Oregon Agriculture, Food and Natural Resources (AFNR)

AFNR - Environmental Service Systems

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

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

- 1a Identify sample types and sampling techniques used to collect laboratory and field data. ESS.01.01.01.A.
- 1b Determine the appropriate sampling techniques needed to generate data. ESS.01.01.01.B.
- 1c Collect and prepare sample measurements using appropriate data collection techniques. ESS.01.01.01.C.
- 2a Identify methods of statistical analysis commonly used in research (e.g., mean, standard deviation, standard error, error bars, etc.). ESS.01.01.02.A.
- 2b Summarize the purpose of statistical analysis methods commonly used in environmental service systems research and explain examples of their use in practice ESS.01.01.02.B.
- 2c Utilize data analysis to identify trends in a data sample and assess the confidence that can be drawn from those conclusions. ESS.01.01.02.C.

2 **Properly utilize scientific instruments in environmental monitoring situations (e.g., laboratory equipment, environmental monitoring instruments, etc.).** ESS.01.02.

- 1a Identify basic laboratory equipment and explain their uses. ESS.01.02.01.A.
- 1b Demonstrate the proper use and maintenance of basic laboratory equipment. ESS.01.02.01.B.
- 1c Calibrate and use laboratory equipment according to standard operating procedures. ESS.01.02.01.C.
- 2a Identify basic environmental monitoring instruments and explain their uses. ESS.01.02.02.A.
- 2b Demonstrate the proper use and maintenance of environmental monitoring instruments ESS.01.02.02.B.
- 2c Calibrate and use environmental monitoring instruments according to standard operating procedures. ESS.01.02.02.C.

Ev Skip to main content **nterpret and evaluate the impact of laws, agencies, policies and practices public policies and affecting environmental service systems.** ESS.02.01.

regulations on environmental service system operations. ESS.02.

1a Distinguish between the types of laws associated with environmental service systems. ESS.02.01.01.A.

1b Analyze the structure of laws associated with environmental service systems. ESS.02.01.01.B.

1c Evaluate the impact of laws associated with environmental service systems for their impact on wildlife, people, the environment and the economy. ESS.02.01.01.C.

2a Distinguish between the types of government agencies (i.e., local, state and federal) associated with environmental service systems. ESS.02.01.02.A.

2b Analyze the specific purpose of government agencies associated with environmental service systems. ESS.02.01.02.B.

2c Evaluate the impact and effectiveness of government agencies (i.e., local, state, and federal) associated with environmental service systems (e.g., regulation of consumption, prevention of damage to natural resources systems, management of ecological interactions, etc.). ESS.02.01.02.C.

3a Research policies, practices and initiatives common in business and advocacy groups associated with environmental service systems (e.g., zero-waste, LEED-certified, locally-grown, etc.). ESS.02.01.03.A.

3b Assess the intent, feasibility and effectiveness of policies, practices and initiatives common in business and advocacy groups associated with environmental service systems. ESS.02.01.03.B.

3c Evaluate the impact of policies, practices and initiatives common in business and advocacy groups associated with environmental service systems on wildlife, people, the environment and the economy. ESS.02.01.03.C.

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2 **Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).** ESS.02.02.

1a Research and categorize the purpose, implementation and impact of greenhouse gas emission policies (e.g., capand-trade, emission offsetting, zero-emissions, carbon-neutrality, carbon sequestration, etc.). ESS.02.02.01.A.

1b Assess the effectiveness and impact of greenhouse gas emissions policies. ESS.02.02.01.B.

1c Devise new policies for controlling greenhouse gas emissions that reduce atmospheric carbon levels while generating additional economic activity. ESS.02.02.01.C.

2a Research the impact of environmental service systems regulations on international trade. ESS.02.02.02.A.

2b Analyze how environmental service systems regulations can both negatively and positively affect international trade. ESS.02.02.02.B.

`c Interpret and evaluate the impact of specific environmental service regulation policies (e.g., Clean Air Act, EISA, Clean Water Act, Superfund, etc.) on international trade. ESS.02.02.02.C.

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3a Examine and summarize the impact that population growth has on environmental service systems ESS.02.02.03.A.

3b Analyze the correlation between increased population size and the need for regulation of environmental service systems. ESS.02.02.03.B.

3c Predict the impact of future population growth on the regulation of environmental service systems and evaluate how changes made today will impact future regulations. ESS.02.02.03.C.

