COURSE INFORMATION

Environmental Science

Grade Level:	10 (w/recommendation), 11, 12
Length:	1 Year
Period(s) per Day	1

ESSENTIAL UNDERSTANDING

The goal of Environmental Science is to provide students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and human-made, to evaluate the relative risks associated with these problems, and to examine alternative solutions for resolving or preventing environmental problems.

Environmental science is interdisciplinary; it includes a wide variety of topics from different areas of study. There are, however, major unifying themes that cut across many topics included in the study of Environmental Science: Human Population, Sustainability, A Global Perspective, The Urban World, People and Nature, and Science and Values.

THEMES

Upon completion of Environmental Science, the following underlying themes will be discussed and incorporated in the units covered in this class.

1. Human Population

- Underlying nearly all environmental problems is a rapidly increasing human population.

2. Sustainability

- Learning ways of how to sustain environmental resources so that they continue to provide benefits for people and other living things on our planet.

3. A Global Perspective

- Understanding Earth System Science seeks a basic understanding of how our planet's environment works as a global system. This understanding can be applied to help solve global environmental problems.

4. The Urban World

- An ever-growing number of people are living in urban areas. It is here people experience the worst air pollution, waste disposal problems, and other stresses on the environment. A greater focus in the future must be placed on towns and cities as livable environments.

5. People and Nature

- People and civilizations have a major effect on the environment. Understanding methods of keeping our earth suitable to sustain life will be essential to future generations.

6. Science and Values

- Finding solutions to environmental problems involves more than simply gathering facts and understanding the scientific issues of a particular problem, it also has much to do with our systems of values.

COURSE STRUCTURE

Each unit in Environmental Science will be designed after the word **QUEST** which is defined by the Merriam Webster dictionary as "a journey made in search of something." Course structure will follow the following format for each unit of study:

Q – Question(s) → Each unit will be introduced with a set of questions that we will answer as we progress through the unit.

U – Understand → A series of lectures, readings, and vocabulary development will help you have a foundation before going to the next part of the unit.

E – Explore, Explain, and Expand → A set of labs, activities, research, and projects will be the next part of the unit to help you deepen your understanding of the concepts being taught.

S – Summarize → Before you are assessed on the content of the unit, you will be asked to summarize what you have learned in a variety of different types of assignments such as written responses on the topics covered.

T – Test → To complete the unit, you will be assessed on your understanding of the content that you learned in the unit. Assessments will be different for each unit, some traditional essay responses, some will be in the form of a project.

COURSE OBJECTIVES AND EXPECTATIONS, STANDARDS

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6)

Stability and Change

- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-3),(HS-ESS3-5)
- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS3-4)

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Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Modern civilization depends on major technological systems. (HS-ESS3-1),(HS-ESS3-3)
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-ESS3-2),(HS-ESS3-4)
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. (HS-ESS3-3)
- Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS3-2)

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Connections to Nature of Science

Science is a Human Endeavor

- Science is a result of human endeavors, imagination, and creativity. (HS-ESS3-3)

Science Addresses Questions About the Natural and Material World

- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (HS-ESS3-2)
- Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. (HS-ESS3-2)
- Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. (HS-ESS3-2)

STUDENT OBJECTIVES

Students mastering the material of this class will be able to do the following:

(1) understand and define terminology commonly used in environmental science;

(2) briefly summarize and describe global, regional, and landscape environmental processes and systems;

(3) students will be able to list common and adverse human impacts on biotic communities, soil, water, and air quality and suggest sustainable strategies to mitigate these impacts;

(4) students will be able to read, critically evaluate presented information and data using scientific principles and concepts, synthesize popular media reports/articles discussing environmental issues, and verbally discuss and;

(5) apply learned information to environmental scenarios to predict potential outcomes.

