



This course was developed in 2024 by the Pacific Education Institute (PEI) with funding from Career Connect Washington. Writing participants include CTE teachers representing Ferndale, Onalaska, Pioneer, and Cape Flattery school districts; Chief Leschi Tribal Compact School; The Colville Confederated Tribes; Washington Department of Fish and Wildlife; and Pacific Shellfish Institute. The writing team also included two representatives from OSPI’s Office of Native Education and the math equivalence secondary science lead. 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 aquaculture and fisheries.

Advanced Aquaculture and Fisheries CTE Framework		
Course: Advanced Aquaculture and Fisheries		Total Framework Actual Hours: 180
CIP Code: Requesting new code	<input type="checkbox"/> Exploratory <input checked="" type="checkbox"/> Preparatory	Date Last Modified: 2/10/2025
Career Cluster: Agriculture, Food and Natural Resources		Cluster Pathway: Natural Resources Systems
<p>Course Summary: This course framework applies scientific and mathematical principles to aquaculture and fisheries management. The course includes units on safety, well-being, and ethics; stewardship and sustainability, aquatic organisms’ biology and ecology, water quality and animal husbandry, data science and analysis, facility and equipment operations and maintenance, communication, and marketing, and career pathways. The course aligns with and can be used with the Exploratory Introduction to Aquaculture and Fisheries framework. Students will complete a Supervised Agricultural Experience (SAE) as part of the course. The course is designed to meet requirements for 1.0 credit of lab science or 1.0 credit of math at a higher level than Algebra 1.</p>		

Unit Information	
Unit 1: Safety, Well-Being, and Ethics	Total Learning Hours for Unit: 10
<p>Unit Summary: This unit will highlight the skills necessary to work safely and effectively at a production facility or in the field.</p>	
<p>Competencies:</p> <ol style="list-style-type: none"> 1. Understand the safe and proper use of tools for aquaculture and fisheries practices (including cleaning, maintenance, and storage). 2. Engage in safe facility and field work procedures (ex: Pacing, adequate food, water, sleep, and use of personal protective equipment). 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 (chemical safety in a hatchery, for example).
5. Understand basic first aid relevant to working in a facility or in the field (recognize hypothermia, dehydration, heat exhaustion, etc.)
6. Understand the preventive measures to avoid slips, trips, and falls.
7. Attain Boater Safety Certification through the Washington Boater Education Safety course.

Components and Assessments

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 facility and field work safely and properly (ex: Pacing, adequate food, water, sleep, and use of personal protective equipment).
- Practice safe crew practices (includes skills in listening, following directions, keeping other crew members safe).
- Practice safe and proper hand tool use.
- Adhere to community partner's safety plans and protocols.
- Lead or assist in first aid skill role play activities.
- Record and update production facility inventory sheets.
- Ensure that supplies are cleaned, maintained, and stored properly.
- Complete an OSHA job hazard assessment form.
- Read a weather report and make safety decisions based on forecast.
- Read a tide chart and make safety decisions based on the information (where applicable).
- Complete the Washington Boater Education Safety Course to attain Boater Safety card.
- Identify potential hazards in a workplace, and suggest preventative measures to avoid slips, trips, and falls.

Related to Supervised Agricultural Experience (SAE):

- Describe the importance of safety protocols in workplaces.
- Create a list of supplies and personal protective equipment needed to implement the final project.
- Include examples of relevant safety signage that could be used in a production facility.
- Create a safety plan that includes protocols for a production facility.

Leadership Alignment:

- **3.B.3:** Assume shared responsibility for collaborative work, and value the individual contributions made by each team member **by practicing safe crew practices.**
- **4.B.1:** Use information accurately and creatively for the issue or problem at hand **by using information about weather reports, and map reading to navigate and make informed safety decisions.**
- **7.A.1:** Adapt to varied roles, job responsibilities, schedules, and contexts **in the field as a member of the crew.**
- **12.D.2:** Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance and stress reduction **by performing facility and field work safely and properly (ex: pacing, adequate food, water, sleep, and use of personal protective equipment).**
- **12.D.3:** Using available information to make appropriate health-related decisions **by adhering to community partner’s safety plans and protocols.**

Industry Standards and/or Competencies

Name of standards: National Council for Agriculture Education

Website: <https://thecouncil.ffa.org/afnr/>

AFNR Cluster Skills

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

Career Ready Practices Strand

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

Aligned Washington State Learning Standards

Unit Information

Unit 2: Stewardship and Sustainability

Total Learning Hours for Unit: 20

Unit Summary: This unit will engage students in dialogue about sustainability and stewardship related to the human role in the ecosystem, addressing sustainability from historical first people’s stewardship to today. The competencies and some of the performance assessments are the same as in the corresponding unit in Introduction to Aquaculture and Fisheries to allow students to dive deeper into these important concepts.

