Statewide Framework Document for:

030506 Forest Management

Standards may be added to this document prior to submission but may not be removed from the framework to meet state credit equivalency requirements. Performance assessments and leadership alignment may be developed at the local level. In order to earn state approval, performance assessments must be submitted within this framework. **This course is eligible for 1 credit of lab science.** The Washington State Science Standards performance expectations for high school blend core ideas (Disciplinary Core Ideas, or DCIs) with scientific and engineering practices (SEPs) and crosscutting concepts (CCCs) to support students in developing usable knowledge that can be applied across the science disciplines. These courses are to be taught in a three-dimensional manner. The details about each performance expectation can be found at Next Generation Science Standards..

Enter Your School District Name	
Course Title: Forest Management	**Total Framework Hours:** 180 hours
CIP Code: 030506 ☐ Exploratory ☒ Preparatory	**Date Last Modified:** December 30, 2020
Career Cluster: Agriculture, Food and Natural Resources	**Cluster Pathway:** Natural Resources System
Course Summary: A program that applies scientific and forestry principles to the management of Washington's forests. Includes instruction in tree and tool identification, timber cruising and valuation, timber stand management and silviculture, diseases, pest and fire ecology, mapping and land measurement, forest practice laws. Students prepare and submit a forest management plan to the land owner. A Supervised Agriculture Experience is incorporated to place students in a position where they learn the practices of entrepreneurship and the fundamentals of research and experimentation in the forestry field. Participants in the SAE will conduct exploratory projects with the purpose of learning about and improving forest practices in their surroundings.	
Eligible for Equivalent Credit in: 1 credit of lab science	**Total Number of Units:** 9

Unit 1: Tree and Tool Identification	**Total Learning Hours for Unit:** 20

Unit Summary: This unit will expose the student to the identification and use of major commercial timber species and their associated understory plant communities. Students will also become competent with common tool identification and function used by forest management professionals.

Competencies:

1. Use various resources to locate common and scientific names (binomial naming system).
2. Use field identification keys, including dichotomous keys, to identify major commercial timber species in the field.
3. Understand the present and historical uses of many major plant species.
4. Identify, by sight, the tools and their use in forest management practices.
5. Use GIS maps to display data collected on forestry types.
6. Use forest maps integrated with GIS, consider use of drone technology.
7. Create relational databases for forestry.
8. Use climate projections to project potential impact on native timber species
9. Create apps to mine forestry data.
10. Decide which data sets are pertinent to study and availability of those data sets.
11. Find and test a hypothesis for a problem under study.
12. Increase familiarity with cultural resources related to timber species.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- Read and interpret a dichotomous key.
- Given specimens, use dichotomous keys to identify local plants in a taxonomic practicum
- Identify and properly demonstrate the use of various resources used to identify trees and shrubs.
- 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 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.
- Identify plants and their medicinal and traditional uses.
- Create an herbarium of local flora.
- Participate in traditional land use practices (harvest techniques).
- Identify culturally relevant resources with the help of local elders and tribal representatives.
- Make tools that would have been used to harvest in the past.

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Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Groups of (5) students will each collect 2 samples for trees (live) or unique tools (pictures will work) and then identify each sample and present to the class their finding on their samples.

Industry Standards and/or Competencies:

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.

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	HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. HS-LS4-2: Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

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| | 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. |

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 2: Timber Cruising & Valuation	Total Learning Hours for Unit: 20

Unit Summary: This unit will establish the necessary skills required to accurately assess timber volumes and value in a managed forest.

