for writing a technical report.
7. Find and test a hypothesis for a problem under study. Evaluate and collect information to solve problems.
8. Increase familiarity with cultural resources related to timber species

Performance Assessments: *These can be locally developed or use the suggested assessments below.*

Assessments will be formal and informal, written, verbal and practical. Students can:

- Create a presentation that presents and describes the tools used by foresters to identify various trees and shrubs.
- Create a presentation that presents and describes climate science data to predict future impact on native trees and shrubs.
- Create a map of a plot of land showing relative abundance of tree species.
- Given local weather data, construct an explanation, based on evidence explaining how a tree species through the process of evolution is successful in Washington include: (1) the potential for that species to increase in number, (2) how the heritable genetic variation of individuals in a species contributes, (3) how the species successfully competes for limited resources, and (4) the how it is better able to survive and reproduce in its environment.
- Uses mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- Using appropriate technology, plan and present a technical report.
- Identify plants and their medicinal and traditional uses.
- Participate in traditional land use practices (ex: planting or harvest techniques).
- Identify culturally relevant resources with the help of local elders and tribal representatives.

Related to SAE:

- Use terminology and scientific names to accurately describe forests, trees, and vegetation.
- Utilize gathered data in final report.

Leadership Alignment: Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed for all students.

- 2.C.1 Effectively analyze and evaluate evidence, arguments, claims and beliefs.
- 2.C.2 Analyze and evaluate major alternative points of view.
- 2.C.3 Synthesize and make connections between information and arguments.
- 2.C.4 Interpret information and draw conclusions based on the best analysis.
- 2.C.5 Reflect critically on learning experiences and processes.

Industry Standards and Competencies

Agriculture Food and Natural Resources Standards: Natural Resource Science (NRS)

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 function in a particular region.
- NRS.01.02.01.a. Research and examine the characteristics used to identify trees and woody plants.

- NRS.01.02.01.b. Apply identification techniques to determine the species of a tree or woody plant.
- NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.
 - NRS.01.02.02.a. Research and examine the characteristics used to identify herbaceous plants.
 - NRS.01.02.02.b. Apply identification techniques to determine the species of an herbaceous plant.

AFNR Cluster Skills

CS.01. Analyze how issues, trends, technologies, and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.

- CS.01.01. Research, examine, and discuss issues and trends that impact AFNR systems on local, state, national, and global levels.
 - CS.01.01.01.a. Examine historical and current data to identify issues impacting AFNR systems.
 - CS.01.01.01.b. Analyze and summarize AFNR issues and their impact on local, state, national, and global levels.
 - CS.01.01.01.c. Evaluate and explain AFNR issues and their impacts to audiences with limited AFNR knowledge.
 - CS.01.01.02.a. Research and summarize trends impacting AFNR systems.
 - CS.01.01.02.b. Analyze current trends in AFNR systems and predict their impact on local, state, national, and global levels

Aligned Washington State Academic Standards

Science	<p>HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect the carrying capacity of ecosystems at different scales.</p> <p>HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.</p> <p>HS-LS4-5: Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.</p>
English Language Arts	<p>Text Types and Purposes*</p> <ol style="list-style-type: none"> 1. Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence. 2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. 3. Write narratives to develop real or imagined experiences or events using effective techniques, well-chosen details and well-structured event sequences. <p>Production and Distribution of Writing</p>

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
 5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.
 6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
- Research to Build and Present Knowledge
7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
 8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
 9. Draw evidence from literary or informational texts to support analysis, reflection, and research
 1. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
 - a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
 - b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience’s knowledge of the topic.
 - c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
 - d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
 - e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Constructing Explanations and Designing Solutions Using Mathematics and Computational Thinking Engaging in Argument from Evidence	LS2.A: Interdependent Relationships in Ecosystems LS4.B: Natural Selection LS4.C: Adaptation	Cause and Effect Scale, Proportion, and Quantity

Unit 3: Timber Cruising and Valuation	Total Learning Hours for Unit: 25
Unit Summary: This unit will build upon the student’s knowledge of tree measurement to accurately assess timber volumes and value in a managed forest. Students will explore the implications of tree volumes, spacing, and technology in forest management.	

Competencies:

1. Use mathematical and computational thinking to describe, analyze and interpret various types of volume tables.
2. Work with local foresters to establish a fixed radius plot or a variable plot that estimates timber volume and value.
3. Use sampling intensity to calculate how many plots are needed for a timber cruise.
4. Analyze harvest costs (ex: labor, road building and maintenance, hauling, carbon, taxes) to calculate the profit from a timber sale.

Performance Assessments: *These can be locally developed or use the suggested assessments below.*

Assessments will be formal and informal, written, verbal and practical. Students can:

- Construct an explanation based on evidence regarding stewardship and sustainable forestry to develop a sustainable timber management plan utilizing best practice.
- In a group, discuss a complex real-world global challenge or problem that relates to forest management. Brainstorm possible solutions that consider management objectives as well as social, environmental, and economic impacts.
- Investigate how programming in modern logging equipment can increase lumber milling efficiency
- With a known sampling intensity, design a cruise that includes the number of plots and their plot spacing.
- Investigate how current timber cruising assessment methods have changed over time.
- Review and discuss a timber price sheet.
- Describe characteristics that will impact value and log grade (ex: size, wood grain).
- Use collected data to calculate expected tree density and relative frequency per acre.
- Extrapolate data collected from a sample plot across landscape to make predictions.

Related to SAE:

- Present a PowerPoint to a landowner that demonstrates how different cruising techniques and management objectives affect stand biodiversity and health.
- Create a presentation describing previous and future changes in forestry industry data collection and software use.

Leadership Alignment: Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed for all students.

