AP Environmental Science
Course Syllabus

Course Objective:

The goal of this course is to provide students with the scientific background needed to understand how the Earth works and how we, as human beings, fit into that. At the end of the course, it is expected that students will be able to identify and analyze environmental problems as well as the risks associated with these problems and understand what it is to be a steward in the environment, studying how to live their lives in a more sustainable manner.

Course Description:

Class Size and Schedule:

The size of the class averages around 31 students and meets for 55 minutes, 5 days a week.

Course Prerequisites:

AP Environmental Science is open to students who have earned a B or higher in Biology or Chemistry or an A in Physical Science. Students must also have completed Algebra 1 with a B or higher.

Methods:

This course approaches each concept in a variety of methods including lecture, written assignments, class-wide debates and discussions, lab activities, and outdoor fieldwork. Students are exposed to each concept in a variety of different ways, allowing them to work a concept from a variety of angles.

Textbook:

The text is Environmental Science: Toward a Sustainable Future (Eighth Edition) by Richard T. Wright and Bernard J. Nebel, published by Prentice Hall. Laboratory Investigations in AP Environmental Science by William Molnar (published by Peoples Publishing Group) is used as a supplemental resource for lab activities.

Course Outline:

Unit 1: What is Environmental Science? (2 weeks)

• Topics Discussed
  o What is sustainability? How can we achieve it?
  o What is our footprint? How easy is it to change?
  o Politics and the environment.
  o Environmental regulations.
  o Environmental racism/justice.
• Sample Lab Activities
  o Ecologic Footprint: Quiz taken online which calculates a persons footprint based on the number of acres required to support them (1 day).
Land Use Model: students followed guidelines to create and plan out a city. They were challenged to find ways to meet the needs of the people as well as the needs of the environment (1 day).

- **Other Resources Used:**
  - Radio broadcasts from the National Public Radio program “Living on Earth” regarding environmental racism and sustainable living.
  - Video – “30 Days: Off The Grid” – Follows two high-consuming individuals as they attempt to live for 30 days on a ranch that is completely sustainable and “off the grid”.

Unit 2: Earth’s Resources (3 weeks)

- **Topics Discussed**
  - Renewable vs. nonrenewable resources
  - Minerals
  - Mineral Resources: How do we get minerals (mining), what is the impact of trying to obtain them?
  - Soil: What is soil, what is soil fertility, what factors affect soil fertility, what causes soil erosion, how can we combat desertification?

- **Sample Lab Activities**
  - Mineral Identification: Students use the various properties of minerals to identify them and explore their uses (1 day).
  - Mining simulation: Students formed mining companies and “mined” packing peanuts, simulating the surveying, excavation, and reclamation processes. They need to make the most money for their company with the least amount of environmental damage (1 day).
  - Soil Texture: Students obtained a sample of soil from their home which was then put through a variety of investigations. Students both qualitatively and quantitatively determined the texture of their soil and followed procedures to determine the pH, porosity, and permeability of their soil. From this point, they analyze their data to determine the nutrient and water holding capacity of their soil and ultimately the fertility of the soil (2 days).

- **Other Resources Used:**
  - Radio broadcasts from the National Public Radio program “Living on Earth” regarding environmental racism, sustainable living, tree planting programs, and desertification.

Unit 3: Water (5 weeks)

- **Topics Discussed**
  - The water cycle and our role in it: how can we as human beings change the viability of the water cycle and deplete our water supplies?
  - Surface water: what are rivers and watersheds? How does everything we do affect our watershed? Why are they important?
  - Oceans: what vital roles do the oceans play? How do we use the oceans as a resource? How are the oceans view as a “commons” and why is that leading to the decimation of the life in it?
  - Pollution: How do the things we put in the water affect both aquatic organisms and humans.
  - Treatment: How do we clean the water we have used?

- **Sample Lab Activities**
• Water Use Audit: Students study the water use in their home in order to determine how much water they use, the impact of that on the environment, and how they can reduce their water use (1 day – overnight).

• Tap water testing: students collected a sample of their tap water at home and then proceeded to test the pH of the water, the copper, chlorine, and iron levels, and the hardness of the water. Students then had to analyze the results to determine the impact of these readings on their home and health (2 days).

• Watershed map studies: Students studied the map of a watershed in order to determine the point and non-point sources of pollution that may be affected the river (2 days).

• Field Trip
  • Waste Water Treatment Plant: as a class we received a tour of the local treatment plant, seeing each step of the treatment process as well as learning what was required to decontaminate the water. Students also learned what types of schooling were required to have this job as well (1 day)

• Other Resources
  • Article: Detroit News Series: “Water Pressures” – explores the increasing demand being put upon the Great Lakes and the effects of this demand on the Great Lakes Basin.

Unit 4: Atmosphere (5 weeks)

• Topics Discussed
  • What is the atmosphere? How does it work? How can the atmosphere and the ocean work together to spread heat around the earth? How can this also affect world climates?
  • The Greenhouse Effect: What is it? What causes it? What would an intensification of the greenhouse effect mean for global temperatures?
  • Climate Change: What is climate? How can it be affected or changed? What may be the human role in this? What are the implications of global warming? Why is there controversy over global warming?
  • Air Pollution: What is it? What has been the impact of acid rain and CFCs on the Earth? Can something be done about the impacts air pollution has had on both the Earth and humans?

