AP® Environmental Science

Syllabus 1 **Syllabus Number: 876052v1**

Course Description

Class Size and Scheduling

Class size is held to 26 because of lab facilities. The class periods are 47 minutes long, and a double lab period is scheduled once a week. **[C11]** Each semester consists of two nine-week periods.

C11—The course includes a laboratory and/or field investigation component. A minimum of one class period or its equivalent per week is spent engaged in laboratory and/or field work.

Course Prerequisites and Requirements

AP® Environmental Science is open to students who have taken biology, honors chemistry, and one year of honors integrated math 3. They must also be registered to take physics concurrently. Many students are taking AP Biology, AP Chemistry, and AP Physics at the same time. The students must be prepared to work outdoors for many of the labs.

Textbook

The text is *Living in the Environment* by G. Tyler Miller Jr. (Pacific Grove, Calif.: Brooks/Cole Thomson Learning).

Course Outline

Topic	Duration
Introduction of Environmental Problems Where are we now, and where do we want to go?	3 weeks
Matter and Energy Resources	1 Week
Ecosystems Dynamics, food chains and webs, and flow of energy **[C2]**	2 Weeks
Climate and Weather Global air circulation, ocean currents, and biomes **[C1]**	2 Weeks
Population Dynamics What causes changes in ecosystems **[C3]**	1 Week
Earth Science Plate tectonics, the rock cycle, weathering and erosion, volcanoes and earthquakes, natural disasters **[C1]**	1 Week
Human Population Demography and population distribution **[C3]**	3 Weeks
Loss of Biodiversity Endangered plants and animals **[C7]**	2 Weeks

C2— The course provides instruction in The Living World

C1— The course provides instruction in Earth Systems and Resources

C3— The course provides instruction in Population

C7— The course provides instruction in Global Change

Topic	Duration
Global Warming and Ozone Depletion Causes and solutions **[C7]**	1 Week
Renewable Energy Alternative sources of energy **[C5]**	2 Weeks
End Of First Semester	
Nonrenewable Energy **[C5]**	1 Week
Human Health Toxic and hazardous substances, diseases and risk analysis	2 Weeks
Air Pollution Outdoor and indoor air pollution **[C6]**	1 Week
Water Pollution Water sources and types of pollution	2 Weeks
Soil Structure of soil, erosion, desertification, and conservation **[C1]**	1 Week
Toxic and Solid Waste Disposal, regulations, prevention **[C6]**	2 Weeks
Food Production Biological, physical, and social boundaries	1 Week
Pesticides History, problems, and alternatives	2 Weeks
Land and Water Management Conservation, problems, and wilderness **[C4]**	1 Week
Preserving Animal Diversity Human encroachment and sustainable management **[C2]**	1 Week
Economics, Politics, Ethics and the Environment Dealing with environmental policy, problem solving, and environmental education	2 Weeks

C7— The course provides instruction in Global Change

C5— The course provides instruction in Energy Resources and Consumption

C6— The course provides instruction in Pollution

C1— The course provides instruction in Earth Systems and Resources

C4— The course provides instruction in Land and Water Use

C2— The course provides instruction in The Living World

Laboratory and Field Work

Research Projects

My students are involved in two ongoing projects.

Appalachian Forest Action Plan. In this project, two old-growth forest areas in the western part of our state were selected for sites. To qualify for the project, the trees had to be in the mixed mesophytic forest and be approximately 120 years old. The Nature Conservancy suggested some areas that might contain trees of the required age. I checked out these areas with a member of the Forest Action Plan. Two sites were selected near our school. Data will be collected over the next ten years to help determine what species of trees are dying, in what locations and altitudes, and the rate of die back. This information is submitted to a number of individuals who are putting it into a computer database.

The students were taken to the sites in September while leaves were still on the trees, and they collected a variety of data. They marked off random plots, measured the diameters of all of the trees above 3.5, identified all trees, calculated the height of each tree, and graphed all of the data on paper, recording the position of each tree in the plot. They also located all dead trees and tried to determine the age of death and the species of tree. Large measuring tapes, compasses (with clinometers), stakes, tree borers, and rope were needed to collect the data.

