

AP Environmental Science

Course Philosophy:

Students will use biological, chemical and physical scientific processes and knowledge to classify, analyze and evaluate environmental issues and situations that challenge humans within the framework of social, economic and historical parameters.

High School Course and Career Planning Handbook Course Description:

The AP Environmental Science Course is designed to be the equivalent of a one-semester, introductory college course in environmental science. The 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 and/or preventing them.

Class size and schedule:

The class size is held to 24 students. The class meets 4 days a week. 3 days are 53minute periods and one day is a double period. We equal a 5 days a week meeting time for 53minute periods. We also have 3 all day field trips a year for fieldwork. Approximately one period per week is devoted to hands-on laboratory experiences or fieldwork. All labs and fieldwork requires a written report.

Student Evaluation:

Class is graded by formal lab write ups, quizzes, debates, tests, counter papers, and journal writing. Tests consist of multiple choice questions and free response essays. Tests scored like the AP tests, multiple choice worth 60% and free response essays are worth 40%. Students must keep a notebook will be graded throughout the year. The notebook will have the following sections:

Class notes

Journal writing, example Miller's extra sections, class discussions, and case studies.

Objectives

Labs and issues

Environmental Laws

I provide my students with an APES website. The site includes all my lecture notes so students can preview them before the lecture and review them afterwards. In addition, practice tests are online so students can gauge how they would do on a test before taking it. This website also allows students the opportunity to seek clarification about sections of the test they don't understand. Students often learn best by example, so the website also provides exemplary papers, lab write-ups and model assignments. To provide a diversion from the straight rote memory of content, I created several Jeopardy style review games that can be played on-line or used in class. On the website there is also an outline of terms and concepts found in the AP Environmental Science course. Students can define the words in the outline and expand on the concepts to help prepare them for the exam.

Text Book:

Miller, G. Tyler. Living in the Environment: Principles, Connections, and Solutions. Pacific Grove, CA: Brooks/Cole Thomson Learning.

Lab Manuals:

- Carolina Biological Advanced Placement Environmental Science Labs.
- AP Advantage, Laboratory Investigations, AP Environmental Science by William Molner.
- Environmental Science In Action by Wolf, DeWitt, Jankowski, Van Dyke.
- Environmental Issues By McConnell and Able
- Earth Science Lab by Tarbuck, Lutgens and Pinzke
- Taking Sides, Dushkin/McGraw-Hill

Course Planner

First Semester

Section 1: Introduction to Environmental Science, Science, Systems, Matter and Energy (The Living World) **2 weeks**

Labs:

1. Tragedy of the Commons- Students simulate the use of resources in two different scenarios. In the first they are not aware of the quantity of the resource being used nor are they permitted to communicate. In the second scenario, students know the quantity of resource and are permitted to strategize. In addition, students are provided with a private resource that they can use as they see fit.
2. Pill Bug Lab Animal Behavior AP Biology lab – Test for animal behavior and for scientific method.

Activities:

1. Too Many Rich People: Weighing Relative Burdens on the Planet by Paul Ehrlich counter paper.
2. Environmental Issues by Robert L. McConnell and Daniel C Abel. Population and Migration Issue 1.
3. Video The Lorax. With a student presentation on running a sustainable company.
4. Population math problems – Generated by the teacher. Finding % rate growth.
5. Ecological Footprint - Using the website <http://www.myfootprint.org/> students calculate their ecological footprint and compare it to that of other countries.

Section 2: Aquatic Ecosystem, Water Resource, Water Pollution. (Land and Water Use Pollution) **5 weeks**

Labs and Field Experience:

1. LaMotte Water testing kit Wiley Creek Assessment field experience - This tests the chemical quality of a stream. The tests are: B.O.D. DO pH Odor color turbidity nitrates phosphate alkalinity and temperature change.
2. Qualitative Habitat Environmental Index Wiley Creek. – field experience -The QHEI tests for the physical habitat of the riparian.
3. Macro Invertebrate Identification practice lab. Students will explore the populations of species in the bottom of a stream in order to determine water quality.
4. Primary Productivity Lab – AP Biology
5. Shannon-Weiner Diversity Lab -field experience – by William Molnar Students will collect and count organisms and species in several habitats. Students will analyze and apply data to biodiversity problems using the Shannon-Weiner Diversity Index
6. Water Quality Index- field experience - AP Environmental Science Lab by William Molner. Students will perform tests to determine the Water Quality Index of a local body of water and perform follow-up WQI tests to establish an ongoing record and basis for possible water remediation.
7. Water Loss Drop by Drop Quantitative - AP Environmental Science Lab by William Molner. The students will identify how much water is lost in a their home if they have a leaky facet and to compare that to their community population.
8. Water Diversion- AP Environmental Science Lab by William Molner. The students will look at the affect that water diversions have on water quality around the world.
9. Testing the effectiveness of wetlands for sewage treatment. - field experience - The students will test for DO B.O.D. pH odor color turbidity nitrates phosphate both the influent and the effluent.
10. Pond turnover assessment. -field experience -The students will identify the photo zone by using a Secci disk and to test the pond water for DO, pH and Temperature.
11. Solon Waste Water Treatment Field Trip - field experience-. Environmental Science in Action by Robert J. Wolff.
12. Chagrin River field testing- field experience- Biologic, Chemical, and Physical quality of water. LaMotte Water testing kit. QHEI. Macro Invertebrate Index by the Ohio Department of Natural Resource. The students will test for B.O.D. DO pH Odor color turbidity nitrates phosphate alkalinity temperature change and Taxa macro invertebrate score.