- Students will be divided into cruising teams, be assigned an area in the forestry plot, create a report, and present it to the class. Team members will take on various leadership roles.
- Students will make judgments and decisions based on what they find when cruising their assigned area and communicate that to the class in their report. FFA forestry Career Development Event (CDE), Timber Cruising and Team Activity and economic principles, is a natural extension of this.

Industry Standards and Competencies

Agriculture, Food, and Natural Resources (AFNR) Standards: Natural Resource Science (NRS)

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 function in a particular region.
- NRS.01.01.01.b. Assess the characteristics of a natural resource to determine its classification.
- NRS.01.01.01.c. Devise strategies for the preservation of natural resources based on their classification.
- NRS.01.01.02.c. Conduct analyses of ecosystems and document the interactions of living species and non-living resources.
- NRS.01.01.03.c. Evaluate biodiversity in ecosystems and devise strategies to enhance the function of an ecosystem and the availability of natural resources by increasing the level of biodiversity.

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

- NRS.01.02.01.b. Apply identification techniques to determine the species of a tree or woody plant.
- NRS.01.02.01.c. Evaluate the species of trees present to assess the health of an ecosystem (e.g., presence of native versus invasive species, biodiversity, etc.).
 - NRS.01.02.06.a. Research the purpose and value of resource inventories and population studies.
 - NRS.01.02.06.b. Apply procedures for conducting resource inventories and population studies.
 - NRS.01.02.06.c. Conduct an assessment of the resource inventories or population in a given area.

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

- NRS.02.04. Examine and explain how economics affects the use of natural resources. Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.
 - NRS.02.04.01.b. Assess whether economic value increases or decreases the conservation, protection, improvement and enhancement of natural resources.

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

- NRS.03.02. Demonstrate cartographic skills, tools and technologies to aid in developing, implementing and evaluating natural resource management plans.
 - NRS.03.02.01.a. Summarize how to use maps and technologies to identify directions and land features, calculate actual distance and determine the elevations of points.
 - NRS.03.02.01.b. Apply cartographic skills and tools and technologies (e.g., land surveys, geographic coordinate systems, etc.) to locate natural resources.

Aligned Washington State Academic Standards

Science	<p>HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.</p> <p>HS-LS4-3: Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.</p> <p>HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.</p> <p>HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Using Mathematics and Computational Thinking Analyzing and Interpreting Data Constructing Explanations and Designing Solutions Asking Questions and Defining Problems	LS2.A: Interdependent Relationships in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS4.B: Natural Selection LS4.C: Adaptation ETS1.A: Defining and Delimiting Engineering Problems ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution	Scale, Proportion, and Quantity Patterns Cause and Effect

Unit 4: Diseases, Insects, and Pathogens	Total Learning Hours for Unit: 25
<p>Unit Summary: Students will build upon their knowledge of the role that diseases, insects, and pathogens play in forest health and their effect on both timber and ecosystem services. They will apply these concepts to Washington forest case studies.</p> <p>Competencies:</p> <ol style="list-style-type: none"> 1. Describe how key primary and secondary diseases, insects, and pathogens (ex: mycorrhizae, fungi, pollination) affect forest health. 	

2. Integrate an evidence-based claim that describes a given disease, insect, or pathogen’s impacts on present and future timber yields.
3. Evaluate potential management strategies based on local forest factors (ex: species present, humidity, sunlight, soil type).
4. Gain knowledge of a specific disease, insect, or pathogen of interest

Performance Assessments: *These can be locally developed or use the suggested assessments below.*

Assessments will be formal and informal, written, verbal and practical. Students can:

- Identify at least three plant diseases, insects, or pathogens in a timber stand or forest.
- Translate quantitative or technical information into a visual representation (ex: table, chart, infographic, equation.)
- Research the life history of a disease, insect, or pathogen endemic to a Washington forest.
- Design, evaluate and refine a solution for reducing the impacts of disease and forest pest on a timber stand and the impact on biodiversity,
- Analyze and use data to create a mathematical representation that shows the spread of disease, insect, or pathogen in a local forest.
- Evaluate a locally relevant map to describe complex interactions (ex: disease, invasive plant distribution, tree species presence.

Related to SAE:

- Interview a biologist or forester about diseases, insects, and pathogens that affect local forests.
- Create a collaborative management plan that recommends strategies for managing a specific species. Include life history research in plan.
- Write an informational article that proposes, evaluates, and refines a management solution for specific invasive species in a Washington forest. Acquire and accurately use academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level.

Leadership Alignment: Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed for all students.

- Divide the class into teams of 3 to 5 and have them present to the ownership group of the forestry plot a pest control plan for the forestry plot. FFA tie-in could be the “Prepared Public” speaking contest or agri-science fair.

Industry Standards and Competencies

Agriculture, Food, and Natural Resources (AFNR) Standards: Natural Resource Science (NRS)

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 function in a particular region.
 - NRS.01.02.01.c. Evaluate the species of trees present to assess the health of an ecosystem (e.g., presence of native versus invasive species, biodiversity, etc.).

- NRS.01.02.02.c. Evaluate the species of herbaceous plants present to assess the health of an ecosystem (e.g., presence of native versus invasive plants, biodiversity, etc.).

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

- NRS.03.02. Demonstrate cartographic skills, tools and technologies to aid in developing, implementing and evaluating natural resource management plans.
 - NRS.03.02.01.c. Evaluate the availability of and threats to natural resources using cartographic skills, tools, and technologies (e.g., spread of invasive species, movement of wildlife populations, changes to biodiversity of edge of habitat versus interior, etc.).
 - NRS.03.02.02.b. Analyze an area's resources using GIS technologies.

