

**Course Description:** Principles of Sustainability**DESCRIPTION**

Principles of Sustainability is a dual credit, lab based course through Moraine Park Technical College. It is an environmental science course that will provide students with an understanding of the interacting systems that comprise the environment. It will help students view the earth as a dynamic collection of living systems dramatically affected by abiotic factors and human societies. This class is very lab based with many hands-on activities to investigate environmental issues. Students will be asked to critically analyze individual, community, and global environmental issues, and to effectively problem-solve in these situations. Students will learn to summarize the effects of sustainability on health and well-being, analyze connections among social, economic, and environmental systems, employ energy conservation strategies to reduce the use of fossil fuels, investigate alternative energy options, evaluate options to current waste disposal and recycling in the U.S., and analyze approaches used by your community to promote and implement sustainability.

Adopted Course Primary Resource	Supplementary Resources
<ul style="list-style-type: none"> <li>Living in the Environment by Tyler Miller and Scott Spoolman</li> </ul>	<ul style="list-style-type: none"> <li>Vernier Inquiry Labs</li> </ul>

Standards Addressed In The Course (Note Essential Standards)	
HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-6	Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Units of Study (Sequenced)	Standards Associated	Key Learning Targets & Essential Vocabulary	Essential Question(s)	Common Assessment	Pacing
<b>Introduction to Sustainability</b>	HS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics  HS-ESS3-1 Earth and Human Activity  HS-ESS3-2 Earth and Human Activity  HS-ESS3-6 Earth and Human Activity	Students will be able to: <ul style="list-style-type: none"> <li>• Interpret models describing carrying capacity and homeostasis within ecosystems supported with mathematical evidence</li> <li>• Interpret population graphs or charts containing authentic, real-world data;</li> <li>• Use mathematical reasoning to interpret exponential or logistic growth models</li> <li>• Be given a scenario, designing an experiment to predict the effect of several possible factors on the carrying capacity</li> <li>• Label parts of a graph displaying a real-world application of carrying capacity</li> <li>• Examine the impact of</li> </ul>	<ul style="list-style-type: none"> <li>• In what ways are human activities putting stress on ecosystems?</li> <li>• In what ways are stressed ecosystems affecting human health and well being?</li> <li>• How do my experiences affect the decisions/choices I make and my role as a citizen of the global community?</li> <li>• How do I determine what is "right behavior" toward our environment?</li> <li>• What are my responsibilities to other people and other living things?</li> </ul>	<ul style="list-style-type: none"> <li>• Unit Test</li> <li>• Scientific literacy strategies (data interpretation)</li> </ul>	3 weeks

		<p>sustainability on daily life</p> <ul style="list-style-type: none"> <li>• Develop sustainable literacy.</li> </ul> <p>Vocab: Interdisciplinary, renewable and nonrenewable resources, environmental ethics, modern environmentalism, tragedy of the commons, sustainability</p>	<ul style="list-style-type: none"> <li>• How do my responsibilities for others extend to maintaining the health of the environment?</li> </ul>		
<b>Energy Resources &amp; Conservation</b>	<p>HS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics</p> <p>HS-LS2-2 Ecosystems: Interactions, Energy, and Dynamics</p> <p>HS-LS2-6 Ecosystems: Interactions, Energy, and Dynamics</p> <p>HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics</p> <p>HS-ESS2-2 Earth's Systems</p> <p>HS-ESS3-1 Earth and Human Activity</p> <p>HS-ESS3-2 Earth and Human Activity</p> <p>HS-ESS3-3 Earth and Human Activity</p> <p>HS-ESS3-4 Earth and Human Activity</p> <p>HS-ESS3-6 Earth and</p>	<p>Students will:</p> <ul style="list-style-type: none"> <li>• Design and propose solutions to real world energy problems.</li> <li>• Evaluate the positives and negatives of multiple energy sources used to power society.</li> <li>• Analyze data to make an evidence based forecast of the current rate of global or regional climate change</li> <li>• 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</li> <li>• Connect human activity and energy use to a change in earth's climate.</li> <li>• Identify and describe the different types of nonrenewable and renewable resources.</li> <li>• Analyze statistical data provided on precipitation and temperature for a given city to create explanations of climate change.</li> <li>• Compare climates of designated cities (by referencing climatographs) and their location (with maps provided).</li> <li>• Explanation, using evidence of how the cyclical changes of the Earth's orbit and tilt have causes cycles of ice ages and gradual climate change throughout history through natural occurrences</li> </ul>	<p>What factors, human and non-human, affect changes in climate patterns?</p> <ul style="list-style-type: none"> <li>• What are the best sources to provide power to our society?</li> <li>• What changes would you need to make in your lifestyle to live in a highly energy efficient society?</li> <li>• What goods and services do people receive from the non-human environment—other living things, soil, water, sunlight, atmosphere, water, fossil fuels?</li> <li>• How do environmental problems and solutions change over time?</li> <li>• What can I do to help restore damaged aspects of my environment?</li> </ul>	<ul style="list-style-type: none"> <li>• Unit Test</li> <li>• Highest Lab Report</li> </ul>	5 weeks

