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Environmental Science

"Survey of fundamental concepts of environmental science focusing on the environment and aquatic and terrestrial ecosystems. Topics include the biological and chemical principles that relate to current environmental issues, conservation of plants and animals, energy flow as well as nutrient cycling, basic ecological and technological concerns and advances, and scientific analysis and solutions to environmental problems."

This course provides students with a foundation of understanding, knowledge and skills to deal effectively with environmental problems such as global warming, acid rain, endangered species and invasive plants and animals. Students learn a variety of basic laboratory and field techniques including soil and water sampling. The course incorporates both academic and applied studies that include fieldwork in the local area watershed and onsite field trips. The structure and function of natural ecosystems, the history of the environmental movement, impact of legal, economic and political systems on environmental concerns is taught. Students also gain a broad awareness of environmental science and technological career opportunities. An emphasis is placed on students using critical thinking and analytical skills to make a positive impact on the environment.

COURSE CONTENT

Context for Course (How does it fit into, replace, or augment existing curriculum? How does it fit into the department or program in which it will be included?)

Environmental Science will be a high school elective course that students will typically take after completing biology and a physical science course. Environmental Science will reinforce and expand on student knowledge of both physical and life science by applying them to environmental concepts. Environmental Science will provide another option for students interested in studying science and therefore it might appeal to students who would otherwise not take a third year of science.

Course Goals and/or Major Student Outcomes

Through Environmental Science, the students will

---gain an understanding of environmental science and understand their connection with, and impact on, the world around them.

---develop critical thinking skills by considering controversial environmental problems and complex environmental concepts.

---clearly and confidently express their opinions through writing on tests, research papers and lab reports, and through formal presentations.

---utilize technology in multimedia presentations, laboratory experiments and research.

Course Objectives

At the completion of this course, the students will be able to:

---Locate Earth in a diagram of the solar system and describe the unique features that make it possible for life to exist.

---Describe the regions of the biosphere and explain how organisms interact within the biosphere.

---Define and describe the various biomes of the world.

---Describe an invasive species and discuss its impact on the environment.

---Identify biotic and abiotic factors of an ecosystem and be able to describe their interaction.

---Describe the main materials cycles of nitrogen, carbon, oxygen and phosphorous.

---Identify and understand humankind's impact on atmosphere, soils and hydrologic cycles.

---Describe factors of population growth and regulation.

---Demonstrate an understanding of how human population growth and dynamics function in our biosphere.

---Utilize the concepts of succession in real and modeled ecological systems.

---Demonstrate an understanding of the principles behind and proper procedures for:
- Soil and soil profile sampling
- Air quality sampling
- Water quality sampling

---Identify renewable and nonrenewable resources.
---Explore and test alternative sources of energy.
---Demonstrate an understanding of recycling principals and practices.

---Demonstrate an ability to record, graph and interpret experimental data.

---Assess humankind's impact on terrestrial and aquatic ecosystems.

---Demonstrate an understanding of the interrelationships of environment, economics, and politics in humankind's impact on the biosphere.

---Describe air pollution and identify common outdoor and indoor pollutants.

Course Outline

I. Studying the Earth

A.Discuss the unique characteristics of Earth that make it capable of supporting life.
1. Planet of life.
2. Earth,Äôs land and water.
3. The atmosphere.
4. The biosphere.

B.Introduce students to the methods and skills used by scientists and others who study the environment.
1. The nature of science.
2. Skills and methods
3. Environmental science.

C.Discuss how Earth has changed through time and how these changes have affected the Earth,Äôs ability to support life.
1. The changing environment
2. Needs of organisms
3. The ecosystem.

II. Ecological Interactions

A.Provide an overview of how matter and energy are transferred through an ecosystem via food chains, food webs, and chemical cycles.
1. Roles of living things.
2. Ecosystem structure.
3. Energy in the ecosystem
4. Cycles of matter.

B.Explore ecosystem dynamics through inter- and intra-specific relationships of biotic and abiotic components.
1. Habitats and niches
2. Evolution and adaptation.
3. Populations.

C.Explore ecosystem interactions through a presentation of the events that help to maintain balance in an ecosystem.
1. Relationships in the ecosystem.
2. Ecological succession.
3. Stability in the ecosystem.
4. Land biomes.

III. Biomes

A.Examine Earth,Äôs driest terrestrial biomes,Äîdeserts and tundra.
1. Deserts.
2. Formation of deserts.
3. Tundra.

B.Examine the Earth's grassland biomes.
1. Grasslands.

2. Steppes and prairies.
3. Savannas.

C.Examine the forest biomes of the world.
1. Coniferous forest.
2. Deciduous forest.
3. Rain forest.

D.Examine the Earth's aquatic biomes.
1. Aquatic biomes.
2. Standing-water ecosystems.
3. Flowing-water ecosystems.

E.Examine the marine biomes of the world.
1. The world,Äôs oceans.
2. Neritic zones.
3. Intertidal zones.

IV. People in the Global Ecosystem

A.Discuss the survival needs of people and how they are met by the environment.
1. A portrait of Earth.
2. Human societies.
3. Sustainable development.

B.Explore human population growth and its impact on the global environment.
1. History of human population.
2. Growth and changing needs.
3. Challenges of overpopulation.

C.Review the problem of feeding a growing human population without devastating environmental resources.
1. Human nutrition.
2. World food supply.
3. Modern farming techniques.
4. Sustainable agriculture.

V. Energy Resources

A.Survey the fossil fuels that currently serve as energy sources for most of the world and examine alternative energy systems that may meet the growing energy demands of an expanding world population.
1. The need for energy.
2. Coal.
3. Petroleum and natural gas.
4. Other organic fuels.