Competencies:

1. Understand *tragedy of the commons* through the lens of (A&F).
2. Identify and describe the impact of human activities on A&F systems.
3. Demonstrate media literacy by engaging in dialogue about current A&F issue(s) in their region (ex: Southern resident orcas, invasive species, land use, pollution).
4. Understand key Washington treaties and decisions that relate to tribal sovereignty and co-management (ex: Bolt Decision, Medicine Creek Treaty, Point No Point Treaty).
5. Recognize the role of co-management and tribal sovereignty in stewardship of produced and harvested species.
6. Utilize research on historical and contemporary A&F protocols to make management recommendations.

Components and Assessments**Performance Assessments:**

- Provide an example of how *tragedy of the commons* has, or may, impact local A&F management.
- Analyze potential solutions to mitigate *tragedy of the commons* impacts on a local A&F system.
- Research and identify possible solutions to resolve conflict within 1) an organization and 2) between an organization and external partners and/or agencies.
- Engage in dialogue with peers to create stewardship-based protocols behaviors for propagating, harvesting, and sustaining A&F systems.
- Investigate local habitat and/or culvert restoration work that impacts the sustainability of local A&F industry.
- Describe examples of co-management locally that are grounded in relationships with external partners (local, state, tribal, tribe –to-tribe, federal).
- Research permitting requirements to get, raise, release salmon and/or other farmed aquatic species.
- Study the following Billy Frank, Jr. ([quote source](#)) quote to answer reflection questions:
 - “I don’t believe in magic. I believe in the sun and the stars, the water, the tides, the floods, the owls, the hawks flying, the river running, the wind talking. They’re measurements. They tell us how healthy things are. How healthy we are. Because we and they are the same. That’s what I believe in.”
 - Reflection questions:
 - How can observation identify relationships between elements within natural systems?
 - How can observation identify conditions within a system (ex: Fish health)?
 - What types of measurements could we collect from one “element” described by Billy Frank, Jr.? (ex: sun, stars, tides).
- Define the terms *propagation*, *harvest*, and *sustaining fishery*.

- Know the species name and related story from the local tribal community for what the organism being raised (source: [Indigenous Leaders and Activists](#)).
- Engage in peer discussion about the importance of honest reporting
- Engage in peer discussion about the impact of regional and local management decisions. Discuss the ways example decisions impact human and non-human communities.
- Explain the difference between commercial and wild fishing.
- Respond to one or more of the following questions to connect the school's A&F program to regional initiatives:
 - How does our school's A&F program support stewardship of the local ecosystem?
 - How does our school's hatchery's survival and health data compare to regional and external partners?
 - How does our school work with the nearest tribal facility or nearest state facility to compare data?
 - What percentage of hatchery fish can be added to the environment without impacting wild populations?
 - Based on the results, what ratio of hatchery vs. wild populations would comprise a sustainable system?
 - How do numbers compare regionally?
 - How do numbers compare to nearest federal hatchery?
- Develop a computational simulation or representation to address one of the following A&F sustainability topics:
 - By-catch
 - Logging
 - Heat domes
 - Wildfires
 - Acidification
 - Agriculture
 - Other species and trophic levels (ex: Salmon and whale relationships, birds or seals stealing food from hatchery or fish ladder)
 - Any other human-caused events

Related to SAE:

- Research historical and contemporary production and harvesting protocols for a specific community partner or tribe. Use results of the investigation in the final project.
- Evaluate best practices for a chosen stewardship or sustainability topic that relates to course content.
- Create a list of best practices to use when partnering with organizations to make decisions that benefit the local ecosystem.