Activities

1. Ground Water Demonstrations.

2. A Civil Acton Demonstrations.

Video

1. Mississippi Flood - Nova
2. Water Pollution Discovery

Section 3: Ecosystem, Energy Flow, Matter Cycles, Climate, Biomes, Species Interactions, Biodiversity, Evolution, Endanger Species, and Successions. (Earth Systems and Resources, Global Change, The Living World) **3 weeks.**

Labs and Field Experience:

1. Tracking energy amounts in trophic levels. The students collect the calorie amount of each food they eat for 3 days. They also need to record the type of food they eat. They need to calculate the amount of energy they received as it relates to trophic levels.
2. Predator-Prey Simulation by William Molnar Students will simulate and analyze the interactions between a predator population of coyotes and a prey population of mice. Students will organize and graph data from the simulation, predicting future populations over several generations. Students will compare simulation results to data taken from nature, and apply revised simulation techniques to other population problems.

Activities

1. Invasive species poster lab.
2. Debate on ESA Act – Taking Sides Environmental Issues by Goldfarb.

Video

1. Cane Toads.

Section 4: Population Dynamic, Carry Capacity, Human Population and Demography. (Earth Systems and Resources, The Living World, Population, Energy Resources and Consumption, Global Change)**3 weeks**

Labs and Field Experience:

1. Population Distribution and Survivorship by William Molnar – Students collect data from obituaries to develop survivorship curves and age-sex population pyramids. Students use data to predict characteristics of future populations based on sex, age, fertility, species life cycle and other factors.

2. AP Lemna Minor Population Lab Carolina Biological - Students use *Lemna minor* to identify the similarities and differences between exponential and logistic population growth. Students explain how carrying capacity and biotic potential affect population growth. Students determine a habitat's carrying capacity using a logistic population curve. Students estimate a population's biotic potential from population growth data and calculate the 95% confidence limits for the *Lemna minor* data.
3. Exploring Biodiversity Carolina Biological - Students trap and count different morphotypes of local invertebrates and compare species richness to biodiversity as expressed by the Shannon-Weiner Biodiversity Index. Students set up outdoor sampling islands of different sizes and assess the effect of habitat size on richness, diversity, and extinction.

Activities

1. World Population Growth - by William Molnar Students graph and mathematically analyze the rates of human population growth through history. Students then project human populations into the future based on generalizations from various data sources for modern times.
2. Doubling Time in Exponential Growth - by William Molnar - Students investigate the mathematical concept of exponential growth, applying doubling time as the calculation method and explore the impacts of exponential growth in biological and other processes.
3. Global Population Trends - by William Molnar - Students analyze and compare human population trends in nation of divergent economic development. Students factor in the impacts of various historic events on populations to predict growth and social conditions.

Video

1. The People Bomb.
2. Deer Population Pennsylvania Department of Natural Resources.
3. World Population Zero Population Growth.

Section 5: Geology, Soils, Food Resources, Pesticides and Pest Control. (Earth Systems and Resources, The Living World, Land and Water Use, Global Change, Energy Resources and Consumption, Pollution) **4 Weeks**

Labs and Field Experience:

1. Physical Characteristics of Soil by Carolina Biological
Students conduct comprehensive physical analyses of soil, including soil-type determination, texture analysis, structure, slope, consistency, water-holding capacity, permeability, and capillary action. Students will conduct field and lab investigations and compare both to determine the best use of the land.

2. Chemical Characteristics of Soil by Carolina Biological – Students will take a comprehensive look at soil chemistry and its interaction with environmental changes and effects on plant growth. Students determine pH and ion exchange capacity. Further exercises provide students the opportunity to observe the oxidation/reduction process of iron and to learn about anions and cations while investigating the process of salination and test the effect of increasing salt concentrations on seed germination.
3. Testing Residents Soils with a Write Up. The students will use both physical and chemical tests on two types of soils. The students will provide recommendations for each kind of soil so the resident can have a better garden.
4. LD 50 lab. The students will test meal worms to identify the lethal dose where 50% will die. The products that are tested will be either a pesticide or a herbicide.
5. Rock Identification Lab – by Tarbuck, Lutgens and Pinzke The students will identify characteristics of Igneous, Metamorphic and Sedimentary rocks. They will also use a key to identify the correct rock.

