TAMALPAIS UNION HIGH SCHOOL DISTRICT
Larkspur, California

COURSE OF STUDY

Environmental Science 1-2

I. INTRODUCTION

Environmental Science 1B2 is a two-semester upper division science elective for students who have successfully completed the prerequisites.

This course draws upon the foundation of life, earth and physical sciences as developed in Integrated Science 1-4 and provides an opportunity to integrate the sciences with other disciplines.

The course is designed to give all students the necessary background information and critical thinking skills needed to make informed decisions on global environmental issues, preparation for more advanced studies in science, exposure to careers in environmental fields, and the opportunity to work within the community. This lab and project-based course incorporates field studies to deliver content and skills. Data gathering and interpretation, team research projects and presentation skills are emphasized. These skills are developed/applied within the context of the major concepts in environmental science, and integrate concepts from a variety of scientific disciplines. Students will have the opportunity to employ current technology, instruments and techniques used by professional environmental scientists. Course content includes a study of human impacts on aquatic and terrestrial ecosystems.

This course addresses the following Tam 21st Century goals:

- Preparing students to be problem solvers by increasing their responsibility and independence through project-based learning
- Creating meaningful school-to-career opportunities and/or experiences.
- Permitting students to act responsibly in an ever-changing and increasingly complex socio-economic environment

This course addresses the following 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.
#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.

II. STUDENT LEARNING OUTCOMES

A. **Students will:**

1. 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; Atmosphere; Hydrosphere; Interactions in the Biosphere; Human Population Dynamics; Renewable & Nonrenewable Resources, Environmental Quality & Pollution; Global Changes and Their Consequences.

   * See APPENDIX 1 for correlation of student learning outcomes with CA. Content Standards.

2. Comprehend, evaluate 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 debating, writing, and legislating in support of their decisions.

   * See APPENDIX 1 for correlation of student learning outcomes with CA. Content Standards.

3. Participate in researching global environmental issues.

4. Experience environmentally sound practices by participating in recycling, conservation and/or habitat preservation/restoration.

5. Develop advanced skills in communicating information using written, oral and/or multimedia formats.

6. Use a variety of scientific tools and equipment including water quality analysis test kits and meters.

B. **Students will cover the following state subject 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 and base 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 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 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 cycle.

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 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, 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 (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. A career exploration research paper.
2. A daily scientific journal of all work completed for a specific project and verified by a teacher and/or teammate.
3. A scientific paper reporting the results of laboratory or fieldwork.
4. Given articles containing conflicting points of view on a socially relevant environmental issue, students may interpret the data and present their own conclusions orally and/or in writing.
5. Tests, quizzes and semester exams.

B. Course Assessment

Teachers will review student work to assess levels of student achievement and plan changes, if needed, in the course content and organization.

Feedback from students and/or mentors may be collected through selected interviews

IV. METHODS AND MATERIALS

A. Methods

This course is designed to be at least 50% field study/lab activity. Instruction will include a combination of discussion, demonstration, reading, inquiry and inductive teaching strategies. Student products will include in-depth research, reports, laboratory experiments, and fieldwork away from campus.

B. Materials

Primary source materials will be used in conjunction with an upper division/college-level textbook such as: Miller, G. Tyler *Environmental Science*. Additional lab materials will be required for the field studies and lab experiments.

This course uses the Board-approved textbook and supplementary books (See the District's Approved Textbook List)

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 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

1. Interdependence of Earth's Systems: Fundamental Principles and Concepts (9 weeks)

a. The Flow of Energy
b. The Cycling of Matter
c. The Atmosphere
d. The Biosphere

2.. Human Population Dynamics (3-4 weeks)

a. History and Global Distribution
b. Carrying Capacity -- Local, Regional, Global
c. Cultural and Economic Influences

3. Renewable and Nonrenewable Resources: Distribution, Ownership, Use, Degradation (5-6 weeks)

a. Water
b. Biological
c. Energy

4. Environmental Quality (8-9 weeks)

a. Air/Water/Soil
    1) major pollutants

2) effects of pollutants :
3) pollution reduction, remediation, and control

b. Solid Waste

c. Impact on Human Health (Toxicity)
1) agents: chemical and biological
2) effects: acute and chronic, dose-response relationships
3) relative risks: evaluation and response

5. Global Changes and Their Consequences (5-6 weeks)

a. atmosphere:
b. oceans:
c. biota: habitat destruction, loss of biodiversity, introduced exotics

6. Environment and Society: Trade-Offs and Decision Making (3-4 weeks)

a. Economic Forces
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)

V. GENERAL INFORMATION

Environmental Science 1-2 is a ten credit course open to Juniors and Seniors. Sophomores may be admitted with instructor approval.

A. **Prerequisites**

Students must have completed Integrated Science 1-4 (or equivalent) with passing grades. With instructor's approval and successful completion of Integrated Science 1-2, may be taken concurrently with Integrated Science 3-4.

B. **Requirements Met**

This course may be used as elective credit towards graduation but does not meet any specific graduation requirement.

This course is accepted towards the D requirement for UC admissions. It is also accepted for the CSU physical science requirement.

Adopted: 10/3/94
Revised: 7/26/99
Revised: 8/8/01
Revised: 1/7/04
Revised: 2/23/05 (UC Requirement)
Updated: 6/30/11

Appendix 1:
Correlation of Student Learning Outcomes with CS. Content Standards

II. A. Students will . . .

1.

Topics	A. 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	A. Content Standards
Global Warming Deforestation	E.S. 4a.-4c.,5a.,6a.-6d.
Air & Water Pollution	Chem. 6d.
Waste/Nat. Resource MGT.	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.