	Human Activity	<ul style="list-style-type: none"> <li>Investigate the heating of the Earth by completing a lab investigation.</li> <li>Conservation strategies to reduce the use of fossil fuels</li> <li>Investigate alternative energy options.</li> </ul> <p>Vocab: Greenhouse effect, global warming, types of renewable energy, climate, generator, turbine, energy efficiency</p>			
<b>Air Pollution and Sustainability</b>	<p>HS-ESS2-4 Earth's Systems Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.</p> <p>HS-ESS3-6 Earth and Human Activity</p>	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>Propose and design solutions to problems created by air pollution.</li> <li>Compare and contrast the effects of acid rain, ozone depletion, and global warming on living and nonliving environments.</li> <li>Describe the impact of air pollutants on human health.</li> <li>Identify major air pollutants and their sources.</li> <li>Identify the causes &amp; consequences of ozone depletion</li> <li>Identify human activities that contribute to air pollution</li> <li>Describe the health hazards of air pollution and ozone depletion.</li> <li>Describe the sources and hazards of common pollutants, and suggest ways to mediate their danger to human and environmental health.</li> </ul> <p>Vocab: Primary/secondary pollutants, clean air act, Scrubber, smog, fracking, ventilation, radon, acid rain, ozone depletion</p>	<p>In what ways does the environment affect the health of me and my family, and how do our actions affect the environment?</p> <p>How can I ensure that my environments are healthy enough to keep me healthy and productive?</p> <p>Who/what protects me from toxins in the air?</p> <p>Who/what protects non-humans from toxins in their food, air and water?</p>	<ul style="list-style-type: none"> <li>Unit Test</li> <li>Highest Lab Report</li> </ul>	5 weeks

<b>Ecology and Ecological Footprint</b>	<p>HS-LS2-4 Ecosystems: Interactions, Energy, and Dynamics Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.</p> <p>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.</p>	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Interpret diagrams of food chains and webs to explain real-world relationships or events within an ecosystem</li> <li>• Comprehend scenarios involving niche partitioning, competition for resources, immigration/emigration from an ecosystem, or environmental change</li> <li>• Interpret and summarize how all organisms, both land-based and aquatic, are connected to other organisms by their need for food, and how manipulating that food web can change other trophic levels.</li> <li>• Create an evaluation based on evidence of how succession may result in a new ecosystem</li> <li>• Use a student-created food web, representing various levels of producers and consumers, to show how parts of the food web are interconnected.</li> </ul> <p>Vocab: Ecosystem, species, population, community, biotic vs abiotic, predator prey, competition, symbiosis (types), succession, energy transfer</p>	<p>What are the patterns for energy flow in functioning ecosystems?</p> <ul style="list-style-type: none"> <li>• What goods and services do people receive from the non-human environment—other living things, soil, water, sunlight, atmosphere, water, fossil fuels?</li> <li>• What is the role of the major bio-geo-chemical cycles in the health and survival of living organisms and their habitats?</li> <li>• How do the processes of photosynthesis and respiration work together to allow continuation of life on earth?</li> <li>• In what ways are human activities putting stress on ecosystems?</li> <li>• In what ways do human activities help ecosystems function?</li> </ul>	<ul style="list-style-type: none"> <li>• Unit Test</li> <li>• Highest Lab Report</li> </ul>	<p>3 weeks</p>
<b>Human Population and Waste Disposal</b>	<p>HS-ESS3-1 Earth and Human Activity</p> <p>HS-ESS3-2 Earth and Human Activity</p> <p>HS-ESS3-3 Earth and Human Activity</p> <p>HS-ESS3-4 Earth and Human Activity</p>	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Propose solutions to support a larger human population.</li> <li>• Analyze strategies countries may use to reduce population growth.</li> <li>• Apply factors that control population growth to human populations.</li> <li>• Diagram the three phases of an exponential growth curve and indicate carrying capacity.</li> <li>• Describe the factors that limit the growth of a population.</li> </ul>	<ul style="list-style-type: none"> <li>• What are the causes and consequences of exponential growth on different populations of living things?</li> <li>• How does the concept of “carrying capacity” relate to both ecological and economic issues?</li> </ul>	<ul style="list-style-type: none"> <li>• Unit Test</li> <li>• Highest Lab Report</li> </ul>	<p>3 weeks</p>