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

- NRS.04.02. Diagnose plant and wildlife diseases and follow protocols to prevent their spread.
 - NRS.04.02.01.a. Classify causes of diseases in plants and the correct authorities to whom some diseases should be reported.
 - NRS.04.02.01.b. Analyze a plant disease based on its symptoms, identify if the disease needs to be reported to authorities and determine which authorities it should be reported to.
 - NRS.04.02.01.c. Create a management plan to reduce infection and the spread of plant diseases in natural resource systems.
- NRS.04.03. Prevent or manage introduction of ecologically harmful species in a particular region.
 - NRS.04.03.01.a. Categorize harmful and beneficial insects, as well as signs of insect damage to natural resources.
 - NRS.04.03.01.b. Analyze signs of insect infestation, identify if it needs to be reported to authorities and determine which authorities it should be reported to.
 - NRS.04.03.01.c. Create a management plan to reduce spread of harmful insects in natural resource systems.
 - NRS.04.03.02.a. Identify and classify invasive species common to a particular region.
 - NRS.04.03.02.b. Analyze signs of the spread of invasive species, identify if it needs to be reported to authorities and determine which authorities it should be reported to.
 - NRS.04.03.02.c. Create a management plan to reduce spread of harmful invasive species in natural resource systems.
 - NRS.04.03.03.a. Research and summarize strategies and benefits of preventing the introduction of harmful species to a particular region.
 - NRS.04.03.03.b. Assess and implement a plan for preventing the spread of harmful species for its effectiveness.
 - NRS.04.03.03.c. Identify potentially invasive species and devise strategies to prevent ecological damage that would result from the introduction of that species.

AFNR Cluster Skills

CS.01. Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.

- CS.01.01. Research, examine and discuss issues and trends that impact AFNR systems on local, state, national and global levels.
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.
 - CS.01.01.01.a. Examine historical and current data to identify issues impacting AFNR systems.
 - CS.01.01.01.b. Analyze and summarize AFNR issues and their impact on local, state, national and global levels.
 - CS.01.01.01.c. Evaluate and explain AFNR issues and their impacts to audiences with limited AFNR knowledge.
 - CS.01.01.02.a. Research and summarize trends impacting AFNR systems.
 - CS.01.01.02.b. Analyze current trends in AFNR systems and predict their impact on local, state, national and global levels.

Aligned Washington State Academic Standards

Science	<p>HS-LS2-6: Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem.</p> <p>HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*</p> <p>HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*</p> <p>HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.</p> <p>HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.</p> <p>HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.</p> <p>HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.</p>
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Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Engaging in Argument from Evidence Constructing Explanations and Designing Solutions Using Mathematics and Computational Thinking Developing and Using Models	LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS4.D: Biodiversity and Humans ETS1.B: Developing Possible Solutions LS4.C: Adaptation LS1.C: Organization for Matter and Energy Flow in Organisms	Stability and Change Cause and Effect Energy and Matter Systems and System Models

	LS2.B: Cycles of Matter and Energy Transfer in Ecosystems PS3.D: Energy in Chemical Processes	
Using Mathematics and Computational Thinking Engaging in Argument from Evidence 2. Constructing Explanations and Designing Solutions: Compose, analyze, edit, and format a variety of technical reports		

Unit 5: Timber Stand Management and Silviculture	Total Learning Hours for Unit: 25
<p>Unit Summary: This unit will develop the student’s understanding of the techniques used to manage timber stands for maximum total yield. An exploration of modern silviculture techniques and practices will be embedded in this unit.</p> <p>Competencies:</p> <ol style="list-style-type: none"> 1. Evaluate claims about how ecosystem stability influences stand composition. 2. Conduct a soil test and use results to consider strategies to enhance ecosystem function. 3. Analyze abiotic and biotic data to support claims associated with the management of forests for production. 4. Evaluate how stand density impacts management decisions. 5. Explain how nutrient cycling impacts stand management to create a mosaic within the landscape. 6. Use basal area to make stand management decisions. 7. Conduct tree planting audit evaluate data and analyze findings to improve success rate of planted trees. 8. Identify and describe the impact of human activities on forest resource management planning. 9. Create and evaluate competing design solutions for resource management issues. 10. Analyze computational models used to evaluate the effect of human activities (ex: consumption, material choice, increase in atmospheric carbon) on Earth’s resources. 11. Develop a model illustrating the role of carbon in the biosphere, atmosphere, hydrosphere and geosphere. 12. Describe how organic matter decomposition impacts seedling development from seed scarification through year one. 	
<p>Performance Assessments: <i>These can be locally developed or use the suggested assessments below.</i></p> <p>Assessments will be formal and informal, written, verbal and practical. Students can:</p>	

- Develop a model that shows how the process of photosynthesis and carbon sequestration knowledge can be used to maximize growth of a stand.
- Evaluate the effects of US government regulation on private, state, and national forest timber management.
- Conduct a tree planting audit and analyze findings to recommend strategies for improving tree planting success rates.
- Develop a model that shows how forest canopy levels influence light environment and photosynthesis.
- Complete seed scarification and seed germination lab.
- Determine basal area of a stand based on management objectives and decide which trees to leave and which trees to harvest, include tradeoffs in management decisions and demonstrate that the management objects follow the Washington State Forest Practices.
- Compare state and federal EPA fertilizer, pest and herbicide regulations to evaluate each agency's role in relation to state and national forest management.
- Evaluate best practices for a forest resource conservation topic (ex: old growth forests, stream riparian zones, carbon sequestration).
- Compare and contrast pre-colonial and contemporary forest management objectives and practices.
- Evaluate ways to collect disease, blowdown, roads to decommission, and other data.
- Analyze data to make forest management decisions.
- Utilize legal land descriptions to describe property types (ex: wetland, zoning designations) and find physical boundaries (ex: map school land boundaries).