• Sample Lab Activities
  • Temperature/Carbon Dioxide Study: students graphed data for both temperature and carbon dioxide from the past 420,000 years in order to see if there is any correlation between rising carbon dioxide levels and rising temperatures. Students extrapolated the graphs with current carbon dioxide data in order to predict future temperature change (2 days).
  • Specific Heat and Climate: students used soil leftover from their study of soil fertility to determine the specific heat of land and water. They used this data and applied it to what they know about climate to determine how the two are related (2 days).
  • “Formation of Deserts”: students study how the atmosphere and ocean work together to transport heat around the Earth and how this relationship helps to determine climate in different regions.

• Other Resources
  • Video: “What You Should Know About Global Warming”.
  • Video: “An Inconvenient Truth”.
  • Article: “Global Warming: Are We the Culprit” – explores the violent hurricanes of 2005 and their link to climate change and the warming planet.
  • Pamphlet: EPA: “Testing for Radon Gas in Your Home” – explains what the dangers from radon gas are as well as how and why you should test your home for it.
Unit 5: Energy Resources (3 weeks)

- **Topics Discussed**
  - What is meant by renewable and nonrenewable?
  - What are fossil fuels? How do we get them? How do we use them as fuel sources and in what forms? What are the advantages and disadvantages of using fossil fuels? What are the environmental effects of using fossil fuels?
  - What is nuclear fission? How does it work? How is this used as a fuel source? What are the advantages and disadvantages of using nuclear power? What are the dangers of nuclear power? What are the environmental impacts of nuclear power?
  - What are alternative sources of energy? How do we obtain power from the water, the wind, the sun, the Earth, and biomass? How do we use them as fuel sources? What are the advantages and disadvantages of using these power sources? What are the environmental impacts of using these fuel sources?
  - What are the implications of our fuel choices on future climates? Societies?

- **Sample Lab Activities**
  - Personal Energy Use Audit: Students record where and how electricity and other forms of energy are used around their homes and then discuss ways to reduce their usage (1 day – overnight).
  - Energy Use/Climate Correlation: Students create graphs, which follow the changing uses of fossil fuels since the industrial revolution as well as the changing amounts of carbon dioxide in the atmosphere in order to deduce the impact of fossil fuels on the atmosphere and the world’s climates (2 days).

- **Other Resources**
  - Video: “People’s Century: Fallout” – Studies the implementation of nuclear weapons as well as the promise and perils of nuclear energy.
  - Article: “Plutonium Peril” – looks at the issue of what to do with nuclear waste.

Unit 6: Human Population (3 weeks)

- **Topics Discussed**
  - What is the current human population? Is the growth of our population logistic or exponential? What has caused this massive population explosion?
  - What is demography? What statistics are involved in the study of demography (total fertility rate, infant mortality rate, etc.)?
  - What is a population pyramid? What can we use a population pyramid to determine about a society? What plans can be made using the information from a population pyramid?
  - What is meant by demographic transition? What stage is the U.S. in? What is a survivorship curve?
  - What can we do about the population explosion? How do growth rates differ between developed and developing countries and why?
  - What food resources are available for use? What should be done to reduce hunger worldwide? What role does poverty play in societies globally?

- **Sample Lab Activities**
  - Calculating Land Area: Students record their typical meal choices over the period of a week. They then calculate the amount of calories they eat and convert that over to the number of acres of land that is needed to produce that food. Students then calculate the total land area that is needed to support their daily, monthly, and yearly diet. They analyze these numbers and research ways to reduce their total land use (1 week - overnight).
o Population Pyramid Study: Students create population pyramids for 6 different countries based on census bureau information. The countries represent all levels of development throughout the world. After creating the pyramids, students analyze each pyramid to determine the potential of each to grow, what may happen as time goes forward, and what measures could be taken to curb growth in those countries (2 days).

o “Population Distribution and Survivorship”: Students gather data from area cemeteries to construct survivorship curves for the surrounding area and make conclusions based on the data they’ve collected (3-4 days).

o Population Debate: The teacher reads statements regarding population change and control and students have to choose a side: agree or disagree. Students are then given the opportunity to defend their point of view (1 day).

• Other Resources
  o Video: “The People Bomb”

Unit 7: Tectonics (1 week)

• Topics Discussed
  o What is the structure of the Earth? How do we know? How does this impact the movement of plates around the earth?
  o What are the consequences of these movements? What impacts do earthquakes, tsunamis, and the eruption of volcanoes have on the environment and human societies?

• Sample Lab Activities
  o Plate Tectonics: students research the 25 most recent earthquakes and plot them on a map along with a number of volcanoes and mountain ranges to discover why each occurs where it does. Students research the effects of these tectonically active areas and why they have formed. Finally, they deduce what may happen in the future in these areas (2 days).