Creek Analysis. The students go to two different sites and collect water samples from a nearby creek. One site is above, and the other site is below where acid mine drainage (AMD) enters the creek. By sampling at the two sites, students are documenting the differences in the ecology and chemistry of both sites. A wetland is being constructed that will be able to handle 30 percent of the AMD going into the creek. Over time there should be a testable difference in aquatic organisms, if the wetland is successful.

The following equipment was used:

- Water sampling bottles
- Seine
- Secci disc
- Screen sorters
- Hip waders
- Plankton net
- Surber sorter
- D-frame net
- Dredges
- Keys for aquatic organisms, birds, insects, fish, plants, etc.
- Lamotte test kits
- Sorting trays
- Measuring tape
- Buckets

A grant was obtained through a local corporation to help pay for this equipment.

The creek is only 12 minutes away from our school, so the collecting is done during our two-hour lab period. Each lab group is assigned specific equipment; students use the same equipment each time we go to the creek (they become [C9]

C9—The course includes methods for analyzing and interpreting information and experimental data, including mathematical calculations.

very good at what they are doing). We collect once in the fall, again in late winter, and finally in the spring.

Many class periods are spent studying with the samples. Students do the water chemistry, using colorimeters and spectronic 20s. They identify the microinvertebrates and the macroinvertebrates. Bacterial counts are done, and EMB agar is used to identify the amount of E. coli in the water. Micropore filters are also used for algae and bacterial counts. [C8]

C8—The course provides students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world. The curriculum draws upon various scientific disciplines.

We send water samples to the Environmental Protection Agency for testing so that the students can compare their results with the EPA analysis. (This spring a local representative from the EPA will accompany us on one of our trips and electroshock the fish for data collection.)

Each student writes a very extensive lab report in the fall and again in the spring. Included in these reports is the students' research into other ways (besides constructing wetlands) of preventing and alleviating acidity in surface water. [C10]

C10—The course teaches students how to identify and analyze environmental problems, to evaluate the ecological and human health risks associated with these problems, and to critically examine various solutions for resolving or preventing them.

Second Semester Field Trip

Trail Maintenance Field Trip. Through the Sierra Club, we adopted five trails between 5 and 8.8 miles long on the side of a mountain. The students were divided into five groups and spent an entire day doing trail maintenance—building dry beds, lopping greenbrier, and clearing fallen trees off the trail.

During the other lab periods the following labs and activities are performed:

First Semester

1. **Quadrat lab.** On school grounds, students learn how to mark off a quadrat and identify the large plants in the area. Then they graph the area.

2. **Population lab.** In a nearby meadow, students caught grasshoppers in a specified plot of land, marked them, and then released them. The next week, we returned to recatch the insects and did a population study using the Shannon-Weaver Index. Students also identified any unusual insects or animals in the meadow. [C9]

3. **Ecological succession.** Students did a transect study of ecological succession in a park near the school, from the mowed area to the woods. Plants were identified along a string line, and their root depth was noted.

4. **Soil diversity.** Students collected soil during the lab on ecological succession, and stored it in a refrigerator until the following week. Using Berlese funnels and arthropod identification keys, students identified organisms found in different types of soils.

C9—The course includes methods for analyzing and interpreting information and experimental data, including mathematical calculations.

5. **Computer lab on population growth.** Students used one of the ecology labs from "Biology Explorer" by Logal Educational Software and Systems to compare rabbits in the United States and Australia. When a virus is introduced, they find out what happens to the populations. **[C3]**

6. **Thermal pollution.** This is a timed experiment using yeast cells, heat, stain, and microscopes. **[C6]**

7. **Bacterial identification lab.** Students grew three unknown bacteria on special agar. Using a colony growth key, they identified each.

8. **Acid rain and seed germination.**

9. **Lead lab.** Students collected samples from dishes and pottery at home. In the lab, they tried to determine the presence of lead through a chemical change.