Related to SAE:

- Write a management plan that focuses on a topic of interest (ex: forest health, timber production, and harvesting. replanting, timber stand improvement, mitigating impact of human activities).
- Use technical writing composition formats in reports.
- Use a mathematical model supported by scientific reasoning to guide proposed replanting efforts.
- Use Survey123 to acquire on-the-ground data and create maps showing healthy or diseased forests.
- Measure areas of interest with software tools built into Google Earth or similar software.

Leadership Alignment: Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed for all students.

- Students as a team will present their management plan to the ownership group for their forestry plot.
- Students will communicate clearly and use appropriate media to present their management plan, FFA Forestry CDE - Timber Stand Improvement section.

Industry Standards and Competencies

Agriculture Food and Natural Resources (AFNR) Standards: Natural Resource Standards (NRS)

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

- NRS.03.01. Sustainably 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.03.01.01.a. Summarize forest harvesting methods.
 - NRS.03.01.01.b. Assess harvesting methods in regards to their economic value, environmental impact, and other factors.
 - NRS.03.01.01.c. Develop a forest harvesting plan that ensures economic, environmental and social sustainability.

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.04.01.02.a. Identify and categorize characteristics of a healthy forest.
 - NRS.04.01.02.b. Assess and apply the methods used to improve a forest stand.
 - NRS.04.01.02.c. Create a timber stand improvement plan for a forest.
 - NRS.04.01.05.c. Evaluate the impact of recreational activities on natural resources and create an improvement plan.

Plant Science (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.01.01.01.a. Identify and summarize the three measurements of light – color, intensity and duration – that affect plant growth.
 - PS.01.01.02.a. Identify and summarize the effects of air and temperature on plant metabolism and growth.
 - PS.01.01.02.b. Determine the optimal air and temperature conditions for plant growth.
 - PS.01.01.03.a. Identify and summarize the effects of water quality on plant growth, (e.g., pH, dissolved solids, etc.).
 - PS.01.01.03.b. Analyze and describe plant responses to water conditions.
 - PS.01.01.03.c. Analyze plant responses to water conditions and recommend modifications to water for desired plant growth.
- PS.01.03. Develop and implement a fertilization plan for specific plants or crops.
 - PS.01.03.01.a. Identify the essential nutrients for plant growth and development and their major functions (e.g., nitrogen, phosphorous, potassium, etc.).
 - PS.01.03.01.b. Analyze the effects of nutrient deficiencies and symptoms and recognize environmental causes of nutrient deficiencies.

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

- PS.02.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems. PS.01.02. Prepare and manage growing media for use in plant systems.
 - PS.02.02.02.b. Analyze root tissues and explain the pathway of water and nutrients into and through root tissues.
 - PS.02.02.04.b. Analyze how leaves capture light energy and summarize the exchange of gases.
 - PS.02.02.04.c. Devise a plan for plant management practices that takes into account leaf structure and functions.

- PS.02.03. Apply knowledge of plant physiology and energy conversion to plant systems.
 - PS.02.03.01.b. Apply knowledge of photosynthesis to analyze how various environmental factors will affect the rate of photosynthesis.
 - PS.02.03.01.c. Evaluate the impact of photosynthesis and the factors that affect it on plant management, culture and production problems.
- 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.03.01.01.c. Select and defend the use of pollination methods and practices used to maximize crop pollination.
 - PS.03.01.02.a. Demonstrate sowing techniques for providing favorable conditions to meet the factors of seed germination.
 - PS.03.01.02.b. Handle seed to overcome seed dormancy mechanisms and to maintain seed viability and vigor.
 - PS.03.01.02.c. Conduct tests associated with seed germination rates, viability and vigor.
- PS.03.04. Apply principles and practices of sustainable agriculture to plant production.
 - PS.03.04.01.c. Research, prepare and defend plans for a plant systems enterprise that aligns with USDA sustainable practices criteria.

Aligned Washington State Academic Standards

Science	<p>HS-LS2-6: Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem.</p> <p>HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*</p> <p>HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*</p> <p>HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.</p> <p>HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.</p> <p>HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.</p> <p>HS-PS1-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere</p>
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Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Engaging in Argument from Evidence Constructing Explanations and Designing Solutions	LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS4.D: Biodiversity and Humans	Stability and Change Cause and Effect Energy and Matter

Using Mathematics and Computational Thinking Developing and Using Models	ETS1.B: Developing Possible Solutions LS4.C: Adaptation LS1.C: Organization for Matter and Energy Flow in Organisms LS2.B: Cycles of Matter and Energy Transfer in Ecosystems PS3.D: Energy in Chemical Processes	Systems and System Models
Using Mathematics and Computational Thinking Engaging in Argument from Evidence Constructing Explanations and Designing Solutions: Compose, analyze, edit, and format a variety of technical report		

Unit 6: Fire Ecology Management	Total Learning Hours for Unit: 25
<p>Unit Summary: This unit will apply their knowledge of fire ecology concepts to analyze the role of prescribed fire in the management of commercial forests, and wildland fire suppression policies. Students will also use climate data to identify timber areas with high wildfire risk and design solutions to address the problem.</p>	
<p>Competencies:</p> <ol style="list-style-type: none"> 1. Understand fuel characteristics (ex: fuel loading, fuel hour moisture classes). 2. Describe historical and contemporary relationships between humans and fire in forests and other ecosystems. 3. Compare and contrast fire suppression practices and policies' influence on forest health. 4. Create a model to show how multiple abiotic factors interact with each other to influence fire spread (ex: wind speed, stand density, atmospheric humidity, temperature, topography). 5. Use mathematical representations to illustrate how fire contributes to the cycling of nutrients in the forests. 6. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. 	
<p>Performance Assessments: <i>These can be locally developed or use the suggested assessments below.</i> Assessments will be formal and informal, written, verbal and practical. Students can:</p> <ul style="list-style-type: none"> • Create a model based on the fire triangle to demonstrate the classifications of fire. 	