4a Research current policies related to fracking and shale oil gas. ESS.02.02.04.A.

4b Assess whether current policies related to fracking and shale oil gas sufficiently address the needs of environmental service systems. ESS.02.02.04.B.

4c Evaluate current fracking policies and create suggestions for modification of these policies to more thoroughly address the needs related to environmental, economic and social sustainability. ESS.02.02.04.C.

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3 Examine and summarize the impact of public perceptions and social movements on the regulation of environmental service systems. ESS.02.03.

1a Research and summarize how the perception and regulation of environmental service systems has changed over time. ESS.02.03.01.A.

1b Analyze and summarize specific changes to perceptions and regulations of environmental service systems and their impact on reducing the ecological, economical and sociological impact. ESS.02.03.01.B.

1c Evaluate the impact of specific historical figures, or organizations, on the perception and regulation of environmental service systems. ESS.02.03.01.C.

2a Examine how social views and movements (e.g., zero-waste philosophy, carbon footprints, recycling, etc.) have affected the implementation and need for regulation of environmental service systems. ESS.02.03.02.A.

2b Assess the effectiveness of specific social movements related to regulation of environmental service systems. ESS.02.03.02.B.

2c Research current issues related to modern or future environmental service systems and devise strategies for engaging the public to address these issues through social movements. ESS.02.03.02.C.

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

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

1a Distinguish between the different components and structural layers of the earth's atmosphere. ESS.03.01.01.A.

1b Differentiate how components of the atmosphere (e.g., weather systems and patterns, structure of the atmosphere, etc.) affect environmental service systems. ESS.03.01.01.B.

1c Utilize meteorological data to assess the impact of atmospheric conditions on environmental service systems. ESS.03.01.01.C.

a Analyze how meteorological conditions influence air quality. ESS.03.01.02.A.

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2b Analyze and articulate the relationship between meteorological conditions, air quality and air pollutants. ESS.03.01.02.B.

2c Interpret data measuring air pollution to determine its threat on human populations and ecological interactions. ESS.03.01.02.C.

3a Research climate change and summarize evidence that climate change is occurring. ESS.03.01.03.A.

3b Assess the environmental, economic and social consequences of climate change. ESS.03.01.03.B.

3c Evaluate the predicted impacts of global climate change on environmental service systems. ESS.03.01.03.C.

4a Examine and summarize factors that affect the earth's balance of energy. ESS.03.01.04.A.

4b Analyze the basics of the greenhouse effect and describe how the greenhouse effect alters the earth's balance of energy. ESS.03.01.04.B.

4c Utilize data to predict and forecast future levels of greenhouse gas pollution and outline steps necessary to mitigate the resulting damage. ESS.03.01.04.C.

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

1a Differentiate and distinguish land uses, capability factors and land capability classes. ESS.03.02.01.A.

1b Use a soil survey to determine the land capability classes for different parcels of land in an area. ESS.03.02.01.B.

1c Design a master land-use management plan for a given area that utilizes land capability classes in order to minimize erosion and flooding, maximize development and preservation of topsoil, et cetera. ESS.03.02.01.C.

2a Research and describe the process of soil formation through weathering. ESS.03.02.02.A.

2b Differentiate rock types and relate the chemical composition of mineral matter in soils to the parent material. ESS.03.02.02.B.

2c Evaluate the soil composition in order to predict the impact of that soil on environmental service systems. ESS.03.02.02.C.

3a Examine and explain how the physical qualities of the soil influence the infiltration and percolation of water. ESS.03.02.03.A.

3b Assess the physical qualities of the soil that determine its potential for filtration of groundwater supplies and likelihood for flooding. ESS.03.02.03.B.

3c Conduct tests of soil to determine its potential for filtration of groundwater supplies and likelihood for flooding. ESS.03.02.03.C.

4a Summarize environmental hazards associated with groundwater supplies. ESS.03.02.04.A.

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b Assess the effectiveness of precautions taken to prevent or reduce contamination of groundwater supplies. ESS.03.02.04.B.

4c Evaluate the methods used in a given example to protect groundwater supplies. ESS.03.02.04.C.

5a Research and summarize hydrogeology and differentiate between groundwater and surface water. ESS.03.02.05.A.

5b Analyze how interactions between groundwater and surface water affect flow and availability of water. ESS.03.02.05.B.

5c Construct explanations and solutions to situations involving the declining availability of water that incorporate groundwater flow equations as well as human activity. ESS.03.02.05.C.