Leadership Alignment:

- **3.A.1:** Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in various forms and contexts **by preparing a presentation for your peers.**
- **5.A.3:** Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of media **by engaging in peer discussion about why honest reporting matters and why management decisions matter locally and regionally.**
- **12.E.1:** Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems **by responding to one of the questions listed in the 11th performance assessment above.**
- **12.E.2:** Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, management decision, stewardship actions, etc.) **by investigating the habitat and/or culvert restoration work locally that is impacting the sustainability of the local aquaculture and fisheries industry.**

Industry Standards and/or Competencies**Name of standards:** AFNR: NRS, CCR, CRP**Website:** <https://thecouncil.ffa.org/afnr/>**Agriculture, Food, and Natural Resources (AFNR) Standards: Natural Resource Science (NRS)**

- NRS.01 Plan and conduct resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.
- NRS.01.02.05. c. Evaluate the non-living resources present in an area to determine the best practices for improving, enhancing, and protecting an ecosystem.
- 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.02.05.01. c. Devise and implement a strategy for communicating a natural resources message through media.
- NRS.02.03.03. b. Analyze and document how some technological advancements changed how natural resources were used and viewed (e.g., Industrial Revolution, fossil fuels, green technology, etc.).
- NRS.04. Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.

AFNR Cluster Skills

- CS.04: CCTC Standard: Demonstrate stewardship of natural resources in AFNR activities.
- CS.04.01: Identify and implement practices to steward natural resources in different AFNR systems.

- CS.04.02: Assess and explain the natural resource related trends, technologies, and policies that impact AFNR systems.

Career Ready Practices Strand

- CRP.04.02. Produce clear, reasoned, and coherent written and visual communication in formal and informal settings.

Aligned Washington State Learning Standards

Mathematics

- HS.DS.1: Formulate multivariable statistical investigative questions and determine how data can be collected and provide an answer, consider causality and prediction when posing the question.
- HS.DS.2: Understand the issues of bias and confounding variables when collecting data and their impact on interpretation. Understand practices for collecting and handling data, including sensitive information and concerns for privacy and how that may affect data collection.
- HS.DS.3: Create and analyze data sets and data displays, including but not limited to scatter plots, regressions, histograms and boxplots using technology to sort or filter data, summarize, and describe relationships between quantitative variables.
- HS.DS.4: Acknowledge the presence of missing data values and understand how missing values may add bias to analysis and interpretation. Examine and discuss competing explanations for data trends observed such as confounding variables. Respond to competing arguments or interpretations of the data of different community groups, paying careful attention to what conclusions the data supports.
- HS.F. IF, B.4: for a function that models a relationship between two quantities, interpret key features of the graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- HS.F. IF.B.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- HS.F. IF, C.7d: Graph rational functions, identifying zeros and asymptotes when suitable factorss are available and showing end behavior (related to harvesting and carrying capacity of a system).

Science

- HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

	<p>HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.</p> <p>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.</p> <p>HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.</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>
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Unit Information

Unit 3: Biology and Ecology of Aquatic Organisms

Total Learning Hours for Unit: 20

Unit Summary: Students will explore the characteristics, habitats, and life cycles of local farmed aquatic species. They will learn species anatomy and the role the species play in the ecosystem.

Competencies:

1. Know the correct terminology to describe the anatomy of the farmed organism.
2. Recognize the features of a healthy organism, its habitat, and its role in the ecosystem.
3. Know the differences between the life cycles of farmed fish, shellfish, and macroalgae species.
4. Know the common and scientific name of farmed species.
5. Understand the concepts of fish stocks, ploidy manipulation (for shellfish) and non-native species introduction (for shellfish).
6. Evaluate claims about how ecosystem stability influences population dynamics and health.

Components and Assessments

Performance Assessments:

- Describe common aquatic species with its common and scientific name.
- Use correct terminology to identify the stages of the life cycle of a farmed organism in a working facility.
- Use correct terminology to identify the body parts and the functions of common aquatic species.

- Develop computational or mathematical representations of relationships that exist between an organism’s habitat requirements and its role in the environment.
- Demonstrate understanding of the term ploidy and research the reasons why ploidy manipulation is used in A&F.
- Read the definition of fish stock as defined by the Food and Agricultural Organization (FAO) and research why fish stocks are important in Washington State.
- Identify the non-native species that can impact shellfish and fin fish species through predation and/or competition in Washington State

Related to SAE:

- Use terminology and scientific names to accurately describe aquatic organisms.

Leadership Alignment:

- **2.B.1:** Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems *by developing computational or mathematical representations of relationships that exist between an organism’s habitat requirements and its role in the environment.*
- **2.C.4:** Interpret information and draw conclusions based on the best analysis *by demonstrating understanding of the term ploidy and research the reasons why ploidy manipulation is used in aquaculture and fisheries.*
- **3.A.3:** Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade) *by writing a letter to the editor or produce a video about the impact of aquaculture on the environment and craft a response justifying your answer citing two credible sources.*
- **5.B.1:** Understand and utilize the most appropriate media creation tools, characteristics and conventions *by writing a letter to the editor or produce a video about the impact of aquaculture on the environment and craft a response justifying your answer citing two credible sources.*

Industry Standards and/or Competencies

Name of standards: National Council for Agriculture Education

Website: <https://thecouncil.ffa.org/afnr/>

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

- NRS.01.02: Classify different types of natural resources to enable protection, conservation, enhancement and management in a particular geographical region.
- NRS.01.04: Apply ecological concepts and principles to aquatic natural resource systems.

