TAMALPAIS UNION HIGH SCHOOL DISTRICT
Larkspur, California

Course of Study

ADVANCED PLACEMENT ENVIRONMENTAL SCIENCE 1-2

I. INTRODUCTION

Advanced Placement Environmental Science 1-2 is a year long course intended for those students (primarily eleventh and twelfth graders) who want a challenging, in-depth, college level survey environmental science course while still in high school. AP Environmental Science is a nationally developed, standardized curriculum rather than a district-developed course of study. This course prepares students to take the AP Environmental Science exam and receive one semester of college credit while still in high school (subject to universities restrictions and requirements). This may allow students to accelerate their studies in the environmental sciences (again, depending upon which college the student will attend).

This course draws upon the foundation of life, earth, and physical sciences as developed in Integrated Science 1-4, and provides and opportunity to integrate a wide variety of topics from different areas of study. It expands upon some of the topics covered in the district's existing Environmental Science 1-2 by covering them at a deeper level. The course also enriches the backgrounds of students interested in career fields in environmental science.

This course addresses the following TAM 21st Century goals:

1. Student Success

- Preparing students to be problem solvers by increasing their responsibility and independence through involvement in a UC-recommended college preparatory course.
- Helping students acquire technological skills for further personal, educational, and employment success through state-of-the-art lab experiments, word processing and spread-sheet lab reports, and modern classroom activities and demonstrations.
- Permitting students to act responsibly in an ever-changing and increasingly complex socio-economic environment.

2. Instruction

- The AP Environmental Science curriculum allows for more student and parental choice of instructional programs.
- The AP Environmental Science curriculum provides a system of assessment that strengthens students, classes, programs, and schools by adhering to a national

standard developed by the College Board. This allows students, teachers, and parents to measure success relative to others across the country.

II. STUDENT LEARNING OUTCOMES

#1 Communicate articulately, effectively, and persuasively when speaking and writing.
#2 Read and analyze material in a variety of disciplines.
#3 Use technology as a tool to access information, analyze and solve problems, and communicate ideas.
#4 Demonstrate knowledge of the rights and responsibilities of the individual in a democratic society.
#5 Apply mathematical knowledge and skills to analyze and solve problems.
#6 Demonstrate scientific literacy.
#7 Demonstrate knowledge of the global environment and its resources.
#9 Apply principles of economics.
#10 Analyze and propose solutions to contemporary issues using a variety of perspectives.
#12 Demonstrate school-to-work/post secondary transition skills and knowledge.
#13 Participate in community, social, civic, or cultural service.

This course is designed to help students attain the state Content Standards in Science.

A. Upon completion of this course, students will be able to:

1. Take the Advanced Placement Environmental Science examination. The specific topics, concepts, and themes to be covered by this exam are defined in the College Board's AP Environmental Science syllabus, which provides a detailed outline of the topics and percentage of time devoted to curriculum, labs, and field studies. (See Appendix A)
2. Demonstrate critical thinking skills by analyzing student-generated data, forming hypotheses, and working as a team to design laboratory and field research, drawing conclusions to scientific inquiry in the areas of Energy Flow; Matter Cycling; Solid Earth; Atmosphere; Hydrosphere; Interactions in the Biosphere; Human Population Dynamics; Renewable and Nonrenewable Resources, Environmental Quality & Pollution; Global Changes and Their Consequences; Economic Forces; Cultural and Aesthetic Considerations; Environmental Ethics; Environmental Law; Issues and Options. (See Appendix A)
3. Comprehend, evaluation and make informed decisions about socially relevant issues such as: Global Warming, Deforestation, Air and Water Pollution, Waste/Natural Resource Management, Acid Rain, Population, Introduction of non-native species, and Endangered Species. This may be demonstrated through journal writing, lab reports, research papers, field studies, and examinations. (See Appendix A)

4. Develop advanced skills in communicating information using written, oral and/or multimedia formats.
5. Use a variety of scientific tool and equipment including water quality analysis test kits and meters.

B. **Students will cover the following state subject Content Standards**

(See Appendix B: Correlation of Student Learning Outcomes with CS. Content Standards)

Chemistry: Acids and Bases

5. Acids, bases and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept:

d. Students know how to use the pH scale to characterize acid base and solutions.

Chemistry: Solutions

6. Solutions are homogeneous mixtures of two or more substances. As a basis for understanding this concept:

d. Students know how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million and percent composition.

Biology/Life Sciences: Ecology

6. Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:

a. *Students know* biodiversity is the sum of different kinds of organisms and is affected by alterations of habitats.

b. *Students know* how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.

c. *Students know* how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.

d. *Students know* how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.

e. *Students know* a vital part of an ecosystem is the stability of its producers and decomposers.

f. *Students know* at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid.

Earth Sciences: Energy in the Earth System

4. Energy enters the Earth system primarily as solar radiation and eventually escapes as heat. As a basis for understanding this concept:

a. *Students know* the relative amount of incoming solar energy compared with Earth's internal energy and the energy used by society.

b. *Students know* the fate of incoming solar radiation in terms of reflection, absorption, and photosynthesis.

c. *Students know* the different atmospheric gases that absorb the Earth's thermal radiation and the mechanism and significance of the greenhouse effect.

5. Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. As a basis for understanding this concept:

a. *Students know* how differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.

c. *Students know* the origin and effects of temperature inversions.

d. *Students know* properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms.

e. *Students know* rain forests and deserts on Earth are distributed in bands at specific latitudes.

f. * *Students know* the interaction of wind patterns, ocean currents, and mountain ranges results in the global pattern of latitudinal bands of rain forests and deserts.

g. * *Students know* features of the ENSO (El Niño southern oscillation) cycle in terms of sea-surface and air temperature variations across the Pacific and some climatic results of this cycles.

