AP Environmental Science Syllabus

Course Description:

AP Environmental Science is a yearlong interdisciplinary course, the equivalent of an introductory college course in environmental science. It is intended for students who have completed two years of high school lab science (e.g., biology and chemistry) and one year of algebra, and who have demonstrated a willingness to commit considerable time to studying and completing assignments outside of class. This course incorporates a wide variety of topics from different areas of study—energy flow, natural systems, population dynamics, resources, environmental quality, environmental law, and the impact of humans on all of these areas. The goal of AP Environmental Science is to provide students with the scientific principles, concepts, and methodologies required to understand the natural world, identify and analyze natural and man-made environmental problems, evaluate associated risks, and critically examine alternative solutions. The course includes a laboratory and fieldwork component intended to compliment the lecture portion by allowing students to apply principles and methods firsthand.

Methods of Evaluation:

Students will be evaluated using, but not limited to, the following:

- Teacher-constructed examinations and quizzes
- Homework and class work
- Independent projects
- Class participation
- Laboratory and field investigations and reports
- Standardized examinations

Assignments and Points:

No late work will be accepted. All due dates will be announced in class and will be posted in writing on ***mrthaler.net*** and/or Aeries. Homework assignments and essays will typically be worth 10 points each. Lab reports and projects will be worth 10-20 points each. There will be frequent quizzes (20-30 points, each)—multiple-choice from the reading and free-response from lecture and lab material. There will be exams on every unit or so (50-100 points each) and a semester-cumulative final exam (100-150 points).

Long-term Projects (TBA):

- "M-A-D" (Make A Difference)—collection, disposal, recycle, etc.
- Video write-ups—summary (expository), opinion page (persuasive), your choice
- Present a paper—journal article or relevant book
- Extended field projects and presentations
- Relevant laws and treaties

Grading Policy:

I *estimate* 1000 points available per semester. Cumulative available points equal 100 percent. A test point is weighted no more nor less than any other point. The following scale will be used for assigning letter grades:

A = 100 - 90% B = 89 - 80% C = 79 - 70% D = 69 - 60% F = 59% or less.

A ***C minus*** (70-73%) is considered in danger of failing, as is anything in the ***D*** range. An ***F*** is, of course, failing.

Bonus points may be available on rare occasion at teacher's discretion.

Textbook:

Friedland, A. and Relyea, R. (2019). *Environmental Science for the AP Course*, 3rd ed. New York, NY: Bedford, Freeman & Worth High School Publishers.

Lab Manual:

Molnar, W. (2005). *Laboratory Investigations for AP Environmental Science.* Saddle Brook, NJ: People's Publishing Group.

AP Environmental Science Syllabus

UNIT I: INTRODUCTION: ENVIRONMENTAL SCIENCE: STUDYING THE STATE OF OUR EARTH: READ CHAPTER 1 (SUMMER ASSIGNMENT).

TOPICS: (1st week)

1. Environmental Science
2. Environmental Indicators and Sustainability
3. Scientific Method

CORRESPONDING LABS (# in Molnar)**, PROJECTS, VIDEOS, ETC.**

An Inconvenient Truth video, the rebirth of the environmental movement

UNIT II: THE LIVING WORLD: ECOSYSTEMS AND BIODIVERSITY: READ CHAPTERS 2–5.

TOPICS: (5 weeks)

A. Ecosystem Structure
1. Major Terrestrial Biomes
2. Major Aquatic Biomes

B. Systems and Mater
1. Conservation of Matter
2. Carbon, Nitrogen, Phosphorus, Sulfur, and Water Cycles

C. Energy, Flows, and Feedbacks
1. Energy Forms
2. Power
3. Units and Conversions
4. Laws of Thermodynamics

D. Energy Consumption
1. History
   a. Industrial Revolution
   b. Exponential Growth
   c. Energy Crisis
2. Present Global Energy Use
3. Future Energy Needs

E. Energy Flow
1. Photosynthesis and Cellular Respiration
2. Food Webs and Trophic Levels
3. Ecological Pyramids

F. Ecosystem Diversity
1. Ecological Niches
2. Interactions Among Species
3. Keystone Species
4. Species Diversity and Edge Effects
5. Natural Selection
6. Evolution
7. Ecosystem Services

G. The Atmosphere
1. Composition
2. Structure
3. Weather and Climate
4. Atmospheric Circulation and the Coriolis Effect
5. Atmosphere-Ocean Interactions
6. ENSO (El Niño/Southern Oscillation)
7. Climate Shifts