Aligned Washington State Learning Standards

Mathematics

Relating to understanding of an organism’s habitat requirements and role in the environment:

	<p>HS.F.LE.A.1: Distinguish between situations that can be modeled with linear functions and with exponential functions.</p> <p>HS.F.LE.B.5: Interpret the parameters in a linear or exponential function in terms of a context.</p>
Science	<p>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.</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>

Unit Information

Unit 4: Water Quality and Animal Husbandry

Total Learning Hours for Unit: 20

Unit Summary: Students will build on their understanding of water quality and aquatic organisms to explore and engage in best husbandry practices and determine how they affect production.

Competencies:

1. Understand animal welfare and stocking to participate in the ethical handling of organisms.
2. Understand and explain the importance of water quality for the health of the organisms.
3. Use nutritional knowledge to feed organism.
4. Understand health management to assess health, culling, quarantine, and medicating.
5. Integrate an evidence-based claim that describes a given disease, pest, or nutritional deficiencies impacts on present and future yields.

Components and Assessments

Performance Assessments:

- Independently handle organisms using correct safety and animal welfare protocol.
- Perform water quality tests independently identifying discrepancies and taking corrective steps.
- Design and maintain a nitrogen cycle in a closed system.
- Calculate feed ratios based on size and stock ratios.
- Build and install a filter in an aquaculture tank.

- Diagnose and suggest treatment or protocols for health-related issues.
- Study the foundational design and functions of a fishery/aquaculture system to identify those features that minimize its impact on the environment and suggest improvements to the design that would further minimize its impact on the environment.
- Identify a disease or disease, pest, or nutritional deficiency in an A&F system or local ecosystem.
- Design, evaluate, and refine a solution for reducing impacts of a disease, pest, or deficiency on an A&F system.
- Analyze and use data to create a mathematical representation that shows the spread of a disease or pest in an A&F system.
- Design a system to use multiple shellfish grow out methods to analyze the pros and cons of each.
- Develop or revise a simulation that shows the impact of a common disease and or pest on a specific aquatic species and propose a solution.

Related to SAE:

- 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 health-related issues.

Leadership Alignment:

- **2.A.1:** Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation **by calculating feed ratios based on size and stock ratio.**
- **2.B.1:** Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems **by designing and maintaining a nitrogen cycle in a closed system.**
- **2.D.1:** Solve different kinds of non-familiar problems in both conventional and innovative ways **by designing a system to use multiple shellfish grow out methods to analyze the pros and cons of each.**
- **2.D.2:** Identify and ask significant questions that clarify various points of view and lead to better solutions **by developing or revising a simulation that shows the impact of a common disease and or pest on a specific aquatic species and propose a solution.**

Industry Standards and/or Competencies

Name of standards: National Council for Agriculture Education

Website: <https://thecouncil.ffa.org/afnr/>

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

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

Aligned Washington State Learning Standards

Mathematics

- HS.DS.1: Formulate multivariable statistical investigative questions and determine how data can be collected and provide an answer, consider causality and prediction when posing the question.
- HS.DS.2: Understand the issues of bias and confounding variables when collecting data and their impact on interpretation. Understand practices for collecting and handling data, including sensitive information and concerns for privacy and how that may affect data collection.
- HS.DS.3: Create and analyze data sets and data displays, including but not limited to scatter plots, regressions, histograms and boxplots using technology to sort or filter data, summarize, and describe relationships between quantitative variables.
- HS.DS.4: Acknowledge the presence of missing data values and understand how missing values may add bias to analysis and interpretation. Examine and discuss competing explanations for data trends observed such as confounding variables. Respond to competing arguments or interpretations of the data of different community groups, paying careful attention to what conclusions the data supports.
- HS.S.ID. A.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- HS.S.IC. A.1: Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- HS.S.IC. B.5: Use data from a randomized experiment to compare two treatments: use simulations (mathematical models with or without tech tools) to decide if differences between parameters are significant.
- HS.F.LE.A.1C: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

Science

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

	<p>HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</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-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.</p>
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Unit Information

Unit 5: Data Science and Analysis	Total Learning Hours for Unit: 10
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Unit Summary: Students will explore how to quantify physical and anecdotal observations to make comparisons and predictions. Students will learn best practices to collect data, make inferences, and make management recommendations. Students will conduct their own research and articulate their findings to an audience.