Earth Sciences: Energy in the Earth System (Climate and Weather)

6. Climate is the long-term average of a region's weather and depends on many factors. As a basis for understanding this concept:

a. *Students know* weather (in the short run) and climate (in the long run) involve the transfer of energy into and out of the atmosphere.

b. *Students know* the effects on climate of latitude, elevation, topography, and proximity to large bodies of water and cold or warm ocean currents.

c. *Students know* how Earth's climate has changed over time, corresponding to changes in Earth's geography, atmospheric composition, and other factors, such as solar radiation and plate movement.

d. * *Students know* how computer models are used to predict the effects of the increase in greenhouse gases on climate for the planet as a whole and for specific regions.

Earth Sciences: Biogeochemical Cycles

7. Each element on Earth moves among reservoirs, which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of the biogeochemical cycles. As a basis for understanding this concept:

a. *Students know* the carbon cycle of photosynthesis and respiration and the nitrogen cycle.

b. *Students know* the global carbon cycle: the different physical and chemical forms of carbon in the atmosphere, oceans, biomass, fossil fuels, and the movement of carbon among these reservoirs.

c. *Students know* the movement of matter among reservoirs is driven by Earth's internal and external sources of energy.

Earth Sciences: Structure and Composition of the Atmosphere

8. Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life. As a basis for understanding this concept:

a. *Students know* the thermal structure and chemical composition of the atmosphere.

b. *Students know* how the composition of Earth's atmosphere has evolved over geologic time and know the effect of outgassing, the variations of carbon dioxide concentration, and the origin of atmospheric oxygen.

c. *Students know* the location of the ozone layer in the upper atmosphere, its role in absorbing ultraviolet radiation, and the way in which this layer varies both naturally and in response to human activities.

Earth Sciences: California Geology

9. The geology of California underlies the state's wealth of natural resources as well as its natural hazards. As a basis for understanding this concept:

c. *Students know* the importance of water to society, the origins of California's fresh water, and the relationship between supply and need.

Investigation and Experimentation

1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:

a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, graphing calculators) to perform tests, collect data, analyze relationships, and display data.
b. Identify and communicate sources of unavoidable experimental error.
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
d. Formulate explanations by using logic and evidence.
e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
f. Distinguish between hypothesis and theory as scientific terms.

g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.
h. Read and interpret topographic and geologic maps.
i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomenon (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).
j. Recognize the issues of statistical variability and the need for controlled tests.
k. Recognize the cumulative nature of scientific evidence.
l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.
n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).

III. ASSESSMENT

A. Student Assessment

Students will be given the grading criteria and course expectations, preferably in writing, at the beginning of the course.

Student work will be utilized to assess progress over the course of the year. This work may include, but not be limited to the following:

1. Scientific papers reporting the results of laboratory and field studies.
2. A scientific journal of all work completed for a specific project and verified by a teacher and/or teammate.
3. Given articles containing conflicting points of view on a socially relevant environmental issue, students my interpret the data and present their own conclusions orally and/or in writing.
4. Experimental design and/or analysis of existing data.
5. Tests, quizzes and semester exams.

B. Course Assessment

Annual reports will be prepared to summarize the results of student performance on student participation rates and scores on the AP Environmental Science exam.

IV. METHODS AND MATERIALS

A. Methods

Student's learning activities will include, but not be limited to, labs, reports, presentations, field studies, lectures, exams, sample free-response questions from previous year's AP exams.

B. Materials

Primary source materials will be used in conjunction with the AP-level approved textbook: **Miller, G. Tyler *Living in the Environment: Principles, Connections, and Solutions*.** Additional lab manuals and materials required for the field studies and lab experiments will be necessary.

C. Technology

Students will be using scientific technology appropriate for environmental studies. In addition, students will be expected to use word processing and presentation graphics in preparation for their reports. As appropriate, databases, spreadsheets, probe ware, and simulation software will be incorporated into the course. Telecommunications will be used in research, data collection and information exchange.

D. Suggested Instructional Time Allocation (see Appendix A)

V. GENERAL INFORMATION

AP Environmental Science is a year-long, 10 credit course open to Juniors and Seniors.

A. Prerequisites

Students must have completed Integrated Science 1-4 (or equivalent) with a 2.75 minimum cumulative GPA, or instructor approval. Chemistry must have been completed, or taken concurrently.

B. Requirements Met

This course may be used in partial fulfillment of the 220-credit graduation requirement.

This course is accepted towards the "D" and "G" requirements for UC admissions. It is also accepted for the CSU lab science requirement.

Approved: 1/27/04

Appendix B:

Correlation of Student Learning Outcomes with CS. Content Standards

II. Students will ….

1.

Topics	CA. Content Standards
Energy Flow	E.S. 4a.-4b.
Matter Cycling	Bio 6d., E.S. 7a.-7c.
Atmosphere	E.S. 4c., 5a., 8a.-8c.
Hydrosphere	E.S. 9c.
Interaction in Biosphere	Bio. 6a.-6f.
Human Population Dynamics	Bio. 6b.-6c.
Renewable & Non-Renewable Resources	E.S. 9a., 7c.-7d.
Environmental Quality & Pollution	Chem. 6d.
Global Changes & Their Consequences	E.S. 4a.-4c., 5a., 6a.-6d.

2.

Topics	CA. Content Standards
Global Warming Deforestation	E.S. 4a.-4c., 5a., 6a.-6d.
Air & Water Pollution	Chem. 6d.
Waster/Natural Resources Management	E.S. 9a.
Acid Rain	Chem. 5d.
Population	Bio 6b.-6c.
Intro of Non-Native and Endangered Species	Bio 6a., 6b.

Key

Chemistry = Chem.
Biology/Life Science = Bio.
Earth Science = E.S.