Personal Energy Use Audit (25): Calculate your "carbon footprint." (1 hour)

Food Webbing (handout): Work out the connections in the food web of a Sierra Nevada ecosystem. (2 hours)

Net Primary Productivity (15): Measure NPP of rye grass, apply to problems of crop growth and higher trophic level support. (2 hours)

Eating at a Lower Trophic Level (16): Construct a biomass pyramid, analyze pros and cons of eating at lower trophic levels. (1 hour)

Coral Seas video, biodiversity beyond belief

Species Diversity Lab (handout): Compare the "species" (cars) diversity between two distinct parking lots using Shannon Diversity Index. (2 hours)

Valley of the Wolves video, keystone species

Predator-Prey Simulation (17): Simulate and analyze interactions between coyotes and mice population, predict future populations. (2 hours)

UNIT III: BIOLOGICAL AND HUMAN POPULATIONS: READ CHAPTERS 6 & 7.

TOPICS: (4 weeks)

A. Natural Ecosystem Change
1. Species Movement
2. Ecological Succession

B. Population Biology Concepts
1. Biological Populations and Communities
2. Population Ecology
3. Carrying Capacity
4. Reproductive Strategies
5. Survivorship

Wild Ways video, wildlife diversity health and corridors

Doubling Time in Exponential Growth (20): Investigate exponential growth, applying doubling time calculation method. (1 hour)

World Population Growth (19): Graph and mathematically analyze rates of human population growth, project population into the future. (1 hour)

C. Human Population

1. Human Population Dynamics
    a. Historical Population Sizes
    b. Distribution
    c. Fertility Rates
    d. Growth Rates and Doubling Times
    e. Demographic Transition
    f. Age-Structure Diagrams
2. Population Size
    a. Strategies for Sustainability
    b. Case Studies
    c. National Policies
3. Impacts of Population Growth
    a. Hunger
    b. Disease
    c. Economic Effects
    d. Resource Use
    e. Habitat Destruction

CORRESPONDING LABS (# in Molnar)**, PROJECTS, VIDEOS, ETC**.

Global Population Trends (21): Analyze and compare human population trends in nations of divergent economic development. (1 hour)

Population Distribution and Survivorship (22): Use cemetery data to develop survivorship curves and age-gender population pyramids. (2 hours)

The Plague video, effects of epidemic disease on a population, implications for modern society

UNIT IV: EARTH SYSTEMS AND RESOURCES: READ CHAPTERS 8 & 9.

TOPICS: (4 weeks)

A. Earth Science Concepts

1. Geologic Time Scale
2. Plate Tectonics
3. Earthquakes
4. Volcanism
5. Seasons
6. Solar Intensity and Latitude
7. Climate

B. Soil and Soil Dynamics

1. Rock Cycle
2. Formation
3. Composition
4. Physical and Chemical Properties
5. Main Soil Types
6. Erosion and Other Soil Problems
7. Soil Conservation

C. Mining

1. Mineral Formation
2. Extraction
3. Global Reserves
4. Relevant Laws and Treaties

D. Global Water Resources and Use

1. Freshwater/Saltwater
2. Ocean Circulation
3. Agriculture, Industrial, and Domestic Use
4. Surface and Groundwater Issues
5. Global Problems
6. Conservation

E. Hydroelectric Power

1. Dams
2. Flood Control
3. Salmon
4. Silting
5. Other Impacts

Geologic Time Scale (TBA): Place all of geologic time on a familiar scale, marking significant events in earth history. (1 hour)

How the Earth was Made video, dramatic visual history of our planet

Plate Tectonics (2): Plot key geographic events and correlate them to tectonic plate boundaries. (1 hour)

Rocks and Minerals (TBA): Identify rocks and minerals and their place in the formation of soil. (2 hours)

Soil Lab (handout): Determine (1) percentages of sand, silt, and clay in a soil sample, (2) soil type using a ternary diagram (soil triangle), and (3) soil pH. (2 hours)

Cookie Mining (handout): Simulate a mining operation, considering economics and land reclamation. (1 hour)

Copper Extraction (7): Measure the amount of copper metal you can extract from an ore, model method of profitable extraction. (2 hours)

Personal Water Use Inventory (handout) (1 hour)

Water video, that unique yet ubiquitous stuff we cannot live without

Water Loss Drop by Drop (13): Estimate household water loss from common leaks, then extrapolate water loss to the surrounding community. (1 hour)

UNIT V: LAND USE: READ CHAPTERS 10 & 11.