- Competencies:**
1. Compare and contrast *precision* and *accuracy* in accordance with scientific methods.
 2. Use probability to make decisions surrounding care of organisms.
 3. Know how to use spreadsheets to manipulate data, including calculating and interpreting averages, standard deviations, correlations and identification of outliers.
 4. Interpret categorical and quantitative data and justify conclusions.
 5. Recognize the importance of communicating the findings of research, including the full scope of work, methodology, and conclusions.
 6. Know the kind of data that is archived at local facilities, and why such data is archived.

Components and Assessments

- Performance Assessments:**
- Demonstrate the differences between *accuracy* and *precision* through data-based examples.
 - Download and transport data from automated or online source
 - Review how to calculate the probability of an event and apply this calculation to a decision that is often made in an aquatic facility.
 - Evaluate the quality and validity of personally generated and internet sources of data to form management recommendations.

- Generate a data set of interest, and communicate results of data analysis through oral, written, or electronic media to an audience.
- Analyze a data set including calculating and interpreting averages, standard deviations, correction, and identification of outliers.
- Manipulate data in a spreadsheet (ex: Use sort and arrange functions for graphical analysis).
- Use information from a data set to make management recommendations (ex: Using a population of shellfish on a beach, calculate recreational harvesters' total allowable catch and percent to be allocated to tribes).
- Research the types of data archived in local facilities and evaluate why those data sets were selected for measurement.
- Develop a model that depicts how a chosen variable can be used to maximize production, harvesting, or other factors.
- Analyze computational models used to evaluate the effect of human activities (ex: consumption, pollution, atmospheric carbon, recreation).

Related to SAE:

- Collect data to measure change over time based on a chosen variable.
- Use a mathematical model supported by scientific reasoning to make management recommendations.
- Translate quantitative or technical information into a visual representation or project (ex: table, chart, infographic, equation).
- Use proper documentation and sourcing for final project.
- Use findings from models to make recommendations or test a hypothesis within an A&F system.
- Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of a farmed or wild ecosystem at different scales.
- Input and analyze data relevant to the industry's record keeping/admin needs (ex: Completion of tables and forms).
- Use climate and weather projections to analyze potential impact on A&F production and harvest.
- Use Google Maps and GPS data to track the location of shellfish plantings and growing areas.

Leadership Alignment:

- Given local weather data, students **effectively analyze and evaluate evidence, arguments, claims and beliefs (2.C.1)** to construct an explanation, as to 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.
- Students **analyze and evaluate major alternative points of view (2.C.2)** as they practice identifying culturally relevant resources with the help of local elders and tribal representatives.
- **2.C.4:** Interpret information and draw conclusions based on the best analysis ***by researching the kind of data archived in local facilities and why.***

- **4.A.1:** Access information efficiently (time) and effectively (sources) *by inputting and analyzing data relevant to the industry's recordkeeping/admin needs.*
- **4.A.2:** Evaluate information critically and competently *by evaluating the quality and validity of personally generated and internet sources of data to form a recommendation for a new idea for the workplace.*
- **4.B.1:** Use information accurately and creatively for the issue or problem at hand *by using probability to make decisions surrounding care of organisms.*
- **4.B.2:** Manage the flow of information from a wide variety of sources by using Google Maps and GPS data to track the location of shellfish plantings and growing areas.
- **4.B.3:** Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information *by generating a data set of interest and communicating data through oral, written, or electronic media to an audience.*

Industry Standards and/or Competencies

Name of standards: National Council for Agriculture Education

Website: <https://thecouncil.ffa.org/afnr/>

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.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.

Career Ready Practices

- CRP.07.01. Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.
- CRP.07.02. Evaluate the validity of sources and data used when considering the adoption of new technologies, practices and ideas in the workplace and community.
- CRP.08.01. Apply reason and logic to evaluate workplace and community situations from multiple perspectives.