Competencies:

1. Use mathematical and computational thinking to describe, analyze and interpret various types of volume tables.
2. Know the board foot is the unit of measure for most commercial timber volume/value.
3. Determine tree board foot volume using clinometers, diameter tapes, and Scribner and/or Tariff Access volume tables.
4. Work with local foresters to establish a fixed radius plot or a variable plot to estimate timber volume per acre and total volume, estimate timber value per acre and total value.
5. Make a claim about tree density and relative frequency, calculate tree density and relative frequency per acre and revise explanation based on findings.
6. Calculate the radius for various fixed plots.
7. Given Sampling Intensity, calculate how many plots are needed.
8. Use dot grids to lay out sampling points.
9. Analyze harvest costs (labor), road costs, hauling costs, carbon costs and taxes to calculate the profit from a timber sale and present multiple management outcomes based on different societal needs and wants.
10. Conduct analysis of soil productivity and devise strategies to enhance the function of the ecosystem and the natural resources by increasing the level of biodiversity.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- Prepare and present a Timber Cruising PowerPoint to a land owner applying different cruising techniques and applying different management objectives to a stand to demonstrate factors affecting biodiversity and tree and shrub populations.
- Illustrate and label a board foot.
- Read and interpret a given volume table.

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- With a known sampling intensity, design a cruise, including number of plots and their plot spacing.
- Calculate plot radius.
- Establish a fixed radius plot and calculate trees per acre.
- Given sample trees, use a clinometer and diameter tape to measure trees, calculate tree heights, tree diameters, and eventual board foot volume
- Construct an explanation based on evidence regarding stewardship and sustainable forestry to develop a sustainable timber management plan utilizing best practices.
- Examine and explain the value of a tree using the National Tree Benefit calculator.
- Calculate cords of wood.
- Determine tree board foot volume using prisms or Relaskop and estimate timber volume per acre and total volume.
- Calculate relative density and frequency.
- Analyze a major global challenge related to forestry to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- Create a presentation showing the change in data collection and software used in the forestry industry and a prediction of how technology and software should or will evolve.
- Make a claim, supported by evidence, about the importance of programming in modern logging equipment and in the milling of lumber in addressing varied log quality and size.
- Analyze a solution to a complex real-world global challenge or problem (eg. climate change or invasive species)using qualitative and quantitative criteria and constraints based on prioritized criteria and trade-offs that account for societal needs and wants
- Use metadata to find specific data for GIS mapping.
- Compare historical, current timber cruising assessments (board feet/acre).
- Use handheld GPS units to create data points.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:
- Students are 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 make judgements 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/or Competencies:

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.

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- o NRS.01.01.02.c. Conduct analyses of ecosystems and document the interactions of living species and non-living resources.
- o 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.
  - o NRS.01.02.01.b. Apply identification techniques to determine the species of a tree or woody plant.
  - o 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.).
  - o NRS.01.02.06.a. Research the purpose and value of resource inventories and population studies.
  - o NRS.01.02.06.b. Apply procedures for conducting resource inventories and population studies.
  - o 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.
  - o 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.
- o 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.
- o 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.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.
  - o NRS.04.01.01.a. Identify and categorize different kinds of streams.
  - o NRS.04.01.01.b. Assess and explain indicators of the biological health of a stream.
  - o NRS.04.01.02.a. Identify and categorize characteristics of a healthy forest.
  - o NRS.04.01.02.b. Assess and apply the methods used to improve a forest stand.
  - o NRS.04.01.02.c. Create a timber stand improvement plan for a forest.
  - o NRS.04.01.03.a. Identify and categorize characteristics of a healthy wildlife habitat.
  - o NRS.04.01.03.b. Assess and apply methods of wildlife habitat improvement.

Aligned Washington State Academic Standards

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Science	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-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.
	HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
	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.

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 3: Diseases and Pests	Total Learning Hours for Unit: 20
Unit Summary: In this unit, students explore the role that diseases and pests play in the health of the forest, their effect on both timber and ecosystem services. Competencies: 1. Know key diseases and pests that affect Washington State forests. 2. Make a claim, evaluate, and use evidence and reasoning to describe ways to collect disease data.	