TOPICS: (4 weeks)

A. Tragedy of the Commons

B. Agriculture

1. Feeding a Growing Population
    a. Human Nutritional Requirements
    b. Types of Agriculture
    c. Green Revolution
    d. Genetic Engineering and Crop Production
    e. Deforestation
    f. Irrigation
    g. Sustainable Agriculture
2. Controlling Pests
    a. Types of Pesticides
    b. Costs and Benefits of Pesticide Use
    c. Integrated Pest Management
    a. Relevant Laws

C. Fishing

1. Fishing Techniques
2. Over-fishing
3. Aquaculture
4. Relevant Laws and Treaties

D. Forestry

1. Tree Plantations
2. Old Growth Forests
3. Forest Fires
4. Forest Management
3. National Forests

E. Rangelands

1. Overgrazing
2. Deforestation
3. Desertification
4. Rangeland Management
5. Federal Rangelands
6. Public and Federal Lands
    a. Management
    b. Wilderness Areas
    c. National Parks
    d. Wildlife Refuges
    e. Forests
    f. Wetlands
    g. Land Conservation Options
    h. Preservation
    i. Remediation
    j. Mitigation
    k. Restoration
7. Sustainable Land-Use Strategies

F. Other Land Use

1. Urban land Development
    a. Planned Development
    b. Suburban Sprawl
    c. Urbanization
2. Transportation Infrastructure
    a. Federal Highway System
    b. Canals and Channels
    c. Road-less Areas
    d. Ecosystem Impacts

CORRESPONDING LABS (# in Molnar)**, PROJECTS, VIDEOS, ETC**.

Water Diversions (14): Analyze pros and cons of water diversions on ecosystems and human communities. (1 hour)

Dams video: Will any more big dams be built in the US?

Make-A-Diff Status Reports:
As much as 1—2 weeks may be required for each student to report to the class on the progress of their "Make-A-Diff" endeavor. Students will anonymously grade one another's progress on a rubric that will be supplied in advance. Participation in this process is part of your grade.

Mosquito, video: perhaps the biggest threat to humanity

Dogs Decoded, video: Would agriculture even exist without dogs?

Soil Salinization Lab—An Experimental Design (10): Develop and perform a method to determine at what salt-concentration seeds will no longer germinate. (2 hours)

Natural Areas (5): Research and describe the history, ecosystems, species, and natural importance of a protected area in the United States. (2 hours)

Black Blizzard video, the worst human-induced environmental disaster in our history—the Dust Bowl—due to removal of native species

Surviving the Dust Bowl video, personal accounts of the worst human-induced environmental disaster in our Nation's history

The Crumbling of America video, our old and failing infrastructure

UNIT VI: ENERGY RESOURCES AND CONSUMPTION: READ CHAPTERS 12 & 13.

TOPICS: (4 weeks)

A. Fossil Fuel Resources and Use
1. Formation of Coal, Oil, and Natural Gas
2. Extraction/Purification Methods
3. World Reserves and Global Demand
4. Synfuels
5. Environmental Advantages/ Disadvantages of Resources

B. Energy Conservation
1. Energy Efficiency
2. CAFÉ Standards
3. Hybrid Electric Vehicles
4. Mass Transit

C. Nuclear Energy
1. Nuclear Fission Process
2. Nuclear Fuel
3. Electricity Production
4. Nuclear Reactor Types
5. Environmental Advantages/ Disadvantages
6. Safety Issues
7. Radiation and Human Health
8. Radioactive Wastes
9. Nuclear Fusion

D. Renewable Energy
1. Solar Energy and Electricity
2. Hydrogen Fuel Cells
3. Biomass
4. Wind Energy
5. Small-Scale Hydroelectric
6. Ocean Waves and Tidal Energy
7. Geothermal
8. Environmental Advantages/ Disadvantages

CORRESPONDING LABS (# in Molnar)**, PROJECTS, VIDEOS, ETC**.