Aligned Washington State Learning Standards

Mathematics

- HS.DS.1: Formulate multivariable statistical investigative questions and determine how data can be collected and provide an answer, consider causality and prediction when posing the question.
- HS.DS.2: Understand the issues of bias and confounding variables when collecting data and their impact on interpretation. Understand practices for collecting and handling data, including sensitive information and concerns for privacy and how that may affect data collection.
- HS.DS.3: Create and analyze data sets and data displays, including but not limited to scatter plots, regressions, histograms, and boxplots using technology to sort or filter data, summarize, and describe relationships between quantitative variables.
- HS.DS.4: Acknowledge the presence of missing data values and understand how missing values may add bias to analysis and interpretation. Examine and discuss competing explanations for data trends observed such as confounding variables. Respond to competing arguments or interpretations of the data of different community groups, paying careful attention to what conclusions the data supports.
- HS.S.ID.A.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- HS.S.ID.A.4: Use the mean and standards deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate area under the normal curve.

	<p>HS.S.ID.B.6: Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.</p> <p>HS.S.ID.B.6 Informally assess the fit of a function by plotting and analyzing residuals.</p> <p>HS.S.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.</p> <p>HS.S.ID.C.8: Compute (using technology) and interpret the correlation coefficient of a linear fit.</p> <p>HS.S.CP.A.1: Describe events as a subset of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not).</p> <p>HS.S.CP.A.4: Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.</p>
<p>Science</p>	<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>

Unit Information

Unit 6: Facility and Equipment Operations and Maintenance

Total Learning Hours for Unit: 30

Unit Summary: In this unit, students will build upon skills learned in the exploratory course in the operation and maintenance of basic facilities and equipment.

Competencies:

1. Demonstrate the efficient use of tools and equipment (ex: Pressure washer, weed eater, vehicles)
2. Apply standard routine maintenance (ex: Weed eater check, gas overall maintenance, etc., pre-operation fuel checks).
3. Perform maintenance and troubleshoot basic issues with a pump system.
4. Identify hatchery infrastructure (ex: Wells, pumps, aeration, generators), and evaluate performance.
5. Evaluate potential hazards of electrical systems (covered by L&I or OSHA 10 certification).

Components and Assessments

Performance Assessments:

- Read operations manuals and practice safe use of equipment (pressure washer, weed eater, blower, mower)
- Perform routine maintenance on equipment unsupervised.
- Describe the location of relevant MSDS sheets.
- Review relevant MSDS sheets for safety protocols and information...
- Prepare a lesson to teach exploratory students about MSDS safety aspects.
- Based on research, practice performing basic maintenance and troubleshooting on a pump system.
- Explain hatchery infrastructure to a person not familiar with a hatchery.
- Describe the criteria used to make basic decisions (ex: Cost, safety, or environmental stewardship).
- Complete the one-hour OSHA 10 online electrical safety course and earn certification.

Related to SAE:

Leadership Alignment:

- **2.D.1:** Solve different kinds of non-familiar problems in both conventional and innovative ways **by performing basic maintenance on a pump system as well as troubleshooting basic issues.**
- **7.A.1:** Adapt to varied roles, jobs responsibilities, schedules, and contexts **by explaining the hatchery infrastructure to a person not familiar with a hatchery addressing the criteria used to make basic decisions such as cost, safety, or environmental issues.**
- **8.B.1:** Monitor, define, prioritize, 10.B.1.a Work positively and ethically 10.B.1.b Manage time and projects effectively 10.B.1.c Multi-task 10.B.1.d Participate actively, as well as be reliable and punctual 10.B.1.e Present oneself professionally and with proper etiquette 10.B.1.f Collaborate and

cooperate effectively with teams 10.B.1.g Respect and appreciate team diversity 10.B.1.h Be accountable for results and complete tasks without direct oversight **by performing routine maintenance on equipment unsupervised.**

- **10.B.1:** Demonstrate additional attributes associated with producing high quality products including the abilities to: 10.B.1.a Work positively and ethically 10.B.1.b Manage time and projects effectively 10.B.1.c Multi-task 10.B.1.d Participate actively, as well as be reliable and punctual 10.B.1.e Present oneself professionally and with proper etiquette 10.B.1.f Collaborate and cooperate effectively with teams 10.B.1.g Respect and appreciate team diversity 10.B.1.h Be accountable for results

Industry Standards and/or Competencies

Name of standards: AFNR: Career Cluster Skills

Website: <https://thecouncil.ffa.org/afnr/>

AFNR Cluster Skills

- CS.03.01: identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.
- CS.03.04: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

Aligned Washington State Learning Standards

<p><u>Mathematics</u></p>	<p>Demonstrate understanding of volts, amps, and ohms through the following stds:</p> <p>HS.A.CED. A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p>
<p><u>Science</u></p>	<p>HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</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> <p>HS-PS3-5: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.</p>

Unit Information

Unit 7: Communication and Marketing

Total Learning Hours for Unit: 10

Unit Summary: In this unit, students will build on their understanding of the importance of what (what is appropriate or not) and how best to communicate about A&F operation.