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3. Leverage both mathematical and computer models to quantify the spread of insect and disease in dry or wet years.
4. Classify causes of disease in forest ecosystems, using climate projections make claims supported by evidence for increasing or decreasing likelihood of diseases.
5. Create mathematical or computer models that evaluate the overall scale and resulting impact an infestation will have on timber production and yield.
6. **Integrate an evidence-based claim that, to the extent that the infestation is managed, can and will have lasting impacts on both present and future timber yields.**

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:
- Interview a professional biologist or forester (local industry, US Forest Service, DNR etc.) about local pests, invasive species or diseases affecting nearby forests.
- Identify, in the field, at least one plant disease impacting local forests. Demonstrate to the instructor your process of identification.
- Research the life history of a disease endemic to your local area.
- Conduct forest pest and disease lab.
- Design, evaluate and refine a solution for reducing the impacts of disease and forest pest on a timber stand and the impact on biodiversity, communicate information in educational brochure or with electronic media.
- Analyze and use mathematical representations, based on evidence, to support or revise a locally relevant case study showing the spread of disease in a forest.
- Identify three pest species found in the region by sign and sight.
- Evaluate a locally relevant that (for example) show the spread of disease in a forest using claims, evidence and reasoning that address the complex interactions.
- Create a collaborative management plan on how to manage for a specific species (include life history research in plans).
- Identify three invasive plant species present in a local forest.
- Analyze, using mathematical or computer models, how the inclusion of invasive species has influenced the interdependent relationships among species within the ecosystem.
- Write an informational article about designing, evaluating and refining a solution that addresses the drawbacks and benefits to managing for specific invasive species in a local forest.
- Design, evaluate and refine a communication tool that centralizes all the identification procedures and contact information for your specific area that would be posted near informational signs on the property.
- Create a GIS overlay that could be used to gauge the impact that pests are having on the forest ecosystem.
- Create and use in the field a hard copy map from GIS.
- Use GIS story maps to show change in natural resources from different change agents (fire, disease, human impacts, insects etc.).
- Create GIS maps that show current natural resources.
- Evaluate claims, evidence, and reasoning about the role of disease in 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.

Some schools may also include:

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- Map and categorize invasive species and share with proper entities.
- Create a map of ecological damage from invasive species.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:
- 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/or Competencies:

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.

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- o 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.
- o NRS.04.03.02.c. Create a management plan to reduce spread of harmful invasive species in natural resource systems.
- o NRS.04.03.03.a. Research and summarize strategies and benefits of preventing the introduction of harmful species to a particular region.
- o NRS.04.03.03.b. Assess and implement a plan for preventing the spread of harmful species for its effectiveness.
- o 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.

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.
  - o CS.01.01.01.a. Examine historical and current data to identify issues impacting AFNR systems.
  - o CS.01.01.01.b. Analyze and summarize AFNR issues and their impact on local, state, national and global levels.
  - o CS.01.01.01.c. Evaluate and explain AFNR issues and their impacts to audiences with limited AFNR knowledge.
  - o CS.01.01.02.a. Research and summarize trends impacting AFNR systems.
  - o 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	Interdependent Relationships in Ecosystems
	HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales
	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.*

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Using Mathematics and Computational Thinking Engaging in Argument from Evidence Constructing Explanations and Designing Solutions	LS2.A: Interdependent Relationships in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS4.D: Biodiversity and Humans ETS1.B: Developing Possible Solutions	Scale, Proportion, and Quantity Stability and Change

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Unit 4: Timber Stand Management and Silviculture	**Total Learning Hours for Unit:** 30

Unit Summary: This unit will develop the student's understanding of the techniques used to manage timber stands for maximum total yield. Embedded into this unit will be an exploration of modern silviculture techniques and practices.

