AP Environmental Science

Course Description

"The goal of the AP Environmental Science course 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 them."

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In terms of content, this course emphasizes the 'science' in environmental science, and integrates portions of many different sciences. The course provides students with the scientific principles required to understand the interrelationships of the natural world and draws upon various scientific disciplines. Throughout the course of this semester students will focus on Earth science principles, ecological relationships, and natural and human induced environmental problems and their possible solutions. Throughout the course, students are taught methods for collecting, analyzing, and interpreting information, data, and calculations. They will then use this information and data to be able to identify and analyze environmental problems both natural and human-made, and to evaluate the risks associated with these problems and critically examine alternative solutions for resolving and/or preventing them.

There are six main themes to be addressed in this course:

1. Science is a process.
   - Science is a method of learning more about the world.
   - Science constantly changes the way we understand the world.

2. Energy conversions underlie all ecological processes.
   - Energy cannot be created; it must come from somewhere.
   - As energy flows through systems, at each step more of it becomes unusable.

3. The Earth itself is one interconnected system.
   - Natural systems change over time and space.
   - Biogeochemical systems vary in ability to recover from disturbances.

4. Humans alter natural systems.
   - Humans have had an impact on the environment for millions of years.
   - Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.

5. Environmental problems have a cultural and social context.
   - Understanding the role of cultural, social, and economic factors is vital to the development of solutions.

6. Human survival depends on developing practices that will achieve sustainable systems.
   - A suitable combination of conservation and development is required.
   - Management of common resources is essential

Course Skill Goals: By the end of the course students will have practiced and have greater expertise with the following skills:

1. Designing and carrying out scientific experiments, including the analysis of data and the subsequent lab report.
2. Using technology to collect, organize, analyze and communicate data and information
3. Expressing ideas in writing and arguing a position. They will be able to examine an issue, research it and distill information, and approach and argue the issue from a rational (scientific) point of view using critical thinking and analysis.
4. Solving problems mathematically/quantitatively
5. Notetaking (from lecture and text) and organization and use of notes.

Class Size and Scheduling

This class will meet for 5 periods per week. It will meet daily for a 90 minute period for a total of 450 minutes of class time per week, for the entire academic semester. The class size will range from 10-25.

Course Prerequisites and Requirements

Students enrolled in APES should have successfully completed both biology and chemistry.

Students will be assigned a marking period project for 4 marking periods of the year. Students are expected to study and review nightly, this nightly review is vital for success in this course. In addition to reviewing the days material students may also be assigned textbook reading and related work, reading and creating abstracts on current events, or other types of assignments. The marking period project will rotate between a hands-on activity (community service, or science fair), educational presentation, research paper, or book or movie response paper.

Tests will be given approximately every week, as appropriate in the curriculum. Tests will mimic the AP Exam, and will utilize questions from review books and from past AP Exams. Each test will also include a Free Response Portion. As the semester progresses tests will become longer, to more closely approximate the AP Exam.

Textbook and Lab Resources and Equipment

- Miller, G. Tyler Jr and Spoolman, Scott., *Living in the Environment: Principles, Connections, and Solutions.* New York: Thomson/Brooks Cole, 17th edition. (main text).
- Supplemental readings will also be drawn from other similar texts, review books, newspapers, case studies, etc.
- Vernier probeware (pH, temperature, dissolved oxygen, soil moisture, conductivity) and Logger Pro software

Teaching and Evaluation Methodology (Course Structure)

Teaching methodology within this course will be a mixture of the following:

- Lecture
- Lab
- other hands-on or interactive activities
- Reading/writing practice: free response questions, debates, case studies, written lab reports, analysis of news articles.

Emphasis will be placed on active and interactive hands-on and group work, and the use of case studies and discussion, with lecture and reading primarily and a background resource.

Grading:

Labs: 25%
Class work/homework/quizzes: 15%
Tests and Projects: 60%

Course Outline/Planner

Unit Name and Textbook Chapters	Lab/Activities
I. Humans and Sustainability (1 week) **Chapters 1 and 2**	• Activity: Reading and discussion of The Lorax • Lab: Tragedy of the Commons: Demonstrates how individuals using a common resource for their own personal gain will inevitably results in the degradation of them commons, decreasing the yield for both the group and the individual. • Activity: Math in Environmental Science
II. Earth Systems and Resources (1-2 weeks) **Chapter 13**	• Activity: Plate tectonics review and model: students watch a few video clips, as well as examine earthquake and volcano data, and analyze a model of a hard-boiled egg as the Earth to review ideas on plate tectonics. • Activity: Plate Tectonics: Earthquake Epicenter • Lab: Soil Properties Lab and lab report – Students bring in soil samples from home, or various locations and test analyze each for microorganisms, soil type by particle size, pH, and design a procedure to test permeability, porosity, and infiltration rate.
II. The Living World (2-3 weeks) **Chapters 3-5 and 7-11**	• Lab: Introduction to habitats and species diversity: Students go into the school grounds and compare two different habitats. They take measurements of the biotic factors and abiotic factors (soil temperature, pH and moisture readings). • Activity: Measuring Primary Productivity in an Aquatic Ecosystem. Students will observe and calculate gross and net primary productivity on an algae culture • Activity: Energy Pyramids and Bioaccumulation: As a class students use paperclips to model energy getting passed up the food chain and higher trophic levels using more energy. Then they also model persistent toxins being passed up and accumulating in higher levels of the food chain. This is done in combination with a local news article about mercury levels in fish. • Lab: Ecocolumn lab investigation: Students, in groups, construct 3-level ecocolumns (terrestrial, decomposition, and aquatic) with a testable question and then analyze water quality data and make qualitative observations over the next several weeks. This lab also includes a full lab report and allows them to analyze limiting factors, tolerance, food webs, and eutrophication. • Activity: Eating at a Lower Trophic Level: calculations on energy of various food sources and trophic levels • Activity: Exotic Species Research. Students will research various exotic species in North Carolina. They will determine environmental impact as well as economic impact. • Activity: Colonizing Mars. Students will develop a plan on how they would