Competencies:

1. Verbally articulate the meaning of digital citizenship.
2. Demonstrate ability to discern the most relevant and appropriate topics to communicate about a facility's operation.
3. Articulate the attributes of a quality product and articulate why those attributes are important (ex. A damaged fin could be a place for bacteria).
4. Demonstrate media literacy by developing a communication piece for an external audience.
5. Know the appropriate terminology to use in communicating about tribal sovereignty and co-management.
6. Understand role of sustainability in marketing of A&F.

Components and Assessments

Performance Assessments:

- Produce promotional material for a facility using at least two different forms of communication (ex: Blog, brochure, short video, website).
- Write a blog post or produce a video about the impact of aquaculture on the environment citing two credible sources.
- Research marketing strategies in the fisheries industry. Identify similarities and differences between them.
- Prepare a 30-second speech for peers to communicate components of digital citizenship.
- Write and present responses to frequently asked questions about the facility, the industry, and the role tribal sovereignty and co-management. Make edits based on feedback.

Related to SAE:

- Integrate understanding of stewardship and sustainability concepts into communication and marketing plan for final project.

Leadership Alignment:

- 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 **develop, implement and communicate new ideas to others effectively (1.B.1), be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work (1.B.2), articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts(3.A.1), and assume shared responsibility for collaborative work, and value the individual contributions made by each team member (3.B.3)** as they take on various leadership roles.
- Students will **demonstrate originality and inventiveness in work and understand the real-world limits to adopting new ideas (1.B.3)** 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
- **3.A.3:** Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade) **by writing and presenting responses to frequently asked questions about the facility, the industry, and the role tribal sovereignty and co-management play. Make edits based on feedback.**
- **3.A.4:** Utilize multiple media and technologies and know how to judge their effectiveness a priori as well as assess their impact **by producing promotional material for a facility using at least two different forms of communication.**
- **5.A.1:** Understand both how and why media messages are constructed, and for what purposes.
- **5.A.2:** Examine how individuals interpret messages differently, how values and points of view are included or excluded, and how media can influence beliefs and behaviors by researching different marketing strategies in the fisheries industry and identifying the differences between them.

Industry Standards and/or Competencies

Name of standards: National Council for Agriculture Education

Website: <https://thecouncil.ffa.org/afnr/>

Agriculture, Food, and Natural Resources Standards: Natural Resources Sciences

- NRS.05.01. Communicate natural resource information to the public.

Cluster Skills

- CS.02.01. Research and use geographic and economic data to solve problems in AFNR systems.
- CS.02.02. Examine the components of the AFNR systems and assess their impact on the local, state, national and global society and economy.

Career Ready Practices Strand

- CRP.01.02. Evaluate and consider the near-term and long-term impacts of personal and professional decisions on employers and community before 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.04.03. Model active listening strategies when interacting with others in formal and informal settings.
- CRP.09.02. Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).

Aligned Washington State Learning Standards

Unit Information

Unit 9: Career Pathways

Total Learning Hours for Unit: 15

Unit Summary: This unit will allow students to develop and enhance their employability skills. This unit will highlight the importance of the aquaculture and fisheries industry from a cultural, recreational, and commercial perspective while students explore the positions in the industry and the skills that those positions require. This unit also gives students time to enroll in a dual credit program and/or research the steps required to attain industry recognized credentials.

Competencies:

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 various 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.
10. Demonstrate ability to accept critique and questions regarding their study in a professional manner.
11. Know the value of transferrable skills.
12. Understand the cultural, recreational, commercial value of farmed aquatic species.
13. Understand the steps involved in applying to the Aquaculture and Fisheries program at Bellingham Technical College
14. Experience workplace environment, etiquette, and communication (on-farm conditions).