COURSE OUTLINE, PACING, STANDARDS

Introductory Units	Standards
Unit 1: Key Themes in Environmental Science	HS-ESS2-4, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6.
Unit 2: The Big Picture: Systems of Change	HS-ESS2-2, HS-ESS2-4, HS-ESS2-6, HS-ESS2-7, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6.
Unit 3: Population Dynamics, Human Population and the Environment	HS-ESS2-2, HS-ESS2-4, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6.
Ecology Units	
Unit 4: Ecosystems, Biodiversity, and Biological Invasions	HS-ESS2-2, HS-ESS2-6, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6.
Unit 5: Ecological Restoration	HS-ESS2-2, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6.
Unit 6: Environmental Health, Pollution, and Toxicology	HS-ESS2-2, HS-ESS2-4, HS-ESS3-1, HS-ESS3-4, HS-ESS3-5, HS-ESS3-6.
Resource Management Units	
Unit 7: Agriculture, Aquaculture, and the Environment	HS-ESS2-2, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6.
Unit 8: Forests, Parks, and the Wilderness	HS-ESS2-2, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6.
Unit 9: Wildlife and Fisheries	HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6.
Unit 10: Basic Energy Principles	HS-ESS3-2, HS-ESS3-3.
Unit 11: Fossil Fuels and Alternative Energy	HS-ESS2-2, HS-ESS2-4, HS-ESS3-1, HS-ESS3-2. HS-ESS3-3, HS-ESS3-4, HS-ESS3-6.
Human Impact Units	
Unit 12: Water Pollution	HS-ESS2-2, HS-ESS2-5, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-5, HS-ESS3-6.
Unit 13: Climate Change and Air Pollution	HS-ESS2-2, HS-ESS2-4, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-5, HS-ESS3-6.

Introductory Units	Standards
Unit 14: Urban Environments	HS-ESS2-2, HS-ESS2-4, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-5, HS-ESS3-6.
Unit 15: Integrated Waste Management	HS-ESS2-2, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-5, HS-ESS3-6.

TIMELINE

Unit 1: Key Themes in Environmental Science (4 weeks)

Unit 2: The Big Picture: Systems of Change (2 weeks)

Unit 3: Population Dynamics, Human Population and the Environment (3 weeks)

Unit 4: Ecosystems, Biodiversity, and Biological Invasions (2 weeks)

Unit 5: Ecological Restoration (1 week)

Unit 6: Environmental Health, Pollution, and Toxicology (3 weeks)

Unit 7: Agriculture, Aquaculture, and the Environment (2 weeks)

Unit 8: Forests, Parks, and the Wilderness (2 weeks)

Unit 9: Wildlife and Fisheries (2 weeks)

Unit 10: Basic Energy Principles (2 weeks)

Unit 11: Fossil Fuels and Alternative Energy (3 weeks)

Unit 12: Water Pollution (3 weeks)

Unit 13: Climate Change and Air Pollution (3 weeks)

Unit 14: Urban Environments (2 week)

Unit 15: Integrated Waste Management (2 weeks)

CONTENT STANDARDS

Students who demonstrate understanding can:

HS-ESS2-2. Analyze geoscience data to make the claim that one changes to Earth's surface can create feedbacks that cause changes to other Earth systems.

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth’s systems result in changes in climate.

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

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

HS-ESS2-7. Construct an argument based on evidence about the simultaneous change of Earth's systems and life on Earth.

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 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.

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's systems.

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

DISCIPLINARY CORE IDEAS

ESS2.A: Earth Materials and Systems

Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1), (HS-ESS2-2)

The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4)

ESS2.C: The Roles of Water in Earth's Surface Processes

The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)

ESS2.D: Weather and Climate

The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-2) (HS-ESS2-4)

Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6),(HS-ESS2-7)

Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6),(HS-ESS2-4)

Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6)

ESS2.E Biogeology

The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface. (HS-ESS2-7)

ESS3.A: Natural Resources

Resource availability has guided the development of human society. (HS-ESS3-1)

All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)

ESS3.B: Natural Hazards

Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)

ESS3.C: Human Impacts on Earth Systems

The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)

Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

ESS3.D: Global Climate Change

Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)

Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)

ETS1.B: Developing Possible Solutions

When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-ESS3-2), (secondary HS-ESS3-4)

RESOURCES

Next Generation Science Standards, Disciplinary Core Ideas, and Crosscutting Concepts: http://www.nextgenscience.org/overview-dci

Montana Office of Public Instruction Montana Science Model Curriculum Guide: 9-12 Earth and Space Science: http://montanateach.org/resources/montana-science-model-curriculum-guide-by-grade-level-grade-9-12-earth-and-space-science/