6a Research and describe how groundwater and surface water interactions affect the existence of wetlands. ESS.03.02.06.A.

6b Analyze the importance of the roles played by wetlands in regards to water availability, prevention of flooding and other factors. ESS.03.02.06.B.

6c Evaluate and select strategies for wetlands preservation and restoration that maximize services provided by wetlands while taking human concerns into consideration. ESS.03.02.06.C

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

1a Examine and summarize how chemistry affects soil structure and function (e.g., pH, cation-exchange capacity, filtration capability, flooding likelihood, etc.). ESS.03.03.01.A.

1b Analyze the soil chemistry of a sample. ESS.03.03.01.B.

1c Evaluate a sample's soil chemistry and assess how the results may impact considerations in environmental service systems. ESS.03.03.01.C.

2a Examine and summarize how chemistry affects water quality and function (e.g., oxygen saturation, pH, biomagnification, etc.). ESS.03.03.02.A.

2b Analyze the water chemistry of a sample. ESS.03.03.02.B.

2c Evaluate a sample's water chemistry and assess how the results may impact considerations in environmental service systems. ESS.03.03.02.C.

3a Examine and summarize how chemistry affects air quality and function (e.g., heat retention, formation of smog and acid rain, etc.). ESS.03.03.03.A.

3b Analyze how components of atmospheric chemistry (e.g., air chemical components, heat, moisture, etc.) affect air quality. ESS.03.03.03.B.

3c Assess the impact of atmospheric chemistry on operational decisions in environmental service systems. ESS.03.03.03.C.

4a Examine and summarize the relationship between water and soil chemistry and the formation of different kinds of wetlands (e.g., fens, peat bogs, potholes, etc.). ESS.03.03.04.A.

4b Assess how different kinds of wetlands are formed based on the different kinds of soil and water chemistry present in each case. ESS.03.03.04.B.

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4c Evaluate the services provided by types of wetlands and predict how different types of wetlands respond to pressures due to human activity. ESS.03.03.04.C.

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

1a Describe the microbial biodiversity found in soil and summarize the contribution of microbial biodiversity to the physical and chemical characteristics of soil. ESS.03.04.01.A.

1b Assess how the activities of microorganisms in soil affect environmental service systems and ecosystem biodiversity. ESS.03.04.01.B.

1c Evaluate how soil microorganisms in environmental service systems can be used to minimize waste, maximize nutrient ESS.03.04.01.C.

2a Research and describe how microbial populations in an ecosystem affect carbon cycling. ESS.03.04.02.A.

2b Analyze the microbial populations present in an area and assess how carbon cycling is affected. ESS.03.04.02.B.

2c Develop strategies for negating air pollutants based on soil microbial populations (e.g., carbon sequestration and rates of decomposition). ESS.03.04.02.C.

3a Examine and explain the role that microbes play in wastewater treatment. ESS.03.04.03.A.

3b Assess the impact of wastewater treatment on environmental service systems. ESS.03.04.03.B.

3c Evaluate modern uses of microbial waste water treatment and devise strategies to further reduce the environmental, economic and social impact of wastewater treatment. ESS.03.04.03.C.

4a Research the purposes of bioassay tests and describe potential applications for environmental service systems. ESS.03.04.04.A.

4b Analyze procedures for a bioassay test. ESS.03.04.04.B.

4c Conduct bioassay tests related to environmental service systems and interpret results. ESS.03.04.04.C.

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

1a Research the role that biodiversity plays in environmental service systems and how biodiversity can be measured. ESS.03.05.01.A.

1b Calculate the amount of biodiversity in a given area using an appropriate method (e.g., quadrat assessment, transect measurements, etc.). ESS.03.05.01.B.

1c Evaluate the biodiversity of an area and predict the impact of changing the levels of biodiversity on environmental service systems. ESS.03.05.01.C.

2a Examine and explain the role played by habitats on environmental service systems. ESS.03.05.02.A.

2b Assess the impact of the current rate of hab ESS.03.05.02.B.

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c Evaluate the importance of habitat to environmental service systems and devise strategies to minimize the future loss of habitats. ESS.03.05.02.C.

3a Research and explain how carrying capacities relate to environmental service systems (e.g., waste processing, rate or production of pollution, disease, etc.). ESS.03.05.03.A.

3b Assess and describe the impact of a population exceeding its carrying capacity on environmental service systems. ESS.03.05.03.B.