- Make claims with evidence and reasoning about how abiotic factors influence fire behavior.
- Identify fire-dependent species and their life histories.
- Make a claim using evidence and reasoning to predict future risk due to changing climates.
- Complete a post burn survey.
- Use scientific argumentation to debate fire policy on public lands. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline. Provide a concluding statement or section that follows from and supports the argument presented.

Related to SAE:

- Develop a fire management plan using mathematical representations, quantitative and qualitative data as evidence for management decisions.
- Make claims with evidence and reasoning about how prescribed fire can be a valuable tool in meeting management objectives.
- Include carbon calculations in management recommendations for prescribed and non-prescribed fires.
- Research the historical and contemporary value of fire for indigenous cultures within a local forest.

Leadership Alignment: Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed for all students.

- Divide the class into teams of 5 to 7 and present to the class in teams all sides of the use of fire in the forest. FFA tie-in would be the Ag Issues CDE.

Industry Standards and Competencies

Agriculture, Food, and Natural Resources (AFNR) Standards: Natural Resource Science (NRS)

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 function in a particular region.
 - NRS.01.01.01.c. Devise strategies for the preservation of natural resources based on their classification.
 - NRS.01.01.02.a. Summarize the components that comprise all ecosystems.
- NRS.01.03. Apply ecological concepts and principles to atmospheric natural resource systems.
 - NRS.01.03.02.a. Research and summarize how climate factors influence natural resource systems.
 - NRS.01.03.02.b. Analyze the impact that climate has on natural resources and debate how this impact has changed due to human activity.
- NRS.01.04. Apply ecological concepts and principles to aquatic natural resource systems.
 - NRS.01.04.01.a. Summarize the roles and properties of watersheds.
 - NRS.01.04.01.b. Assess the function of watersheds and their effect on natural resources.

- NRS.01.04.01.c. Evaluate and defend the importance of watersheds to ecosystem function.
 - NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.
 - NRS.01.05.02.a. Compare and contrast the impact of habitat disturbances and habitat resilience.
 - NRS.01.05.02.b. Analyze and summarize examples of habitat disturbances and habitat resilience.
- 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.02.01.02.a. Distinguish between the types of agencies associated with natural resources systems.
 - NRS.02.01.02.b. Analyze the specific purpose of agencies associated with natural resources systems.
 - NRS.02.02.01.a. Summarize the relationship between natural resources, ecosystems and human activity.
 - NRS.02.02.01.b. Assess and explain how different kinds of human activity affect the use and availability of natural resources (i.e., agriculture, industry, transportation, etc.).
- NRS.03. Develop plans to ensure sustainable production and processing of natural resources.
- NRS.03.02. Demonstrate cartographic skills, tools and technologies to aid in developing, implementing and evaluating natural resource management plans.
 - NRS.03.02.01.a. Summarize how to use maps and technologies to identify directions and land features, calculate actual distance and determine the elevations of points.
 - NRS.03.02.01.b. Apply cartographic skills and tools and technologies (e.g., land surveys, geographic coordinate systems, etc.) to locate natural resources
 - NRS.03.02.01.c. Evaluate the availability of and threats to natural resources using cartographic skills, tools, and technologies (e.g., spread of invasive species, movement of wildlife populations, changes to biodiversity of edge of habitat versus interior, etc.).
- NRS.04. Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.
- NRS.04.04. Manage fires in natural resource systems.
 - NRS.04.04.01.a. Differentiate between desirable and undesirable fires and research the role fire plays in a healthy ecosystem.
 - NRS.04.04.01.b. Assess and apply techniques used to fight wildfires, manage prescribed fires and ensure human safety.
 - NRS.04.04.01.c. Develop a prevention plan for harmful fires for a particular region.
 - NRS.04.04.02.a. Research and summarize how fire management techniques have evolved.
 - NRS.04.04.02.b. Assess the effectiveness of techniques previously and currently used to prevent harmful fires.

Aligned Washington State Academic Standards

Science	<p>HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.</p> <p>HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.</p> <p>HS-PS1-5 Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Constructing Explanations and Designing Solutions Using Mathematics and Computational Thinking	LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Energy and Matter

Unit 7: Forest Practices Laws and Agencies	Total Learning Hours for Unit: 25
<p>Unit Summary: In this unit, students will learn about state, tribal, and national forest practice laws and complete a Forest Practices Application/Notification (FPA/N) for a designated timber unit.</p> <p>Competencies:</p> <ol style="list-style-type: none"> 1. Use components of the Department of Natural Resources’ Washington State Forest Practices Rules to create a management plan. 2. Use key components of Department of Ecology’s State Environmental Policy Act (SEPA) Forestry Assessment Guidelines and watershed restoration-fish habitat enhancements RCW 43.21.030(2)(c) to create a management plan. 3. Review the Fish habitat enhancement projects – permit and approval process, and use the understanding to create a management plan. 4. Use key components of US Fish and Wildlife’s Endangered Species Act (ESA and NEPA) create a management plan. 5. Identify water quality impacts that may occur from harvest activity and understand Riparian Management Zone (RMZ) and include in a forest management plan. 6. Use wildlife data collected from the field to create a habitat conservation plan (HCP). 7. Understand culturally significant resources important to local indigenous populations. 8. Evaluate Road Maintenance and Abandonment Plan (RMAP) to the unit being harvested. 9. Use maps in forest management decisions (ex: pest/disease; invasive species; streams/wetlands; wildlife habitats; recreation; jurisdictions). 10. Understand legal land descriptions to describe property boundaries (ex: map school land boundaries). 	