	HS-ESS3-6 Earth and Human Activity	<ul style="list-style-type: none"> <li>Define terms related to populations and growth.</li> <li>Design or simulate a population growth model by manipulating environmental conditions;</li> <li>Given population graphs or charts containing data, analyzing the history or predict the future of an ecosystem</li> <li>Interpret population graphs or charts containing authentic, real-world data about changes in biodiversity</li> <li>Explain the importance of biodiversity using the correct definition</li> <li>Evaluate options to current waste disposal</li> </ul> <p>Vocab:</p> <p>General population - Density, dispersion, growth rate, exponential growth, logistic growth, carrying capacity, survivorship, limiting factors</p> <p>Human Population - Demography, structure, fertility rates, replacement level, migration, demographic composition</p>			
<b>Biodiversity</b>	<p>HS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics</p> <p>HS-LS2-2 Ecosystems: Interactions, Energy, and Dynamics</p> <p>HS-LS2-6 Ecosystems: Interactions, Energy,</p>	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>Recognize impacts of individual choices on the environment.</li> <li>Explain habitat destruction and the loss of biodiversity, and how they are related to the endangerment of species.</li> <li>Distinguish between the natural rate of extinction and the accelerated rate due to human impact.</li> <li>Explain the causes of deforestation and its effects on</li> </ul>	<p>How are we responsible for living and non-living things?</p> <ul style="list-style-type: none"> <li>Why should we care about biodiversity?</li> <li>Why are endemic species often more vulnerable to extinction?</li> <li>What human actions are associated with biodiversity loss?</li> <li>How might climate change lead to</li> </ul>	<ul style="list-style-type: none"> <li>Unit Test</li> <li>Highest Lab Report</li> </ul>	5 weeks

	<p>and Dynamics</p> <p>HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics</p>	<p>biodiversity.</p> <ul style="list-style-type: none"> <li>Identify methods of decreasing the impacts of humans on the rate of extinction.</li> <li>Design or simulate a population growth model by manipulating environmental conditions;</li> <li>Given population graphs or charts containing data, analyzing the history or predict the future of an ecosystem</li> <li>Interpret population graphs or charts containing authentic, real-world data about changes in biodiversity</li> <li>Explain the importance of biodiversity using the correct definition</li> </ul> <p>Vocab: HIPPO +C, Hot spots, keystone species, mass extinction, endangered species Act</p>	<p>increased loss of biodiversity?</p>		
<p><b>Land and Agriculture Sustainable Practices</b></p>	<p>HS-ESS2-2 Earth's Systems</p> <p>HS-ESS3-1 Earth and Human Activity</p> <p>HS-ESS3-2 Earth and Human Activity</p> <p>HS-ESS3-3 Earth and Human Activity</p> <p>HS-ESS3-4 Earth and Human Activity</p> <p>HS-ESS3-6 Earth and Human Activity</p>	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>Identify and explain methods for reducing the volume of waste.</li> <li>Compare and contrast biodegradable and nonbiodegradable wastes and their significance in landfills.</li> <li>Summarize the positive and negative effects of urban planning.</li> <li>Explain the negative effects of agriculture on the land and the benefits of sustainable agriculture.</li> <li>Identify how land is used and how land use affects ecosystems.</li> <li>Define different methods of land usage.</li> <li>understand how human needs for food and water are fulfilled and how climate change will impact the agriculture industry and our</li> </ul>	<p>How large of a population can the world's agricultural acreage support?</p> <p>What are the costs and benefits of large scale vs. small scale farms?</p> <p>Will the trend toward large corporate farms work for or against good land use practices?</p> <p>What farming lessons can we learn from subsistence societies where plots of land have been intensively farmed for hundreds of years without losing their</p>	<ul style="list-style-type: none"> <li>Unit Test</li> <li>Highest Lab Report</li> </ul>	<p>3 weeks</p>