Coal Mines video, the story behind the rock that supplies much of our energy

CO_2 Emissions from Fossil-Fuel Burning (24): Track long-term energy production, correlate data to emissions and atmospheric concentrations of CO_2, and investigate effects of this and other greenhouse gases on global temperatures. (1 hour)

Energy Resource Comparison (23): Research and compare current US power production technologies. (1 hour)

Environmental Tech video, technology that could sustain our way of life

Renewable Energy video, energy of the future (hopefully)

Solar Absorption (26): Design an experiment to calculate and compare solar heat-absorbing capacities of fluids, determine efficient applications, and compute heat absorption rates for passive materials. (2 hours)

UNIT VII: POLLUTION: AQUATIC, ATMOSPHERIC, AND TERRESTRIAL: READ CHAPTERS 14–17

Presentations of Journal Papers/Books

TOPICS: (6 weeks)

A. Hazards to Human Health
1. Environmental Risk Analysis
2. Acute and Chronic Effects
3. Dose-Response Relationships
4. Air Pollutants
5. Smoking and Other Risks

B. Air Pollution
1. Sources—Primary and Secondary
2. Major Air Pollutants
3. Measurement Units
4. Smog
5. Acid Deposition—Cause and Effects
6. Heat Islands and Temperature Inversions
7. Indoor Air Pollution
8. Remediation and Reduction Strategies
9. Clean Air Act and Other
10. Relevant Laws

C. Water Pollution
1. Types, Sources, Causes, and Effects
2. Cultural Eutrophication
3. Groundwater Pollution
4. Maintaining Water Quality
5. Water Purification
6. Sewage Treatment/Septic Systems
7. Clean Water Act and Other Relevant Laws

Risk Survey (handout): Compare actual risks with perceived risks ascertained by surveying 12 subjects. (2 hours)

Specific Heat and Climate (3): Determine specific heat of soil vis-à-vis water and relate findings to climatic phenomena. (2 hours)

Formation of Deserts (4): Explain factors in existence and location of deserts, and analyze data in relation to desert formation. (1 hour)

Tropospheric Ozone Lab (handout): Prepare and use chemically reactive paper to measure the concentration of ground-level ozone. (2 hours)

Particulate Air Pollution (27): Measure particulate matter locally and evaluate data by EPA standards. (2 hours)

D. Solid Waste
1. Types
2. Disposal
3. Reduction

E. Noise Pollution
1. Sources
2. Effects
3. Control Measures

F. Hazardous Chemicals in the Environment
1. Types of Hazardous Waste
2. Treatment/Disposal of Hazardous Waste
3. Cleanup of Contaminated Sites
4. Biomagnification
5. Relevant Laws

G. Pollution: Economic Impacts
1. Cost-Benefit Analysis
2. Externalities
3. Marginal Costs
4. Sustainability

UNIT VIII: GLOBAL CHANGE AND A SUSTAINABLE FUTURE: READ CHAPTERS 18–20.

TOPICS: (4 weeks)

A. Stratospheric Ozone
1. Formation of Stratospheric Ozone
2. Ultraviolet Radiation
3. Causes of Ozone Depletion
4. Effects of Ozone Depletion
5. Strategies for Reduction of Ozone Depletion
6. Relevant Laws and Treaties

B. Global Warming
1. Greenhouse Gases and The Greenhouse Effect
2. Impacts and Consequences of Global Warming
3. Reducing Climate Change
4. Relevant Laws and Treaties

C. Loss of Biodiversity
1. Habitat Loss; Overuse; Pollution; Introduced and Invasive Species; Endangered and Extinct Species
2. Maintenance Through Conservation
3. Relevant Laws and Treaties

CORRESPONDING LABS (# in Molnar)**, PROJECTS, VIDEOS, ETC**.

Solid Waste Collection (30): Quantify and analyze household solid waste. (2 hours)

Garbage (recycling) video, how landfills and our treatment of refuse have changed

Energy and Recycling (8): Compare energy costs of recycling aluminum cans to making cans from raw materials. (1 hour)

Auto and Truck Tires and the Environment (31): Calculate energy available from burning tires for electricity, compare SO_2 emissions to those of burning coal. (1 hour)

The Environmental Movement video, the legacy of Love Canal, NY

Global Climate Change (33): Analyze and graphically depict interrelationships among a complex of effects of global warming. (1 hour)

Make-A-Diff Status Reports 2:
Students will report to the class on the yearlong progress of their "Make-A-Diff" endeavor: Will the project continue? If you had to do over, how would improve your efforts? What advice would you give the next year's class? Students will again grade one another's progress on a rubric. Participation in this process is part of your grade.