Performance Assessments: *These can be locally developed or use the suggested assessments below.*

Assessments will be formal and informal, written, verbal and practical. Students can:

- Complete a practice Forest Practices Application/Notification (FPA/N) for a unit that is to be harvested soon.
- Identify culturally significant resources important to local indigenous populations.
- Identify and suggest RMZ boundaries for streams of different size classes under the Forest Practices Rules.
- Evaluate the appropriateness of Road Maintenance and Abandonment Plan (RMAP) to the unit being harvested.
- Develop and host a student-led town hall or presentation for the city council, tribal council or other decision-making body addressing a current forestry issue using evidence from current forest practice or tribal rules.
- Use wildlife data collected from the field to create a habitat conservation plan (HCP).
- Use legal descriptions to describe property boundaries.

Related to SAE:

- Map and integrate GPS data into final report or presentation.

Leadership Alignment: Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed for all students.

- Divide the students into teams, have them set up their team with specific responsibilities for a public presentation.
- FFA tie-in could be Forestry or Natural Resources CDEs.

Industry Standards and Competencies

Agriculture, Food, and Natural Resources (AFNR) Standards: Natural Resource Science (NRS)

NRS.02. 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.02.01.01.a. Distinguish between the types of laws associated with natural resources systems.
 - NRS.02.01.01.b. Analyze the structure of laws associated with natural resources systems.
 - NRS.02.01.01.c. Evaluate the impact of laws associated with natural resources systems (e.g., mitigation, water regulations, carbon emissions, game limits, invasive species, etc.).
 - NRS.02.01.02.a. Distinguish between the types of agencies associated with natural resources systems.
 - NRS.02.01.02.b. Analyze the specific purpose of agencies associated with natural resources systems.
 - NRS.02.01.02.c. Evaluate the impact and effectiveness of agencies associated with natural resources systems (e.g., regulation of consumption, prevention of damage to natural resources systems, management of ecological interactions, etc.).

- NRS.02.04. Examine and explain how economics affects the use of natural resources
 - NRS.02.04.01.a. Compare and contrast how the economic value of a natural resource affects its availability.
 - NRS.02.04.01.b. Assess whether economic value increases or decreases the conservation, protection, improvement and enhancement of natural resources.
 - NRS.02.04.01.c. Devise a plan to improve the conservation, protection, improvement and enhancement of natural resources based on economic value and practices.
 - NRS.02.04.02.c. Anticipate and predict how changes to the availability of natural resources because of human activity may impact a local, state and national economy.

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

- NRS.03.02. Demonstrate cartographic skills, tools and technologies to aid in developing, implementing and evaluating natural resource management plans.
 - NRS.03.02.02.c. Use GIS data for a given area to devise a management plan for the management, conservation, improvement, and enhancement of its natural resources.

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.04.01.01.a. Identify and categorize different kinds of streams.
 - NRS.04.01.01.b. Assess and explain indicators of the biological health of a stream.
 - NRS.04.01.01.c. Create an enhancement plan for a stream.
 - NRS.04.01.02.a. Identify and categorize characteristics of a healthy forest.
 - NRS.04.01.02.b. Assess and apply the methods used to improve a forest stand.
 - NRS.04.01.02.c. Create a timber stand improvement plan for a forest.
 - NRS.04.01.03.a. Identify and categorize characteristics of a healthy wildlife habitat.
 - NRS.04.01.03.b. Assess and apply methods of wildlife habitat improvement.
 - NRS.04.01.03.c. Devise a comprehensive improvement plan for a wildlife habitat.
 - NRS.04.01.04.a. Identify and categorize characteristics of healthy rangeland.
 - NRS.04.01.04.b. Assess and apply methods of rangeland improvement.
 - NRS.04.01.04.c. Evaluate and revise a rangeland management plan.
 - NRS.04.01.05.a. Identify and categorize characteristics of natural resources that make them desirable for recreational purposes.
 - NRS.04.01.05.b. Assess and apply management techniques for improving outdoor recreation opportunities.
 - NRS.04.01.05.c. Evaluate the impact of recreational activities on natural resources and create an improvement plan.
 - NRS.04.01.06.a. Identify and categorize characteristics of healthy marine and coastal natural resources.

- NRS.04.01.06.b. Assess and apply methods to improve marine and coastal natural resources.
- NRS.04.01.06.c. Create an improvement plan for marine or coastal natural resources.
- NRS.04.02. Diagnose plant and wildlife diseases and follow protocols to prevent their spread.
 - NRS.04.02.01.a. Classify causes of diseases in plants and the correct authorities to whom some diseases should be reported.
 - NRS.04.02.01.b. Analyze a plant disease based on its symptoms, identify if the disease needs to be reported to authorities and determine which authorities it should be reported to.
 - NRS.04.02.01.c. Create a management plan to reduce infection and the spread of plant diseases in natural resource systems.
 - NRS.04.02.02.a. Classify causes of diseases in wildlife and aquatic species and determine the correct authorities to whom some diseases should be reported.
 - NRS.04.02.02.b. Analyze a wildlife or aquatic species disease based on its symptoms, identify if the disease needs to be reported to authorities and determine which authorities it should be reported to.
 - NRS.04.02.02.c. Create a management plan to reduce infection and spread of wildlife or aquatic species diseases in natural resource systems.
- NRS.04.03. Prevent or manage introduction of ecologically harmful species in a particular region.
 - NRS.04.03.01.a. Categorize harmful and beneficial insects, as well as signs of insect damage to natural resources.
 - NRS.04.03.01.b. Analyze signs of insect infestation, identify if it needs to be reported to authorities and determine which authorities it should be reported to.
 - NRS.04.03.01.c. Create a management plan to reduce spread of harmful insects in natural resource systems.
 - NRS.04.03.02.a. Identify and classify invasive species common to a particular region.
 - NRS.04.03.02.b. Analyze signs of the spread of invasive species, identify if it needs to be reported to authorities and determine which authorities it should be reported to.
 - NRS.04.03.02.c. Create a management plan to reduce spread of harmful invasive species in natural resource systems.
 - NRS.04.03.03.a. Research and summarize strategies and benefits of preventing the introduction of harmful species to a particular region.
 - NRS.04.03.03.b. Assess and implement a plan for preventing the spread of harmful species for its effectiveness.
 - NRS.04.03.03.c. Identify potentially invasive species and devise strategies to prevent ecological damage that would result from the introduction of that species.