Competencies:

1. Evaluate claims on how ecosystem stability influences stand composition.
2. Identify and minimize the impact of human activities on forest resources.
3. Design a plan to mitigate the impact of human activities on forest resources.
4. Use a mathematical model supported by scientific reasoning to guide proposed replanting efforts.
5. Explain the role of the cycling of energy and matter as it pertains to seedling development from seed scarification through year one.
6. Evaluate stand density relative to management decisions.
7. Determine basal area using wedge prism AND fixed plot method.
8. Evaluate ways to collect disease, blowdown, roads to decommission, and other data.
9. Analyze abiotic and biotic data to support claims associated with the management of forests for production.
10. Create and evaluate competing design solutions for resource management issues.
11. Analyze computational models used to evaluate the effect of human activities (eg. consumption, material choice, increase in atmospheric carbon) on the earth's resources and develop a model illustrating the role of carbon in the biosphere, atmosphere, hydrosphere and geosphere.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- Write a management plan report concentrating on forest health, timber production, and harvesting. (WA DNR Stewardship Plan as a possible model)
- Measure and evaluate Soil Site Index.
- Develop a model that shows how the process of photosynthesis and carbon sequestration knowledge can be used to maximize growth of a stand.
- Write a tree re-planting proposal focusing on area conditions.
- Create a timber stand improvement plan.
- Complete a seed scarification lab. (Source: Forestry Science 3rd Edition, Peugh and Burton)and a seed germination lab.
- Make a claim, evaluate the impact of photosynthesis and the factors that affect it on plant management, culture and production problems, use evidence and reasoning to revise the claim.
- Conduct tree planting audit, evaluate data and construct an explanation based on findings to improve success rate of planted trees.
- Determine basal area of a stand based on management objectives and decide which trees to leave and which trees to harvest, include trade offs in management decisions and demonstrate that the management objects follow the Washington State Forest Practices.
- Find and use metadata to locate data sets in local, state, and federal forestry databases to create a model to illustrate some aspect of forest management.
- Model effects of climate change over time.
- Evaluate the effects of US government regulation on private, state, and national forest timber management.

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- Compare state and federal EPA fertilizer, pest and herbicide regulations then evaluate each agency's role as they pertain to control in state and national forest decisions
- Evaluate the importance of conservation of forest resources, including but not limited to old growth forests, stream riparian zones, carbon sequestration etc.
- Evaluate current logging practices with historical logging practices and their effect on the environment.
- Compare and contrast pre-contact forests with forests in the 19th and 20th Centuries, today and predict future forest in Washington State.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

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

Industry Standards and/or Competencies:

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.03.01.01.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.

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- 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	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 andbiodiversity.* HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.* HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. 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.

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	HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy amongorganisms in an ecosystem. HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon amongthe biosphere, atmosphere, hydrosphere, and geosphere.p	
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 LS2.B: Cycles of Matter and Energy Transfer in Ecosystems PS3.D: Energy in Chemical Processes	Stability and Change Cause and Effect Energy and Matter Systems and System Models

Unit 5: Fire Ecology & Management	**Total Learning Hours for Unit:** 20
Unit Summary: This unit will expose students to the ecological importance of fire, the role of prescribed fire in the management of commercial forests and basics of wildland fire suppression. Students will also use climate data to identify timber areas at risk of increasing wildfire and design solutions to address the problem. Competencies: 1. Construct and revise an explanation of how fire is responsible for the cycling of nutrients in both aerobic and anaerobic environments. 2. Use mathematical representations to illustrate how fire contributes to the cycling of nutrients in the forests. 3. Describe the historical relationships that have existed between humans and the presence of fire in forests and other ecosystems. 4. Compare and contrast abiotic components and their influence on fire spread. 5. Identify and measure the environmental variables that affect forest fire dynamics and its management.	
Performance Assessments: (Districts to complete for each unit) *Example assessments for this unit include:* ● Research how fire suppression policy has influenced the role of fire. ● Model the fire triangle, chemical reactions, and use the model to demonstrate the classifications of fire. ● Identify fire-dependent species and their life histories, make a claim using evidence and reasoning to predict future risk due to changing climates. ● Describe secondary succession ● Make claims with evidence and reasoning about how abiotic factors influence fire behavior--climate, wind (speed/direction) fuel, topography, aspect, weather, etc.	

