FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

Preliminary Course Outline
AP Environmental Science

Date: January 2003 **Subject Area: Elective**

Proposed Grade Level(s): 11 & 12 **Course Length: 1 Year**

Grading: A-F **Number of Credits: 5/semester**

Prerequisites: Two Years of College Prep Science with a grade of B or better

Algebra 1 with a grade of B or better

Concurrent enrollment in/or completion of Algebra 2 or higher recommended

BRIEF COURSE DESCRIPTION:

The AP Environmental Science course is designed to be the equivalent of a one-semester, introductory college course in environmental science. Environmental science integrates a wide variety of science disciplines, including geology, biology, environmental studies, environmental science, chemistry, and geography. It also incorporates a sociological and political perspective. It is intended to enable students to undertake, as first-year college students, a more advanced study of topics in environmental science, or to fulfill a basic requirement for a laboratory science and thus free time for taking other courses. AP Environmental Science is designed 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. Environmental science is interdisciplinary; it embraces a wide variety of topics from different areas of study.

GENERAL GOALS/PURPOSE:

A. Science is a process.
- Science is a method of learning more about the world.
- Science constantly changes the way we understand the world.

B. Energy conversions underlie all ecological processes.
- Energy cannot be created; it must come from somewhere.
- As energy flows through systems; at each step more of it becomes unusable.

C. The Earth itself is one interconnected system.
- Natural systems change over time and space.
- Biogeochemical systems vary in ability to recover from disturbances.

D. Humans alter natural systems.
- Humans have had an impact on the environment for millions of years.
- Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.

E. Environmental problems have a cultural and social context.
- Understanding the role of cultural, social, and economic factors is vital to the development of solutions.

F. Human survival depends on developing practices that will achieve sustainable systems.

STUDENT READING COMPONENT:

Students will:

- Read expository text from a college-level science text such as *Living in the Environment*, 12th Edition, by G. Tyler Miller
- Read at least one classic book on environmental science such as *Silent Spring* by Rachel Carson or *Sand County Almanac* by Aldo Leopold.
- Practice critical reading strategies through the reading of current research articles in environmental science.
- Use reading strategies to extract meaning from text independently.

STUDENT WRITING COMPONENT:

Students will:

- Write lab reports that include a conclusion written in an expository style.
- Practice for the free response questions on the AP exam by writing at least one essay style response per unit of study.
- Report findings of an environmental study using a standard format.

STUDENT ORAL COMPONENT:

Students will:

- Informally discuss the concepts demonstrated by the lab.
- Participate in whole class discussion of science concepts.
- Present projects for each unit of study to the class in a formal manner.
- Present the culminating environmental study project to a broader audience as appropriate.

DETAILED UNITS OF INSTRUCTION:

This is a brief outline of topics to be addressed in this course. Lessons for teaching these concepts will be developed later. The percentages indicate the approximate amount of time dedicated to each area. The numbers and letters reference specific Science Content Standards that are aligned to the content.

I. Interdependence of Earth's Systems: Fundamental Principles and Concepts (25%)

A. The Flow of Energy (Physics 3a-f, Earth 1, 3)
   1. Forms and quality of energy
   2. Energy units and measurements
   3. Sources and sinks, conversions

B. The Cycling of Matter (Biology 6d, Earth 7a-d)
   1. Water
   2. Carbon
   3. Major nutrients
      a. Nitrogen
      b. Phosphorus
   4. Differences between cycling of major and trace elements

C. The Solid Earth (Earth 1b, c, 3a-f)

1. Earth history and the geologic time scale
2. Earth dynamics: plate tectonics, volcanism, the rock cycle, Soil formation

D. The Atmosphere (Earth 6a, c, 8a-c)
1. Atmospheric history: origin, evolution, composition, and structure
2. Atmospheric dynamics: weather, climate

E. The Biosphere (Biology 6a-g, 7a, d, 8a,b)
1. Organisms: adaptations to their environments
2. Populations and communities: exponential growth, carrying capacity
3. Ecosystems and change: biomass, energy transfer, succession
4. Evolution of life: natural selection, extinction

II. <u>Human Population Dynamics</u>

A. History and Global Distribution (Biology 6c)
1. Numbers
2. Demographics, such as birth and death rates
3. Patterns of resource utilization

B. Carrying Capacity—Local, Regional, Global (Biology 6c)

C. Cultural and Economic Influences (Earth 9a)

III. <u>Renewable and Nonrenewable Resources: Distribution, Ownership, Use, Degradation</u> (15%)

A. Water (Earth 9c)
1. Fresh: agricultural, industrial, domestic
2. Oceans: fisheries, industrial

B. Minerals

C. Soils
1. Soil types
2. Erosion and conservation

D. Biological (Earth 7a-d)
1. Natural areas
2. Genetic diversity
3. Food and other agricultural products

E. Energy (Earth 4a-d, Biology 6f)
1. Conventional sources
2. Alternative sources

F. Land (Earth 9a)
1. Residential and commercial
2. Agricultural and forestry
3. Recreational and wilderness

IV. <u>Environmental Quality</u> (20-25%)

A. Air/Water/Soil (Earth 4c)
1. Major pollutants
a. Types, such as SO2, NOx, and pesticides
b. Thermal pollution
c. Measurement and units of measure such as ppm, pH, µg/L
d. Point and nonpoint sources (domestic, industrial, agricultural)
2. Effects of pollutants on:
a. Aquatic systems
b. Vegetation
c. Natural features, buildings and structures
d. Wildlife
3. Pollution reduction, remediation, and control

