Havre Public Schools Environmental Science High School

Course Information
Course Title: Environmental Science (Dual Enrollment w/ MSU – Northern BIOE 110; 3 credits)
Grade Level: 10 (w/ recommendation), 11 and 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.

- **Human Population**
  Underlying nearly all environmental problems is a rapidly increasing human population.
- **Sustainability**
  Learning ways of sustaining environmental resources so that they continue to provide benefits for people and other living things on our planet.
- **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.
- **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.
- **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.
- **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 Objectives and Expectations (NGSS Crosscutting Concepts):

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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Pacing Guide/Course Outline with pertinent Montana Content Standard

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.
IEFA: IEFA: American Indian Response to Environmental Challenges	MCA 29-1-306
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.
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)
IEFA: American Indian Response to Environmental Challenges (1 week)
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

Cunningham, W. and Cunningham, M. "Advanced Placement Environmental Science – A Global Concern" McGraw-Hill Education, 2018.
Next Generation Science Standards, Disciplinary Core Ideas, and Crosscutting Concept.
Montana Office of Public Instruction Montana Science Model Curriculum Guide: 9-12 Earth and Space Science. https://opi.mt.gov/Educators/Teaching-Learning/K-12-Content-Standards/Science-Standards#88989482-resources
Science Standards- https://opi.mt.gov/LinkClick.aspx?fileticket=qHA5q8j-oGw%3d&portalid=182
Comparison MT Sci Content Standards and NGSS.pdf

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