Aligned Washington State Academic Standards

Science

[HS-ESS2-2](#): Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

HS-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

[HS-ESS3-1](#): Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

[HS-ESS3-2](#): Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. *

[HS-ESS3-3](#): Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

[HS-ESS3-4](#): Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

[HS-ESS3-5](#): Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

[HS-ESS3-6](#): Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

[HS-LS2-2](#): Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

[HS-LS2-6](#): Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem.

[HS-LS2-7](#): Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
*

[HS-LS4-6](#): Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*

[HS-ETS1-1](#): Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

[HS-ETS1-2](#): Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

[HS-ETS1-3](#): Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

[HS-ETS1-4](#): Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Constructing Explanations and Designing Solutions Analyzing and Interpreting Data	ESS3.A: Natural Resources ESS3.B: Natural Hazards ESS2.A: Earth Materials and Systems	Cause and Effect Stability and Change Systems and System Models

<p>Engaging in Argument from Evidence Using Mathematics and Computational Thinking Asking Questions and Defining Problems</p>	<p>ESS2.D: Weather and Climate ETS1.B: Developing Possible Solutions ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change ESS2.D: Weather and Climate LS2.A: Interdependent Relationships in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS4.D: Biodiversity and Humans LS4.C: Adaptation ETS1.A: Defining and Delimiting Engineering Problems ETS1.C: Optimizing the Design Solution</p>	<p>Scale, Proportion, and Quantity</p>
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Unit 8: Career Pathways	Total Learning Hours for Unit: 10
<p>Unit Summary: This unit will expose students to various career pathways in the natural resources profession and provide opportunities for students to develop and enhance their employability skills.</p>	
<p>Learning Targets:</p> <ol style="list-style-type: none"> 1. Understand the key components to include in applications, cover letters, and resumes. 2. Describe individual skills and experiences that are relevant to natural resource jobs. 3. Understand components of a professional introductory email. 4. Compare employment sections of natural resource organization websites (both public and private). 5. Learn about natural resource jobs that relate to the student’s career goals. 6. Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts. 7. Know about job shadowing and internship opportunities. 8. Understand aspects of verbal and non-verbal communication in professional settings. 9. Recognize the importance and impact of one’s digital presence on future employment opportunities. 	
<p>Performance Assessments: <i>These can be locally developed or use the suggested assessments below.</i></p> <p>Assessments will be formal and informal, written, verbal and practical. Students will be able to:</p> <ul style="list-style-type: none"> • Complete a self-assessment to identify qualifications and reflect on opportunities for future job skill growth. • Create a list of gained individual skills and experiences that are relevant to natural resource jobs. 	

- Update resume and cover letter to integrate course learning and recent career-related experiences.
- Write a professional introductory email.
- Create Indeed or Linked In profile.
- Prepare and participate in a mock interview for a natural resources position.
- Contact a natural resources organization to request an informational interview.
- Demonstrate professional introduction of self to stakeholders.
- Conduct a job search.

Related to SAE:

- Present SAE project to the public and potential employers.
- List knowledge, skills, and abilities gained in the course.

Leadership Alignment: Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed for all students.

Suggested skills include:

- 3.A.1 Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts
- 8.C.2 Demonstrates initiative to advance skill levels towards a professional level
- 8.A.2 Balance short-term and long-term goals

Industry Standards and Competencies

AFNR Cluster Skills

- CS.05 Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.
- CRP.10.01. Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.

CRP Strand (Career Ready Practices)

- CRP.01.03. Identify and act upon opportunities for professional and civic service at work and in the community.
- CRP.02.01. Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.
- CRP.04.01. Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.
- CRP.04.02. Produce clear, reasoned and coherent written and visual communication in formal and informal settings.

Aligned Washington State Academic Standards

Science	<p>HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*</p> <p>HS-ESS3-3: Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.</p> <p>HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Engaging in Argument from Evidence Using Mathematics and Computational Thinking Constructing Explanations and Designing Solutions	ESS3.A: Natural Resources ETS1.B: Developing Possible Solutions ESS3.C: Human Impacts on Earth Systems	Stability and Change

Unit 9: Supervised Agricultural Experience (SAE) Project	Total Learning Hours for Unit: 10
<p>Unit Summary: Students will demonstrate their learning by completing a Supervised Agricultural Experience Project (SAE). Students will work individually and, in a group, to consider their strengths as well as their areas for future learning in performing restoration work.</p> <p>Competencies:</p> <ol style="list-style-type: none"> 1. Understand the benefits of the SAE for skill development, leadership and career success. 2. Understand the connection between SAE and FFA. 3. Describe the two types of SAE: <ul style="list-style-type: none"> o Foundational SAE (Career exploration & planning (high school and beyond plan), Personal financial planning and management, Workplace Safety, Employability skills for college and career readiness, agricultural or forestry literacy) o Immersion SAE (Entrepreneurship/Ownership, Placement/Internships, Research (Experimental, Analytical, Invention), School Business Enterprises, Service Learning) 4. Select an SAE topic that relates to course topics as well as the student’s personal interests, academic goals, and career goals. 5. Develop procurement and funding plans. 6. Understand how presentation and reporting formats influence delivery of content to audiences. 7. Use systems thinking (interconnectedness, emergent properties, causality, feedback loops in an ecosystem) to develop SAE project. 8. Demonstrate flexibility. 9. Demonstrate self-directed learning skills. 	
<p>Performance Assessments: <i>These can be locally developed or use the suggested assessments below.</i></p> <p>Assessments will be formal and informal, written, verbal and practical. Students will be able to:</p>	