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- Demonstrate use of sling psychrometer determine relative humidity.
- Make claims with evidence and reasoning about how prescribed fire can be a valuable tool in meeting management objectives, include carbon calculations in management of prescribed vs. no prescribed fires.
- Use scientific argumentation to debate Fire Policy on public lands, e.g., "Let it Burn?"
- Develop a fire management plan using mathematical representations, quantitative and qualitative data as evidence for management decisions.
- Use satellite imaging to find margins and damage from fire, and climate data to show comparative margins with changing abiotic conditions.
- Correlate weather and wind forecasts to predict fire movement.
- Create data sets to characterize fire damage into categories.
- Complete a post burn survey.

Some Schools may also include:
- Explain the historical value of fire for indigenous cultures.
- Use local, state and federal data to update active fire maps.
- Create GIS maps for active fire maps that show spread, containment, and assist firefighting.
- Use weather data to predict fire area mudflows and slides.
- Obtain certification as S-130 Wildland Firefighter

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:
- 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/or Competencies:

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.

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○ 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.03.02.02.a. Summarize how GIS can be used to manage, conserve, improve and enhance the natural resources of an area.
    ○ NRS.03.02.02.b. Analyze an area's resources using GIS technologies.
    ○ 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.04.02. 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.04.04. 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	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.

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Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
	HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. 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.	
Constructing Explanations and Designing Solutions Using Mathematics and Computational Thinking	LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Energy and Matter

Unit 6: Mapping and Land Measurement	Total Learning Hours for Unit: 20

Unit Summary: In this unit, students will examine how computer models are used to map and measure land to explore the interdependent relationships among organisms found within a forest. Competencies will include:

1. Understand the role of mapping specific populations of organisms located in a forest unit or units.
2. Utilize legal land descriptions to describe property types (eg. wetland, zoning designations) and boundaries and find physical boundaries (eg. map school land boundaries)
3. Use GIS to process spatial data to track the individual movements of species of interest as they interact with the landscape.
4. Use GIS data gathered in the field to create a stand composition map that can be used to guide management decisions.
5. Use GIS data gathered in the field to identify and map pockets of disease and invasive species.
6. Understand legal descriptions.
7. Use compass and pacing to navigate across a designated area.
8. Use GPS.
9. Topographical map interpretation—slope, aspect, scale, elevations.
10. Use aerial photos to collect data.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- Use measurement tools in ArcGIS Online(AGOL) to measure areas of interest.
- Use tools in AGOL to find elevations.
- Create maps that display data showing necessary data in a fashion that makes sense for the problem.
- Use AGOL latitude and longitude tools.
- Use AGOL to make decisions of scale, symbols, and colors to create readable maps.
- Create GIS maps that display data showing necessary data in a fashion that makes sense for the problem.
- Create spreadsheets, charts, tables, and graphs to show relationships in real-world systems.

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- Create and alter models to show change in systems.
- Use AGOL story maps to show relationships between healthy and unhealthy forests.
- Use data from local, state, and federal agencies to create user surveys about upcoming studies of a specific area.
- Use image data to assess health of forest and spread of disease or pests to enter in GIS maps, consider using drone technology if possible..
- Use satellite imaging to identify areas of interest.
- Use Survey123 to acquire on-the-ground data and create maps showing healthy or diseased forests.
- Create forest health GIS maps from Survey123 data.
- Measure areas of interest with software tools built into Google Earth or similar software.
- Use email, text, and survey tools to communicate and collaborate.
- Create Maps in GIS and use at least two to show complex interactions in forest ecosystems, and prepare argumentation from evidence for a particular management objective.
  - Create GIS maps that show spread of disease and invasive species and their effects on populations of native species.
  - Create a GIS map showing: disease and pest treatment and the effects on the health of the forest; monitoring those treatments.
  - Create GIS maps of stream riparian management zones and their effectiveness over time.
  - Create GIS maps of wildlife corridors and their impact on wildlife.
  - Create GIS maps that show what wildlife is being managed in certain areas, as well as the effectiveness of the management.
  - Create GIS maps of harvested areas, the type of clearing done, and the replant density and type.
  - Create GIS maps of thinning and new road construction.
  - Create GIS maps of estimated board footage of timber in given areas.
  - Create GIS maps of other mineral and forestry products.
  - Create GIS maps of areas treated with herbicides or insecticides.
  - Create GIS maps of organic or inorganic fertilizer application.
- Compare current imaging with past imaging to measure change in a particular area of interest.
- Participate in orienteering course.
- Participate in geocaching activity.
- Participate in a topographical map lab.