• Other Resources
  o Video: Nova “The Next Wave” – studies the forces behind the Sumatra tsunami of 2004 as well as the threat of a similar event in the future.
  o Video: National Geographic “Naked Science: Supervolcano” – studies the past eruptions of the Yellowstone volcano as well as the possibilities of future eruptions and what that means for society and the environment.
  o Software: “Seismic/Eruption” – shows where volcanoes and earthquakes occur around the globe, allowing for speculation as to what may be causing the patterns that are seen. Also shows the events that can occur before and after a volcanic eruption, allowing for an understanding of the possibility of predicting eruptions.

Unit 8: Geologic Time (2 weeks)

• Topics Discussed
  o When and how did the universe form? What events occurred to form the Earth? What had to happen for life to form on the Earth?
  o What is evolution? How does it happen? What are the different theories that are related to evolution?
  o What are the controversies surrounding Big Bang and Evolutionary theories?

• Sample Lab Activities
  o Fossil Study: students are given a series of fossils that all have a common ancestor. Their task is to organize these fossils by age and morphology to create a cladogram for the organism. Students then hypothesize about its evolutionary history as well as the factors that may have led to the morphological changes they observed (2 days)
• Other Resources
  o Article: Newsweek: “Evolution Wars” – explores the debate surrounding the teaching of evolution, creationism, and intelligent design in schools by defining each side of the debate and giving reasons for and against each theory.

Unit 9: Ecosystems (5 weeks)

• Topics Discussed
  o What is a biome? Where are the major biomes of the world? What is a climatogram? How does climate affect biomes? How does climate change affect the location and structure of biomes?
  o What is an ecosystem? How are ecosystems structured? What factors affect ecosystems?
  o How does energy flow through an ecosystem? What is trophic structure? How much energy is passed between trophic levels? Why are there only a few trophic levels?
  o How is energy cycled through an ecosystem? What are the major biogeochemical cycles? How do human activities impact them?
  o How do organisms in ecosystems interact? How does this affect the ecosystem? What happens when an alien species is introduced into an ecosystem?
  o How are populations in ecosystems interrelated? What are reproductive strategies? What is carrying capacity and what affects it?
  o What is succession and how does it occur? Why is fire important to ecosystems?

• Sample Lab Activities
  o “Eating At A Lower Trophic Level”: students determine how their footprints would change if they only ate things from certain trophic levels.
  o Biomes maps: Students study maps of annual rainfall and precipitation and compare them to the locations of the world’s biomes in order to determine the relationship between all three.
  o Predator-Prey Interactions: Students simulate an ecosystem by releasing “mice” into a small area then dropping “coyotes” into the area. The mice that are eaten are removed and new coyotes are added, simulating how populations change in response to other organisms in the environment.
  o Mark/Recapture: students model estimating animal populations through the mark-recapture method using dry bean to represent animals.

• Other Resources
  o Article: Detroit News: “Foreign Species Crowd Out Local Fish” – explores the impact of introduced species on the native aquatic organisms of the Great Lakes.
  o Article: “The Call of the Wild”. Explores current rates of extinction around the world.

Unit 10: Pollution (3 weeks)

• Topics Discussed
  o What is risk and how do we assess it? What risks affect the human population? How do our choices impact us and the environment? What are emerging diseases and who do they affect the most? Why is poverty the leading cause of death globally?
  o What is toxicology? Why is it important to know everything we can about the chemicals we use? How can we find out about the chemicals we use?
  o What are pesticides? What are the advantages and disadvantages of using them? How has the use of pesticides impacted humans?
What do we do with wastes? What are we referring to when we say “reduce, reuse, recycle”?

**Lab Activities**
- Investigating Toxic Sites: students use scorecard.org to find the areas in their hometown that are most polluted as well as the companies that are the culprits.
- “Bioassay Experiment”: students test the toxicity of salt on lettuce seeds to determine the LD$_{50}$ of the salt on the seeds.
- “Solid Waste Collection”: students record the total volume of waste generated in their home for one week in order to determine the amount of waste they produce and then study ways to reduce that waste.

**Other Resources**
- Video: “People’s Century: Endangered Planet” – studies the threat to the planet of human activities over the past 50 years by examining major pollution disasters (Love Canal, Chernobyl, etc). Also chronicles the rise of the environmental movement worldwide.

**Field Work (1 week per semester)**
- Stream Leaders Program: Two times in the school year (once in fall and once in spring), our classes take a trip to the Clinton River. Here, they work with members of the Clinton River Watershed Council as well as environmental engineers from General Motors to monitor the quality of the river. Students don waders and go into the river to collect samples from chemical as well as biological testing. They observe the inhabitants of the river as well as note changes that have occurred since they last conducted tests. Chemical testing includes testing the pH, total solids, fecal coliform, dissolved oxygen, biochemical oxygen demand, turbidity, and temperature. The data from these tests are aligned with data collected by categorizing macroinvertebrates in the water as well as physical characteristics in and around the river in order to determine the river’s overall quality. Students are required to prepare a report to share their findings and compare this year’s data to previous year’s data in order to determine if the health of the river is improving. Discussion follow to determine things we can do as a class to help bring awareness in the community that is part of the watershed as well as ways to solve some of the major issues affecting the health of the river.