10. **Skull lab.** I borrowed all types of skulls (herbivores, carnivores, and omnivores) from a local museum. The students determined what the animal's lifestyle was from its dentition, jaw shape, location of eye orbits, zygomatic breadth, size of the nasal cavity, and shape of the cranium.

11. **Detecting mutant bacteria.** The students grew E. coli on streptomycin agar and collected the mutants. They grew the mutants in nutrient broth and replated them on specific concentrations of streptomycin agar plates.

12. **Oxygen cycle Lab—with snails and elodea.** The students determined whether there was any chemical change, over time, by using indicator solutions in test tubes.

13. **Horns and antlers—Bovidae and Cervidae.** Again I went to our local museum and borrowed all kinds of skulls with different horns and antlers. The students determined the chord, catching arch, stabbing zone, greatest reach, and length of the stem. This information enables the students to determine how the animal used these structures, and it leads to good discussions on natural selection.

C3— The course provides instruction in Population

C6— The course provides instruction in Pollution

Second Semester

1. **Chaparral seeds.** Requirements for germination.

2. **Bacterial enrichment from a carrot medium.** This demonstrates bacterial succession over a period of weeks.

3. **Growing plants hydroponically and macronutrient effects.**

4. **Winogradsky column.** A study of ecological succession in a microbial community with an oxygen gradient.

5. **Population dynamics of Drosophila growth.** Determining the potential for increase and how different conditions affect population dynamics.

6. **Human population study in a cemetery.** Students collected data from tombstones over the last few hundred years to create survivorship curves, age pyramids, death per age group graphs, etc.

7. **Physiology activity—perception and behavior.** Houseflies are used to determine behavioral response.

8. **Modeling a wet scrubber.** Students build a wet scrubber with laboratory equipment and determine how well it operates.

9. **Controlling pests in stored grain.** Oat cereal is used to show pest control.

10. **Amount of land needed to grow our food.** Students calculate the amount of calories in our food and then the amount of land required for different kinds of foods. **[C9]**

11. **Experimental eutrophication.** Using creek water, students cause eutrophication and observe the resulting changes in small aquatic organisms.

12. **Hike to sites of acid mine drainage to see how drainage enters different watersheds.** We explore an old railroad track not too far from us that has excellent examples of AMD and an old closed portal from the original mine.

13. **Creek analysis.** There will be two more trips to the water this semester; this involves a great deal of lab time.

14. **Local trail maintenance.** My students were asked to help improve trails in a park in our township. We lined the trails with logs, staked the logs, and added gravel to areas that had poor drainage, covering the gravel with shredded bark. Materials were provided by the township.

C9—The course includes methods for analyzing and interpreting information and experimental data, including mathematical calculations.

Special Teaching Strategies and/or Techniques

- Once a semester, assigned groups of students teach a chapter in a form of cooperative learning.

- I select student names from 3 x 5 cards and occasionally designate new lab groups so that students get to work with partners other than their friends.

- Due to time constraints, I give a 10-point quiz on each chapter (each class gets a different quiz) and a final at the end of each semester.

- I assign essay questions periodically that require students to solve environmental problems.

Resources

Textbooks

Kaufman, Donald G., and Cecilia M. Franz. Biosphere 2000: *Protecting Our Global Environment*. 2nd ed. Dubuque, Iowa: Kendall/Hunt, 1996.

Miller, G. Tyler. *Living in the Environment.*

Turk, Jonathon, and Turk, Amos. *Environmental Science*. Philadelphia: Saunders College Publishing, 1988.

Lab Manuals

Bernstein, Leonard. *Environmental Science: Ecology and Human Impact*. Menlo Park, Calif.: Addison-Wesley, 1996.

Gilligan, Matthew R., Thomas Kozel, and Joseph P. Richardson. *Environmental Science Laboratory*. Savannah, Ga.: Halfmoon Publishing.

Video Tapes

Race to Save the Planet

Software Packages

Logal Educational Software and Systems, Biology Explorer, Population Ecology.

Environmental Science Curricular Requirements

The course provides instruction in each of the following seven content areas outlined in the *AP Environmental Science Course Description:*