B.Discuss nuclear energy and evaluate this resource in terms of its potential use and its potential danger in the event of a nuclear accident.
1. Atoms and radioactivity.
2. Reactions and reactors.

3. Radioactive waste.

C.Present alternatives to nuclear and fossil fuels, including solar energy, wind energy, geothermal energy, and hydroelectric power.
1. Solar energy.
2. Hydroelectric energy.
3. Wind energy.
4. Geothermal energy.

VI. Resources In The Biosphere

A. Discuss the availability of minerals and soil.
1. Minerals and their uses.
2. Obtaining minerals.
3. Soil and its formation.
4. Soil mismanagement.

B.Explore problems associated with land pollution and land management.
1. Solid wastes.
2. Hazardous wastes.
3. Topsoil erosion.
4. Controlling pollution on land.

C.Discuss the importance of water as a resource.
1. Uses for water.
2. Water resources.
3. Water treatment.

D.Discuss forms of water pollution and methods of reducing it.
1. The water pollution problem.
2. Chemical pollutants.
3. Radioactivity and thermal pollution.
4. Controlling water pollution.

E.Explore the causes and effects of air pollution and noise pollution.
1. The air pollution problem.
2. Air pollution and living things.
3. Global effects of air pollution.
4. Controlling air pollution.
5. Noise pollution.

VII. Managing Human Impact

A.Address the problem of loss of habitat and explore the need for maintaining biodiversity.
1. The loss of biodiversity.
2. Humans and habitats.
3. The importance of biodiversity.
4. Controlling habitat destruction.

B.Explore ways to attain a sustainable environmental ethic that will maintain resources for

future generations.
1. Conservation.
2. Recycling.
3. Conserving biodiversity.

C.Discuss activities in progress to correct past environmental damage and to protect the environment for future generations.
1. The global ecosystem.
2. Local policies.
3. Federal policies.
4. International policies.

24. Key Assignments

---Biosphere III Project: the development and presentation (with a model) of a fictional biosphere which includes the biotic and abiotic factors necessary for life.

---Endangered Species Project: study an endangered species and analyze past human impact and possibilities for species preservation through a research paper

---Biomes study: comparison and presentation (including a powerpoint slide show or poster) of the major ecosystems of the world including desert, grasslands, forests, freshwater and marine.

---Eco-Column Project: development and maintenance of a miniature ecosystem (including terrestrial and aquatic plants, fish, insects, earthworms) used to study species interaction and learn the techniques of soil and water testing

---Alternative Energies Labs: monitor and analyze electricity production of photovoltaic cell system at AHS, build working model solar cars and solar ovens

---Issues and Decisions: read the current and past laws relevant to environmental issues and debate viewpoints with peers, formally present articles and current environmental events, study environmental problems including global warming, acid rain, endangered species and invasive plants and animals

---Ecological Pyramid Labs: numbers, biomass and energy pyramids include the following topics
- species interaction: including predator/prey relationships, owl pellet lab and decomposer lab
- matter cycles including carbon, nitrogen and water
- energy transfer
- biological magnification

---Populations: develop detailed graphs including Yeast Population Density Lab, Deer Population Study, Human Population Growth in the Past, Present and Future.

---Natural Selection: develop simulations for Mutation and Adaptation Labs

---Ecological Succession Study: sketch the stages and types of ecological succession

---Animal Migration and Behavior Study: research animal navigation and behavior and present your finding to the class via powerpoint presentations, videos, etc.

25. Instructional Methods and/or Strategies

A successful course incorporates a variety of strategies. Some important instructional strategies include:

---Reading and Writing: The students will gain important information through reading the textbook, current event articles, issues papers, resource materials for research papers, etc. The students will be expected to extract information from their readings and will therefore develop their analytical reading skills. Writing will be used in many different contexts, such as lab reports, short essays, research papers, and persuasive papers.

---Local and onsite field trips/In-class projects: Many of the concepts of environmental science can be studied directly by students working on projects in and outside of the classroom. These types of hands-on activities make concepts easier to understand and demonstrate the connection between environmental science and the area our students live in.

---Research reports: Research allows the students to move beyond the concepts covered in class and apply them to the examples that interest them most. The students develop computer skills and have a chance to research relative data, graphs and maps.

---Group labs and activities: Students in lab groups learn from each other by sharing knowledge and comparing results. Environmental science provides many opportunities for hands-on learning activities, including creating miniature ecosystems, simulations, graphing, mapping, and model making.

---Videos: Environmental Science covers topics that span the globe. Video recordings provide a way for teachers to show students biotic and abiotic factors that students cannot observe locally.

---Discussion of issues: Discussion of controversial issues is an excellent way to develop academic comprehension and student interest. Students enjoy sharing their own opinions and by listening to the opinions of others, they develop a more complete understanding of the concepts being discussed.

---Instructional lecture: Direct instruction can be a valuable method when it is not used in excess and leaves time for other instructional strategies. Teachers should include models, real-life examples, and other enhancements to their presentations.

26. Assessment Methods and/or Tools

Assessment should be an ongoing process that is used to check for understanding at the beginning, during and at the end of a unit. Some possible methods of assessment include:
---Student presentations that incorporate multimedia tools, relevant models or demonstrations and appropriate presentation style (voice, eye contact, posture, etc.)

---Research papers that develop writing skills including the ability to organize and clearly

state ideas

---Lab reports which include a clear statement of the problem, data analysis, graphs, and thoughtful discussions

---Tests and quizzes that feature multiple-choice, short essay and interpretation of graphs, data tables, maps, and labeled diagrams.

[from 5/9/2011:]
27. Financial Implications
The course textbook has already been purchased and is currently satisfactory. Since this course is already being taught (as Science III), there will not be any start-up costs. The course materials will be purchased with the yearly science department funds.