Components and Assessments

Performance Assessments:

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

- With the resources provided by Bellingham Technical College OR through a classroom visit by a BTC instructor, complete the necessary steps to enroll in the Aquaculture and Fisheries program. *
- 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.
- Identify the skills necessary to perform the duties of selected positions within the field of aquaculture and fisheries that could be transferrable to other positions (ability to work on a crew, for example)
- Research multiple sources to complete an overview of either the cultural, recreational, or commercial value of aquatic species as a whole and evaluate that information relative to other major industries in the state
- Research multiple sources to complete an overview of the value of a single aquatic species/stock to Washington state's economy
- Complete the steps necessary to complete one or more of the following:
 - Dual credit articulation
 - Certification for Boater Safety,
 - Receipt of a Driver's license
 - OSHA10 certification
 - Pacific Education Institute's Document of Competency

Related to SAE:

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

*See the course outline of teacher resources OR contact the college directly to access these resources

Leadership Alignment:

- **3.A.1:** Students will articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts in ***a mock interview for a natural resources position.***
- **4.A.2** Evaluate information critically and competently ***by researching multiple sources to complete an overview of either the cultural, recreational, or commercial value of aquatic species as a whole and evaluating that information relative to other major industries in the state.***
- **8.A.2:** Students will balance short-term and long-term goals ***to create a list of gained individual skills and experiences that are relevant to natural resource jobs.***
- **8.B.1** Monitor, define prioritize and complete tasks without direct oversight ***by experiencing workplace environment, etiquette, and communication (on-farm conditions).***
- **8.C.2:** Students will demonstrate the initiative to advance skill levels towards a professional level ***by contacting a natural resources organization to request an informational interview.***
- **8.C.4:** Students will reflect critically on past experiences to inform future progress ***by completing a self-assessment to identify qualifications and reflect on opportunities for future job skill growth.***

Industry Standards and/or Competencies

Name of standards: National Council for Agriculture Education

Website: <https://thecouncil.ffa.org/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.05.02. Examine and choose career opportunities that are matched to personal skills, talents, and career goals in an AFNR pathway of interest.
- CRP.10.01. Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.

Career Ready Practices Strand

- 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.

Aligned Washington State Learning Standards

Unit Information

Unit 9: Supervised Agricultural Experience (SAE) Project

Total Learning Hours for Unit: 25

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 aquaculture and fisheries work.

Competencies:

1. Understand the benefits of the SAE for skill development, leadership and career success.
2. Demonstrate self-directed learning skills.
3. Describe the two types of SAE:
4. 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)
5. Immersion SAE (Entrepreneurship/Ownership, Placement/Internships, Research (Experimental, Analytical, Invention), School Business Enterprises, Service Learning)
6. Select an SAE topic that relates to course topics as well as the student's personal interests, academic goals, and career goals.
7. Develop procurement and funding plans.
8. Understand how presentation and reporting formats influence delivery of content to audiences.
9. Use systems thinking (interconnectedness, emergent properties, causality, feedback loops in an ecosystem) to develop SAE project.
10. Demonstrate flexibility.

Components and Assessments

Performance Assessments:

- 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:
 - Determine the goals of the SAE project.
 - Identify resources and data to be collected to meet project goals.
 - Select the types of data that will be meaningful.
 - Collect data to be used in the final project.
 - Keep records that pertain to the chosen SAE project.
 - Enter data into an Excel spreadsheet.

- Create maps that display necessary data.
- Cite sources that are included in the proposal.
- Prepare and deliver final project deliverables.

Leadership Alignment:

- Students will **demonstrate initiative to advance skill levels towards a professional level (8.C.2)** and **balance short-term and long-term goals (8.A.2)** as they enter their own data into the system and use Ag Experience Tracker (AET) System or equivalent utilized to track SAE project.

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/or Competencies

Name of standards: National Council for Agriculture Education	Website: https://thecouncil.ffa.org/afnr/
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Agriculture, Food, and Natural Resources Standards: Natural Resources Sciences

- 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.

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.

Career Ready Practices Strand

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

Aligned Washington State Learning Standards

HS.DS.1: Formulate multivariable statistical investigative questions and determine how data can be collected and provide an answer, consider causality and prediction when posing the question.

HS.DS.2: Understand the issues of bias and confounding variables when collecting data and their impact on interpretation. Understand practices for collecting and handling data, including sensitive information and concerns for privacy and how that may affect data collection.

HS.DS.3: Create and analyze data sets and data displays, including but not limited to scatter plots, regressions, histograms and boxplots using technology to sort or filter data, summarize, and describe relationships between quantitative variables.

HS.DS.4: Acknowledge the presence of missing data values and understand how missing values may add bias to analysis and interpretation. Examine and discuss competing explanations for data trends observed such as

Mathematics

	<p>confounding variables. Respond to competing arguments or interpretations of the data of different community groups, paying careful attention to what conclusions the data supports.</p> <p>Additional math standards will be based on the SAE selected by the student.</p>
Science	Standards will be based on the SAE selected by the student.