		<p>freshwater supplies.</p> <ul style="list-style-type: none"> <li>• understand that there is a limited amount of freshwater available to us.</li> <li>• understand that the choices they make can have a positive impact on both water availability and water quality.</li> <li>• understand the role of human activities in polluting and degrading aquatic resources, and what they can do to reduce their impact.</li> </ul> <p>Land Vocab: Urban vs rural, ecosystem service, urbanization, land use planning, deforestation, national parks</p> <p>Agriculture Vocab: Fammon, calories, yield, arable, erosion, pests, domesticated, GMOs</p>	<p>fertility and productivity?</p> <p>What environmental impacts does growing cotton have on soil, water, air, health of farmers and consumers?</p> <p>What is fair trade cotton?</p> <p>How much does it really “cost” to produce a \$20 cotton t-shirt?</p> <p>What are the environmental impacts associated with the production of your food?</p> <p>What information do consumers need in order to make the best choices (reduce their environmental footprint) at a restaurant or supermarket?</p>		
<b>Water Sustainable Practices</b>	<p>HS-ESS2-2 Earth's Systems</p> <p>HS-ESS3-1 Earth and Human Activity</p> <p>HS-ESS3-2 Earth and Human Activity</p> <p>HS-ESS3-3 Earth and Human Activity</p> <p>HS-ESS3-4 Earth and Human Activity</p> <p>HS-ESS3-6 Earth and Human Activity</p>	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Debate the ecological, economic, and social issues related to water.</li> <li>• Relate the importance of wetlands to the health of aquatic ecosystems to human health and well being.</li> <li>• Describe environmental conditions and human activities that cause groundwater pollution.</li> <li>• Identify how water is used in society and how water use affects ecosystems.</li> <li>• Trace the water cycle from land (include groundwater) to sea, to atmosphere, etc.</li> <li>• List the major water pollutants and</li> </ul>	<p>What are the major water uses and problems of the western United States?</p> <p>How much freshwater is available, and how much of it are we using?</p> <p>Where does your water come from?</p> <p>What can we do to waste less water?</p> <p>Can we really run out of water?</p>	<ul style="list-style-type: none"> <li>• Unit Test</li> <li>• Highest Lab Report</li> </ul>	5 weeks



		<p>their sources and relate them to human and environmental health.</p> <ul style="list-style-type: none"> <li>• understand how human needs for food and water are fulfilled and how climate change will impact the agriculture industry and our freshwater supplies.</li> <li>• understand that there is a limited amount of freshwater available to us.</li> <li>• understand that the choices they make can have a positive impact on both water availability and water quality.</li> <li>• understand the role of human activities in polluting and degrading aquatic resources, and what they can do to reduce their impact.</li> </ul> <p>Water Vocab: Fresh vs Salt water, water cycle, ground water, potable, irrigation, desalination, point source vs nonpoint source, eutrophication.</p>	<p>What pollutes our water, where do these pollutants come from and what effects do they have?</p> <p>What are the major water pollution problems affecting lakes and streams?</p> <p>What are the major water pollution problems affecting oceans?</p> <p>How safe is your drinking water?</p>		
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