Leadership Alignment: (Districts to complete for each unit)
Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.
Example:
- Divide the students up into teams, have them set up their team with specific responsibilities, and collect and enter GIS data for a team report to the class. FFA tie-in could be Forestry or Natural Resources CDE's.

Industry Standards and/or Competencies:
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.

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- ○ 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.03.02.02.a. Summarize how GIS can be used to manage, conserve, improve and enhance the natural resources of an area.
- ○ NRS.03.02.02.b. Analyze an area's resources using GIS technologies.
- ○ 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.04.02. Diagnose plant and wildlife diseases and follow protocols to prevent their spread.

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.

Aligned Washington State Academic Standards	
Science	HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales 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.*

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Engaging in Argument from Evidence Constructing Explanations and Designing Solutions Using Mathematics and Computational Thinking	LS2.A: Interdependent Relationships in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS4.D: Biodiversity and Humans ETS1.B: Developing Possible Solutions	Scale, Proportion, and Quantity Stability and Change Cause and Effect Energy and Matter Systems and System Models

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Unit 7: Forest Practice Laws and Government Agencies	**Total Learning Hours for Unit:** 35

Unit Summary: In this unit, students will learn about forest practice (state, tribal and national) laws and complete a Forest Practices Application/Notification (FPA/N) for a designated timber unit.

Competencies:

1. Know key components of Department of Natural Resource's Washington State Forest Practices Rules
2. Know key components of Department of Ecology's State Environmental Policy Act (SEPA) Assessment.
3. Know key components of US Fish and Wildlife's Endangered Species Act (ESA and NEPA).
4. Know key components of Department of Natural Resource's cultural resources rules
5. Use wildlife data collected from the field to create a habitat conservation plan (HCP).
6. Understand culturally significant resources important to local indigenous populations.
7. Evaluate Road Maintenance and Abandonment Plan (RMAP) to the unit being harvested.
8. Interpret aerial photographs in stereo.
9. Examine key components of a road maintenance inspection.
10. Identify water quality impacts that may occur from harvest activity and understand Riparian Management Zone (RMZ).
11. Use GIS data to identify and suggest RMZ boundaries for streams of different size classes under the Forest Practices Rules.
12. Learn how to identify and delineate wetlands.
13. Manage and update databases.
14. Categorize data for usability.
15. Use of maps in forest management decisions—pest/disease; invasive species; streams/wetlands; wildlife habitats; recreation; jurisdictions.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

● Complete a Forest Practices Application/Notification for a unit that is to be harvested in the near future.
● Identify the key components of a SEPA Assessment by addressing what impacts the assessment mitigates for in terms of environmental impacts.
● Use a survey to identify all species of concern within a forest management unit to include at least all species that are covered by the Endangered Species Act (ESA).
● Synthesize how environmental and endangered species rules and laws have a direct impact on economics and forest resources.
● Identify culturally significant resources important to local indigenous populations.
● Evaluate the appropriateness of Road Maintenance and Abandonment Plan (RMAP) to the unit being harvested.
● Use aerial photograph data to identify and suggest a landing area to be used during harvest.
● Examine key components of a road maintenance inspection.
● Identify water quality impacts that may occur from harvest activity outside of the RMZs.
● Use GIS data to identify and determine RMZ boundaries for streams of different size classes.
● Create databases in a team focusing on usability of forestry information for industry and science.