Activities

1. GMO debate.
2. Global Grain Production Issue 4 . by Robert L. McConnell and Daniel C Abel

Video

1. Harvest of Fear Frontline.

Second Semester

Section 6: Energy Efficiency, Renewable Energy, Nonrenewable Mineral and Energy Resources. (Earth Systems and Resources, The Living World, Land and Water, Use Energy Resources and Consumption, Pollution, Global Change) **6 weeks**

Labs and Field Experience:

1. Solar Absorption- by William Molnar – The students will test color and different materials to look at the rate of solar absorption.
2. Fuel Cell Car – a demo car that uses solar power to separate Oxygen and Hydrogen for power.
3. Personal Energy Use Audit by William Molnar - Students research and compare current US electric power production technologies. Students outline and defend a power production policy, including feasible alternative technologies, for the coming century.
4. Me and My SUV Issue 5 by Robert L. McConnell and Daniel C Abel - The students will compare both the CAFÉ and gas mileage.
5. Solar Homes Collection. The students will test passive solar homes to see their effectiveness.

Activities

1. Design an Energy Efficient Home.

2. Debate on Yucca Mountain.
3. Energy Resources Comparison - Students compare energy costs of recycling aluminum for cans to making cans from raw materials. Students investigate extrinsic benefits and disadvantages of recycling, such as environmental and economic factors.
4. Waste, Packaging, and Subsidies Issue 7 by Robert L. McConnell and Daniel C Abel

Video

1. Power Plants - Modern Marvels.
2. Energy Tech – Modern Marvels.
3. Yucca Mountain
4. Mining Equipment Video – Discovery
5. Alternative Energy Video

Section 7: Air and Air Pollution, Climate Change and Ozone Loss, Indoor Air Pollution Solid and Hazardous Waste. (Earth Systems and Resources, The Living World, Land and Water Use, Pollution, Global Change) **5 weeks**

Labs and Field Experience:

1. Acid Rain – Carolina Biological - The Threat from Above by Carolina Biological- students determine the buffering effects of 3 different types of bedrock, track the direction of wind patterns, and locate major pollutant sources to determine where acid deposition forms, where it falls, and where it may affect aquatic habitats. Maps of authentic acid precipitation pH and acid sensitivity data are included. Students may also collect and test local water samples to determine their sensitivity to acid deposition.
2. Car Exhaust Gas Collection - by Carolina Biological - Students measure the concentration of several air pollutants found in the exhaust streams of cars, lawn equipment, campfires, cigars, and cigarettes (pollutants not included) using syringe pumps and professional gas detector tubes. Students compare these concentrations to the National Ambient Air Quality Standards established by the EPA. From their measurements, students calculate the mass of each air pollutant added to the atmosphere by each point source and identify the source that produces the most air pollution. In addition, they learn what the Pollutant Standards Index and Air Quality Index mean and how they are related to human health.
3. Car Exhaust Particulate Matter Collection. Student use particulate collectors to see how much particulate matter car's exhaust produce over time.
4. Indoor Particulate Matter of Collection - Student use particulate collectors to see how much particulate matter is collected over time.
5. Solid Waste Collection - by William Molnar – Students quantify and analyze household solid waste and propose general strategies for reduction and recycling of solid waste.
6. Landfill, Recycling Center and Transfer Field Trip - field experience-, Environmental Science in Action by Robert J. Wolff.

Activities

1. Debate on Credits Used for Energy Pollutants.
2. CO₂ Emissions From Fossil-Fuel Burning - Students track long-term energy production and correlate the data to emissions and atmospheric concentrations of CO₂ and investigate the effects of CO₂ and other greenhouse gases on global temperatures.

Video

1. Garbage – Modern Marvels
2. A Civil Action.

Section 8: Urban Land Use and Management. (Earth Systems and Resources, The Living World, Land and Water Use, Global Change, Energy Resources and Consumption)

3weeks

Labs and Field Experience:

1. Land Use Changes in Your Area by William Molnar – Students research and record land use changes in their state or a nearby urbanized area and analyze land use trends for their environmental impact.
2. Evaluating Impacts of Local Population Growth Issue 2 by Robert L. McConnell and Daniel C Abel

Video

1. Expanding Cities – PBS

(Note Senior go on Project at the end of April)

Review

Days before the AP exam I have an all-day review. The students do a variety of activities to increase their interest. While reviewing we play games with food prizes that relate to the section being reviewed. For example, while studying water quality, the students can win “gushers” or take small group sectional tests for prizes. I also make my world famous “chicken wings” for lunch on the review day. My all day review is always conducted somewhere off campus so students don’t get distracted from the happenings of a regular school day. I give practice tests for each unit. I go over the two released exams. I also review each released free response questions.

After The Exam Environmental Science Project.

The students are to work on an Environmental Project after the exam. One example of a project was to develop environmental labs around our school that elementary and middle school teachers could use. Students need to write the lab and teach the lab to either elementary and middle school students.