3c Devise a strategy for monitoring and supporting environmental service systems through management of a species' carrying capacity. ESS.03.05.03.C.

4a Examine and describe how ecological interactions can be used to assess environmental service systems (i.e., macroinvertebrates and/or amphibians as bioindicators). ESS.03.05.04.A.

4b Evaluate the benefits and drawbacks of using bioindicator species in environmental service systems. ESS.03.05.04.B.

4c Utilize evidence from bioindicator species to detect pollutants in a given area. ESS.03.05.04.C.

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

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

1a Identify and distinguish types of pollution and distinguish between point source and nonpoint source pollution. ESS.04.01.01.A.

1b1 Assess how industrial and nonindustrial pollution has damaged the environment. ESS.04.01.01.B.

1c Evaluate evidence for a given area for industrial and nonindustrial pollution. ESS.04.01.01.C.

2a Research ways in which pollution can be managed and prevented and propose solutions to meet the needs of local systems. ESS.04.01.02.A.

2b Conduct tests to determine the presence and extent of pollution. ESS.04.01.02.B.

2c Create a plan for pollution remediation, management or prevention for a given area. ESS.04.01.02.C.

3a Interpret the conditions necessary for waste to be labeled as hazardous. ESS.04.01.03.A.

3b Classify examples of pollution as hazardous or nonhazardous. ESS.04.01.03.B.

3c Construct a plan for handling hazardous waste in given situations. ESS.04.01.03.C.

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

1a Compare and contrast different types of solid waste and options for treating solid waste. ESS.04.02.01.A.

1b Analyze environmental hazards created by different types of solid waste, solid waste accumulation and solid waste disposal. ESS.04.02.01.B.

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1c Develop a plan for solid waste disposal for a given situation that considers the environmental hazards, economic realities and social concerns associated with this task. ESS.04.02.01.C.

2a Examine and describe the components of disposing waste in sanitary landfills. ESS.04.02.02.A.

2b Analyze and document basic sanitary landfill operating procedures and design. ESS.04.02.02.B.

2c Evaluate sanitary landfill procedures for environmental, economic and social sustainability ESS.04.02.02.C.

3a Research and summarize the benefits and processes of composting. ESS.04.02.03.A.

3b Apply scientific principles to explain the benefits and processes of composting. ESS.04.02.03.B.

3c Evaluate the appropriateness of composting methods in different situations. ESS.04.02.03.C.

4a Examine and describe the importance and potential impact of recycling. ESS.04.02.04.A.

4b Analyze and document different recycling methods and classify materials that can be recycled. ESS.04.02.04.B.

4c Survey and evaluate recycling programs and procedures. ESS.04.02.04.C.

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

1a Categorize chemical and physical properties of drinking water. ESS.04.03.01.A.

1b Analyze and document all steps in the public drinking water treatment process according to applicable standards. ESS.04.03.01.B.

1c Evaluate samples of water and the processes necessary to verify that the samples are safe for consumption according to applicable standards. ESS.04.03.01.C.

2a Research methods commonly used to treat wastewater and septic waste. ESS.04.03.02.A.

2b Analyze and document the steps necessary to ensure that wastewater and septic waste can be safely released into the environment. ESS.04.03.02.B.

2c Evaluate examples of wastewater and/or septic waste for its potential to cause environmental, economic and/or social problems. ESS.04.03.02.C.

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

1a Research conventional energy sources and list conservation measures to reduce the impact on environmental service systems. ESS.04.04.01.A.

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1b Assess the advantages and disadvantages of conventional energy sources in regards to environmental service systems. ESS.04.04.01.B.

1c Evaluate the impact burning of fossil fuels has on environmental service systems. ESS.04.04.01.C.

2a Research alternative energy sources and describe the motivations for seeking alternatives to conventional energy sources as they relate to environmental monitoring. ESS.04.04.02.A.

2b Identify advantages and disadvantages of alternative energy sources as they pertain to environmental service systems. ESS.04.04.02.B.

2c Evaluate the impact alternative energy sources have on environmental conditions. ESS.04.04.02.C.

3a Examine the factors that affect energy consumption and describe how these factors are related to environmental monitoring. ESS.04.04.03.A.

3b Analyze and document the main categories of energy consumption. ESS.04.04.03.B.

3c Evaluate strategies for reducing energy consumption to determine the most effective course of action based on the needs of environmental service systems. ESS.04.04.03.C.