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- Develop and host a student-led town hall or presentation for the city council, tribal council or other decision making body addressing an current forestry issue using evidence from current forest practice or tribal rules
- Create a database that will directly apply to GIS (such as KML, Survey123).

Some schools may also include:
- Use wildlife data collected from the field to create a habitat conservation plan (HCP).
- Create GIS maps to show areas impacted by different Environmental Impact Statement (EIS) rules and regulation and show who has jurisdiction in what areas.
- Produce GIS map of recreational uses (story map).
- Create a map of insect and disease infestations and report on forest health.
- Create a GIS maps of stream types, stream health, and stream enhancement plans.

Leadership Alignment: (Districts to complete for each unit)
Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.
Example:
- Divide the students into teams, have them set up their team with specific responsibilities, and collect and enter GIS data for a team report to the class.
- FFA tie-in could be Forestry or Natural Resources CDEs.

Industry Standards and/or Competencies:
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.

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○ 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.

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- ○ 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.

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	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

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	ESS3.A: Natural Resources ESS3.B: Natural Hazards ESS2.A: Earth Materials and Systems 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	
Constructing Explanations and Designing Solutions Analyzing and Interpreting Data Engaging in Argument from Evidence Using Mathematics and Computational Thinking Asking Questions and Defining Problems		Cause and Effect Stability and Change Systems and System Models Scale, Proportion, and Quantity

Unit 8: Supervised Agricultural Experience (SAE) Project/Record Keeping	**Total Learning Hours for Unit:** 5

Unit Summary: Students will demonstrate the complex interactions in forest ecosystems and the challenge of managing forest land in Washington State following the Forest Management Practices by establish and conduct Supervised Agricultural Experience Projects (SAE)

Competencies:

- Explain the benefits of SAE projects to skill development, leadership and career success.
- Explain the connection between SAE and FFA.
- Explain the two types of SAE:
    - 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)
- Explore ideas for SAE projects.and explain how SAE projects support academic achievement.
- Select and establish an SAE project.

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- Explain and keep records on established SAE projects.
- Explain SAE project Supervision, visitation and assessment.
- Explain the three circle concept for SAE, FFA Leadership, Classroom/Laboratory in an Agriculture Education program.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:
- Create an app or program for ideas for forestry projects
- Create models of landslide behavior, landslide prone areas, climate models to predict future events (fire, flood, wind damage)
- Make presentations that show different riparian areas and the modifications done to enhance the stream environment
- Show with data presentation the effects of positive riparian area reconstruction or repair
- Where applicable, create data sets for salmon recovery in streams that have had riparian area enhancements
- Create maps that update with automated weather station data
- Use drones to show pre- and post-riparian area repair or enhancement in a GIS story map

Some Schools may also include:
- Create an educational multimedia presentation. Examples being---tri-fold display; PowerPoint; YouTube video; a tweet; radio Public Service Announcement; poster/brochure, etc.
- Write a fact-based newspaper article and submit for publishing.
- Write an opinion-based article and submit for publishing on.
- Research and write a report on how historical figures played a prominent role in shaping how natural resources
- Agricultural Issues CDE
- Create an app for ideas for projects
- Create a website to show the care of and utilization of natural resources
- Create videos that show the stewardship of the environment from a particular viewpoint.
- Create a product that shows a timeline for forest regeneration after harvest.
- Effects of disease abatement
- Research the pros and cons of a current issue such as: endangered species, forest certification programs, climate change, small landowner incentives, Healthy Forests Initiative, prescribed burning policies, "Let it Burn" policy, biomass production.
- Use Ag Experience Tracker (AET) System or equivalent utilized to track SAE Project - Forestry Land Lab volunteer hours, home timber analysis, issues research out of class.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:
- Students are responsible for entering their own data into system and the data will be used in the annual Agriculture Education Report.

Industry Standards and/or Competencies:

Natural Resource Science (NRS)

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

[Type here]

- 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.