	colonize Mars. They will also research the current Mars Colonization project and discuss pros and cons for this venture. www.Mars-One.com • Lab: Natural Selection: For the Birds. Students will simulate the natural selection of birds having different adaptations for feeding. • Activity: Biomes Project. Students will complete a research project on various biomes. • Activity: Endangered species legislation timeline, and computer lab research on specific endangered species and causes of becoming endangered (HIPPO)
III. Population (2-3 weeks) Chapter 6	• Lab: Population Dynamics Deer Lab – As a class, students model a deer population that reproduces, has limited resources, and undergoes density dependent and independent population controls. They keep population data and graph it. Then analyze real similar data. • Lab: Survivorship Curves & Cemetery Data: Two sets of data are collected from a computer database to answer student designed questions about local populations (different towns, different time periods, gender). Students then plot survivorship curves based on gender and age of death and analyze data • Activity/Video: "The Wolf that Changed America". After watching this video from the Nature series on PBS students will research population data on the Wolves of Yellowstone. They will also compare their data to population numbers for Elk and other large carnivores in the region. • Lab: Estimating Population Size by Capture and Recapture • Activity: population calculations • Case Study: Urban Deer Management modified from http://ublib.buffalo.edu/libraries/projects/cases/deer/deer.html to more accurately reflect a local situation. • Research Paper: Students choose a country and research birth and death rates and population control policies.
IV. Land and Water Resources (2 weeks) **Chapters 12 and 13**	• Activity: Estimating Human Carrying Capacity: students track what they eat for one typical day and then determine how much arable land they require for one year to feed themselves. Students then use their data to determine the carrying capacity of the earth based on a variety of diets and other factors. • Activity: Origins of Food – Students visit a grocery store and investigate different aspects of the food they consume. • Guest Speaker: Botany Professor from Oregon State University. We will discuss genetically modified plant species and their role in modern agriculture. • Activity: Courtroom trial of Genetically modified organisms: Students learn about the arguments for and against genetically modified foods.

	• Lab: Cooking Mining and Land Reclamation Lab – Provides a introduction to the economics of mining. Students purchase land areas and mining equipment and must pay for mining operations and reclamation, and receive payment for ore mined. • Case Study: Wetland/rainforest development PBL: Students, in groups will work through one of two case studies about land use and expanding development; either an airport expanding into a wetland, or development in the Amazon rainforest. • Activity**:** Students will further analyze forestry data from the Earth Watch research fellowship discussed above. • Activity: Students will analyze aerial photos and look at the urbanization and suburban sprawl of our local area.
V. Energy Resources and Consumption (1-2 weeks) **Chapter 14-16**	• Lab: Biodeisel from waste oil lab – students make biodiesel from both new vegetable oil and varying qualities of waste oil. They then design their own system for making larger quantities of oil. They must research the costs and benefits of this system on a large scale. • Lab: School Energy Use: Analysis of School Energy use data in cooperation with Green Schools club and resulting in changes for our school. This may be combined with a Kill-A-Watt personal energy audit. • Activity: Yucca Mountain Nuclear Waste Disposal debate • Lab: Passive Solar Heating lab • Activity: Analysis of Niagara Falls as energy producer for the region • Activity: Carbon Footprint Calculations and Personal improvement plan
VI. Pollution (4 weeks) **Chapters 19-21**	• Lab: Air Pollution and Particulates • Lab: Global Warming and Greenhouse Gases – students test temperatures in 3 different environments (open, greenhouse, and greenhouse with CO_2 to model global warming) • Activity: Kyoto Protocol Debate OR Global Warming Debate: Students will have a debate focused on either whether or not the US should sign the Kyoto Protocol, or evidence for or against Global Warming as a real phenomenon. • Lab: Sources of CO_2 Emissions: Students will use a chemical indicator (BTB) to detect the presence of carbon dioxide from various sources. • Lab: Acid Rain: students learn the chemical equations explaining the formation of acid rain in the atmosphere, predict where deposition will occur in the US and Canada, test various solutions and rain samples for pH and determine the buffering capacity of different types of bedrock. • Activity: Urban Heat Islands – students will analyze radar and weather data to learn about urban heat islands, as well as collecting data of their own.

	• Lab: Students pollute a watershed and learn about point and nonpoint sources of pollution. As well, we examine a local nonpoint source pollution problem. • Field Trip: Wastewater treatment plant and local landfill, waste management, or recycling plant • Lab: Sparkling Water – Students will develop strategies to remove contaminants from "wastewater" • Lab: Dose-Response relationships and toxicity – students use seeds to conduct dose-response relationships. • Video: Love Canal • Activity: Examination of local hazardous waste sites– students choose one to do a summary presentation
VII. Management/Risk Analysis/Sustainability (1 week and integrated) **Chapters 17, 23, 24**	• Activity: Brownfield Sites: Students learn about Brownfields and research local Brownfield's sites • Activity: Green Business Plan: Students read a case study about green business practices and analyze it. Then put together their own business plan for a green business in our home town. • Activity: Ethical Dilemmas: What's A Body To Do? Students will distinguish between decisions based on ambitions and dreams versus environmental ethics surrounding water