4a Research the impact on environmental service systems that occur because of energy consumption. ESS.04.04.04.A.

4b Analyze and document the most significant impacts that energy consumption has on environmental monitoring. ESS.04.04.04.B.

4c Devise a strategy for improving future energy consumption in a manner consistent with the intents of environmental service systems. ESS.04.04.04.C.

5a Examine and explain how energy consumption and the carbon cycle relate to environmental monitoring. ESS.04.04.05.A.

5b Calculate the impact of the carbon cycle imbalance (due to energy consumption) and assess how this imbalance affects environmental service systems. ESS.04.04.05.B.

5c Use data from environmental monitoring to evaluate methods for reducing the imbalance in the carbon cycle through changes to energy consumption. ESS.04.04.05.C.

6a Research and describe the purpose and applications of life cycle assessments to environmental service systems. ESS.04.04.06.A.

6b Interpret a life cycle assessment and explain how it can be utilized in environmental service systems to assess the potential ecological impact of an energy source. ESS.04.04.06.B.

6c Conduct a life cycle assessment for a given source of energy and use this assessment to determine the best option for energy in regards to environmental service systems. ESS.04.04.06.C.

Use tools, equipment, ma tec

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

tasks in environmental service systems. ESS.05.

1a Examine the importance and describe applications of surveying and mapping for environmental service systems. ESS.05.01.01.A.

1b Apply surveying and mapping principles to a situation involving environmental service systems and identify and explain the use of equipment for surveying and mapping. ESS.05.01.01.B.

1c Demonstrate surveying and cartographic skills to make site measurements in order to address concerns and needs within an environmental service systems situation. ESS.05.01.01.C.

2a Research the methods in which GIS can be used in environmental service systems (e.g., tracing of point pollution, control of the spread of invasive species, etc.). ESS.05.01.02.A.

2b Apply GIS skills to a situation specific to environmental service systems. ESS.05.01.02.B.

2c Interpret and evaluate GIS data to come to a conclusion about a scenario specific to environmental service systems. ESS.05.01.02.C.

3a Research how advancements in technology (e.g., unmanned aerial vehicles and drones, genetic modification, fracking, alternative energy, etc.) have changed environmental service systems. ESS.05.01.03.A.

3b Analyze and document examples of utilization of breaking technology in environmental service systems. ESS.05.01.03.B.

3c Evaluate trends in technology and develop predictions about how these advancements will change environmental service systems. ESS.05.01.03.C.

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

1a Research and summarize methods used to determine water quality (e.g., dissolved oxygen, chemical tests, macroinvertebrates, etc.) and determine if a source of water has been contaminated. ESS.05.02.01.A.

1b Research and summarize methods used to determine water quality (e.g., dissolved oxygen, chemical tests, macroinvertebrates, etc.) and determine if a source of water has been contaminated. ESS.05.02.01.B.

1c Evaluate a sample of water to determine its quality and if it has been contaminated. ESS.05.02.01.C.

2a Research and summarize methods and tools used to measure soil health and determine if an area of land has been contaminated (e.g., soil probes, core monolith, soil fertility tests, etc.). ESS.05.02.02.A.

2b Assess different measurements of soil quality (e.g., soil horizons, soil texture, organic matter, soil respiration, etc.) to determine their effectiveness and limitations. ESS.05.02.02.B.

2c Evaluate a sample of soil to determine its quality and if it has been contaminated. ESS.05.02.02.C.

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3a Research and summarize methods and tools used to determine air quality and determine if pollution is present (e.g., CO2 probe, particulate matter sampler, etc.). ESS.05.02.03.A.

3b Assess different measurements of air quality (e.g., ozone, carbon monoxide, particulate matter, etc.) to determine their effectiveness and limitations. ESS.05.02.03.B.

3c Perform an evaluation of air quality to determine and assess its impact of human and ecological populations. ESS.05.02.03.C.

4a Research and summarize methods used to determine ecological health and determine if an ecosystem is threatened (e.g., quadrat analysis, bioindicators, mark-recapture, etc.). ESS.05.02.04.A.

4b Assess different measurements of assessing ecological health (e.g., quadrat biodiversity assessments, transect surveys, population counts, detection of disease and invasive species, etc.) to determine their effectiveness and limitations. ESS.05.02.04.B.

4c Evaluate a habitat to determine its ecological quality and if it is threatened. ESS.05.02.04.C.