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

Cluster Skills ANRS
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

Aligned Washington State Academic Standards		
Science	Standards will be based on the SAE selected by the student	
Science and Engineering Practice	**Disciplinary Core Idea**	**Crosscutting Concept**

Unit 9: Forestry/Natural Resources Careers	**Total Learning Hours for Unit:** 10
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. Competencies include:	

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1. Become familiar with applications, cover letters, and resume writing.
2. Develop familiarity with the employment sections on the websites of various natural resource organizations (both public and private).
3. Understand the importance of both "soft" and "hard" skills in gaining employment.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- AET System or equivalent utilized to track SAE Project - Forestry Land Lab volunteer hours, home timber analysis, issues research out of class.
- Create resume, cover letter, and other documents a for natural resource/forestry position.
- Mock Interview.
- Examine various agencies' employment opportunities posted online.
- Explore post high school training/educational opportunities in natural resources career pathways.
- Create a multimedia presentation on a career.
- Job shadows/onsite visits.
- Decide best software programs to create portfolio for a specific job.
- Use apps to search and display job requirements and openings.
- Create skills assessment survey to show interest in different natural resources careers.
- Create GIS maps of different regional natural resources job openings.
- Create databases of jobs associated with natural resources.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students will be graded based on the hours entered into the record keeping system. Reports to the teacher will be printed out. Students in FFA can use this information as well as other information to apply for state degree and proficiency awards.

Industry Standards and/or Competencies:

Natural Resource Science (NRS)

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

- CS.05.01. Evaluate and implement the steps and requirements to pursue a career opportunity in each of the AFNR career pathways (e.g., goals, degrees, certifications, resumes, cover letter, portfolios, interviews, etc.).
    - CS.05.01.01.a. Identify and summarize the steps to pursue a career in an AFNR pathway (e.g., self-assessment, set goals, etc.).
    - CS.05.01.01.b. Create a personal plan outlining goals and steps to obtain a career in an AFNR pathway. CS.05.01.01.c. Evaluate progress toward AFNR career goals and identify opportunities for improvement and necessary adjustments to one's plan of action
    - CS.05.01.02.a. Examine the educational, training and experiential requirements to pursue a career in an AFNR pathway (e.g., degrees, certifications, training, internships, etc.).

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- ○ CS.05.01.02.b. Analyze personal skill set and create a plan for obtaining the required education, training and experiences to obtain a career in an AFNR pathway.
- ○ CS.05.01.02.c. Implement one's personal plan of action for obtaining the required education, training and experiences and evaluate progress to identify opportunities for improvement and necessary adjustments.
- ○ CS.05.01.03.a. Research and summarize specific tools (e.g., resumes, portfolios, cover letters, etc.) and processes (e.g., interviews, applications, etc.) needed to pursue a career in an AFNR pathway.
- ○ CS.05.01.03.b. Assess personal goals, experiences, education and skill sets and organize them to produce the appropriate tools and develop the skills to effectively communicate about one's qualifications for an AFNR career.
- ○ CS.05.01.03.c. Evaluate, update and improve a set of personal tools to reflect current skills, experiences, education, goals, etc. and complete the processes needed to pursue and obtain a career in an AFNR pathway.
- CS.05.02. Examine and choose career opportunities that are matched to personal skills, talents, and career goals in an AFNR pathway of interest. 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.
- o CS.05.02.01.a. Examine and categorize careers in each of the AFNR pathways.
- o   CS.05.02.01.b. Assess personal skills and align them with potential career opportunities in AFNR pathways. CS.05.02.01.c. Interpret and evaluate the results of a personal career assessment and connect them to potential careers in AFNR pathways.
- o CS.05.02.02.a. Research and describe careers in each of the AFNR pathways and choose potential careers connecting to personal interests and skills.
- o CS.05.02.02.b. Assemble and analyze examples of careers and related statistics on a local, state, national and global level.
- o CS.05.02.02.c. Conduct interviews with career professionals within AFNR pathways and summarize the results.

Aligned Washington State Academic Standards	
Science	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 the 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.*

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept

[Type here]

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