- Select a final project format that effectively delivers content (ex: PowerPoint, YouTube video, report, radio public service announcement, poster, tri-fold display, brochure, map, website or blog, event, phone app, etc.)
- Write a report that investigates a topic covered in the course.
- Use Ag Experience Tracker (AET) System or equivalent utilized to track SAE Project.
- Outline the components to be used in final project:
 - o Determine the goals of the SAE project.
 - o Identify resources and data to be collected to meet project goals.
 - o Select the types of data that will be meaningful.
 - o Collect data to be used in the final project.
 - o Keep records that pertain to the chosen SAE project.
 - o Enter data into an Excel spreadsheet.
 - o Create maps that display necessary data.
 - o Cite sources that are included in the proposal.
- Prepare and deliver final project deliverables.

Leadership Alignment: Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.

Suggested skills include:

- Students are responsible for entering their own data into the system and the data will be used in the annual Agriculture Education Report
- 8.C.2 Demonstrates initiative to advance skill levels towards a professional level
- 8.A.2 Balance short-term and long-term goals

Resources:

Future Farmers of America (FFA) Supervised Agricultural Experience (SAE) Washington FFA site: www.ffa.org

How to start a new chapter: <https://www.washingtonffa.org/starting-a-new-chapter>

SAE specific resources: <https://saeforall.org/> resources for students and teachers.

Industry Standards and Competencies

Agriculture Food and Natural Resources Standards: Natural Resource Science (NRS)

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

- NRS.03.01. Sustainably 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.03.02.01.b. Apply cartographic skills and tools and technologies (e.g., land surveys, geographic coordinate systems, etc.) to locate natural resources. Create GIS maps that show different projects in a forest and the ongoing results of those projects.

AFNR Cluster Skills

CS.05 Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.

CS.01.05: Awareness: Desire purposeful understanding related to professional and personal activities.

Level 2

CS.01.05.01.b. Analyze the impact of trends and issues on the community.

Level 3

CS.01.05.01.c. Articulate current issues that are important to the local, state, national and global communities.

CS.01.05.02.c. Perform leadership tasks associated with citizenship.

CRP Strand (Career Ready Practices)

- CRP.01.03. Identify and act upon opportunities for professional and civic service at work and in the community.
- CRP.02.01. Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.
- CRP.04.01. Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.
- CRP.04.02. Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
- CRP.10.01. Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.

SAE

- SAE.01.01 Students will establish and conduct Supervised Agricultural Experience Projects (SAE).
 - SAE.01.01.b. Explain the benefits of SAE projects to skill development, leadership and career success.
 - SAE.01.01.c. Explain the connection between SAE and FFA.
 - SAE.01.01.d. Explain the five types of SAE. (Entrepreneurship, Placement, Research, Exploratory, Improvement)
 - SAE.01.01.e. Explore ideas for SAE projects.
 - SAE.01.01.f. Explain how SAE projects support academic achievement.
 - SAE.01.01.g. Select and establish an SAE project.
 - SAE.01.01.h. Explain and keep records on established SAE projects.
 - SAE.01.01.i. Explain SAE project Supervision, visitation and assessment.

- SAE.01.01.I. Explain the three-circle concept for SAE, FFA Leadership, Classroom/Laboratory in an Agriculture Education program.

Aligned Washington State Academic Standards

Science	Standards will be based on the SAE selected by the student
Environment & Sustainability	Standard 1: Ecological, Social, and Economic Systems -- Students develop knowledge of the interconnections and interdependency of ecological, social, and economic systems. They demonstrate understanding of how the health of these systems determines the sustainability of natural and human communities at local, regional, national, and global levels. Standard 2: The Natural and Built Environment -- Students engage in inquiry and systems thinking and use information gained through learning experiences in, about, and for the environment to understand the structure, components, and processes of natural and human-built environments.

21st Century Skills

Check those that students will demonstrate in this course:

<p>LEARNING & INNOVATION</p> <p>Creativity and Innovation</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Think Creatively <input checked="" type="checkbox"/> Work Creatively with Others <input checked="" type="checkbox"/> Implement Innovations <p>Critical Thinking and Problem Solving</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Reason Effectively <input checked="" type="checkbox"/> Use Systems Thinking <input checked="" type="checkbox"/> Make Judgments and Decisions <input checked="" type="checkbox"/> Solve Problems <p>Communication and Collaboration</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Communicate Clearly <input checked="" type="checkbox"/> Collaborate with Others 	<p>INFORMATION, MEDIA & TECHNOLOGY SKILLS</p> <p>Information Literacy</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Access and /evaluate Information <input checked="" type="checkbox"/> Use and Manage Information <p>Media Literacy</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Analyze Media <input checked="" type="checkbox"/> Create Media Products <p>Information, Communications and Technology (ICT Literacy)</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Apply Technology Effectively 	<p>LIFE & CAREER SKILLS</p> <p>Flexibility and Adaptability</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Adapt to Change <input checked="" type="checkbox"/> Be Flexible <p>Initiative and Self-Direction</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Manage Goals and Time <input checked="" type="checkbox"/> Work Independently <input checked="" type="checkbox"/> Be Self-Directed Learners <p>Social and Cross-Cultural</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Interact Effectively with Others <input checked="" type="checkbox"/> Work Effectively in Diverse Teams <p>Productivity and Accountability</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Manage Projects <input checked="" type="checkbox"/> Produce Results <p>Leadership and Responsibility</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Guide and Lead Others <input checked="" type="checkbox"/> Be Responsible to Others
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