B. Solid Waste

1. Types, sources, and amounts
2. Current disposal methods and their limitations
3. Alternative practices in solid waste management

C. Impact on Human Health (Biology 10a-f)

1. Agents: chemical and biological
2. Effects: acute and chronic, dose-response relationships
3. Relative risks: evaluation and response

V. Global Changes and Their Consequences (15-20%)

A. First-order Effects (changes) (Biology 6b, Earth 7a,c, 8a-c)

1. Atmosphere: CO2, CH4, stratospheric O3
2. Oceans: surface temperatures, currents
3. Biota: habitat destruction, introduced exotics, over harvesting

B. Higher-order Interactions (consequences) (Earth 5a-d, Biology 6a, 8e)

1. Atmosphere: global warming, increasing ultraviolet radiation
2. Oceans: increasing sea level, long-term climate change, impact on El Niño
3. Biota: loss of biodiversity

VI. Environment and Society: Trade-Offs and Decision Making (10%)

A. Economic Forces

1. Cost-benefit analysis
2. Marginal costs
3. Ownership and externalized costs

B. Cultural and Aesthetic Considerations

C. Environmental Ethics

D. Environmental Laws and Regulations (International, National, and Regional)

E. Issues and options (conservation, preservation, restoration, remediation, sustainability, mitigation) agricultural)

THIS COURSE WILL PREPARE STUDENTS FOR THE CAHSEE AND/OR FCUSD EXIT EXAMS IN:

This course will prepare students for a four-year university program.

LAB FEE, IF REQUIRED:

There are no lab fees; however, there will be two field trips in which students will offset transportation and food costs.

SUBJECT AREA CONTENT STANDARDS[i] TO BE ADDRESSED:

Biology

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 total 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 deter-mined 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 photosyn-thesis 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.

g.* *Students know* how to distinguish between the accommodation of an individual organism to its environment and the gradual adaptation of a lineage of organisms through genetic change.

Evolution

7. The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept:

a. *Students know* why natural selection acts on the phenotype rather than the genotype of an organism.

b. *Students know* why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.

c. *Students know* new mutations are constantly being generated in a gene pool.

d. *Students know* variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.

8. Evolution is the result of genetic changes that occur in constantly changing environments.

As a basis for understanding this concept:

a. *Students know* how natural selection determines the differential survival of groups of organisms.

b. *Students know* a great diversity of species increases the chance that at least some organisms survive major changes in the environment.

c. *Students know* the effects of genetic drift on the diversity of organisms in a population.

d. *Students know* reproductive or geographic isolation affects speciation.

Chemistry

Heat and Thermodynamics

3. Energy cannot be created or destroyed, although in many processes energy is transferred to the environment as heat. As a basis for understanding this concept:

a. *Students know* heat flow and work are two forms of energy transfer between systems.

Conservation of Matter and Stoichiometry

3. The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.

Chemical Thermodynamics

7. Energy is exchanged or transformed in all chemical reactions and physical changes of matter. As a basis for understanding this concept:

a. *Students know* how to describe temperature and heat flow in terms of the motion of molecules (or atoms).

b. *Students know* chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.

c. *Students know* energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.

d. *Students know* how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.

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.

d.* *Students know* the differing greenhouse conditions on Earth, Mars, and Venus; the origins of those conditions; and the climatic consequences of each.

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 under-standing this concept:

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

b. *Students know* the relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers.

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 cycle.

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.

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 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.

d.* *Students know* the relative residence times and flow characteristics of carbon in and out of its different reservoirs.

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.

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:

a. *Students know* the resources of major economic importance in California and their relation to California's geology.

b. *Students know* the principal natural hazards in different California regions and the geologic basis of those hazards.

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

d.* *Students know* how to analyze published geologic hazard maps of California and know how to use the map's information to identify evidence of geologic events of the past and predict geologic changes in the future.

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, and 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 phenomena (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.

DISTRICT ESLR'S TO BE ADDRESSED:

Students will be:

Self-Directed Learner: Success in this class will require students to independently monitor their progress in a variety of activities and determine the next steps and direction needed to complete assigned work. This class will prepare students for the rigors of college through an emphasis on self-directed learning.

Effective Communicator: Students will communicate their understanding of science concepts through written and oral expression.

Quality Producer/Performer: Students will demonstrate successful performance with two culminating assessments: the AP exam and presentation of a year long study and analysis of part of the local community.

Constructive Thinkers: Observation and analysis of lab phenomena will develop students' problem solving skills.

Collaborative Workers: Students will work in teams to complete labs and study a part of the local ecosystem.

Responsible Citizens: Students will share their ecological study of local environmental change by reporting their findings to the Folsom City Counsel.

Science Content Standards for California Public Schools, Kindergarten Through Grade Twelve
http://www.cde.ca.gov/board/pdf/science.pdf