

# AP Environmental Science

## Torah High School

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Office Hours: I will be available after school Monday and Wednesday. You may email me anytime or ask in class to schedule conferences or otherwise ask questions. Emails should be returned within 24 hours and please follow up if you have not received a response.

### Course Materials:

- Textbook will be distributed at school and should be brought to each class
- Laptop for lab simulations and research
- Single-subject notebook for taking notes and drawing diagrams
- Optional: color pencils or highlighters to help organize annotations or color in diagrams

### Course Description

The goal of this course is to provide students with the scientific principles, concepts, and methodologies required to:

- Understand the interrelationships of the natural world
- Identify and analyze environmental problems both natural and human-made
- Evaluate the relative risks associated with these problems
- Examine alternative solutions for resolving and/or preventing them
- Develop and focus their own political perspective

Environmental science is interdisciplinary and embraces a wide variety of topics from different areas of study. However, across the curriculum there will be several major unifying constructs, or themes, that cut across the many topics included in the study of environmental science. These provide for the foundation for the structure of the AP Environmental Sciences (APES) Course:

- Science is a process and can change as new information arises
- Energy conversions underlie all ecological processes
- The Earth itself is one interconnected system
- Humans alter natural systems
- Environmental problems have a cultural and social context
- Human survival depends on developing practices that will achieve sustainable systems

This course will be designed following the format of the APES exam. There are seven units with varying weights on the APES exam:

- Unit 1: Earth Systems and Resources (10-15%)
- Unit 2: The Living World: Ecosystems (6-8%) and Biodiversity (6-8%)
- Unit 3: Populations (10-15%)
- Unit 4: Land and Water Use (10-15%)
- Unit 5: Energy Resources and Consumption (10-15%)
- Unit 6: Pollution: Atmospheric (7-10%), Aquatic, and Terrestrial Pollution (7-10%)
- Unit 7: Global Change (10-15%)

Throughout these units we will discuss applicable environmental policies and legislation. Some examples include:

Clean Air/Water Acts	Montreal and Kyoto Protocols	Safe Drinking Water Act (SDWA)	Marine Mammal Protection Act
Convention on International Trade in Endangered Species (CITES)	Paris Accords	Delaney Clause for Food, Drug and Cosmetic Act	National Environmental Policy Act (NEPA)
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	Endangered Species Act	Delaney Clause for Food, Drug and Cosmetic Act	Resource Conservations and Recovery Act (RCRA)

**Classroom Expectations:**

This class only meets twice a week and there is a lot of content to cover for the AP exam. Students are expected to arrive to class on time, keep electronic devices away unless otherwise instructed, and participate in classroom discussions. During labs, students are expected to follow all safety protocols and ask questions if they are unsure of any procedures or equipment. No food or drink will be allowed in the classroom during labs. This class will follow the schools academic honesty (cheating) standards outlined in the student handbook and includes the use of AI. AI will not be strictly prohibited, however, exploiting AI to plagiarize or copy work will result in a zero on the assignment and further disciplinary actions depending on severity. We will discuss the expectations and how to use AI as a tool during class.

**Late Work, Resubmissions, Missed Exams:**

Late work will generally be accepted with a penalty. Each day the assignment is not turned in will have 10% removed from the final grade down to a 50%. Late work will not be accepted after a week has passed. Assignments done on paper may be turned in via picture and email if the class does not meet that day. Some assignments are eligible to be resubmitted for a higher grade. It will be made clear beforehand if an assignment can be resubmitted. In order for a student to be able to resubmit an assignment that is eligible, the original must have been turned in on time. Any missed exams or assignments due to absences must be made up the day the student returns to school.

## Homework:

Work will be assigned at the end of each class and will be available on the class agenda. Homework may include, but is not limited to:

- Reading current unit content and answering textbook questions
- Reviewing lecture notes
- Reviewing online content/lectures
- Readings and case studies
- Lab write ups
- Essays
- Projects such as posters, surveys, field work, etc.

## Assessments:

Periodic multiple choice quizzes will be given throughout each unit. Quizzes may be during class or homework. These quizzes will be designed to help students understand what topics may be covered on exams. Exams will be a combination of multiple choice and essays to simulate the AP exam. Questions will be taken from AP exam banks to best prepare students. Initially, the essay portion of exams will be taken home as homework. As we approach winter break, essays will be incorporated into the exam and timed along with the multiple choice sections to simulate the AP exam environment.

## Labs:

We will have about 20 lab activities and/or field work lessons throughout the course. Some labs will require preparation at home prior to conducting the lab in class due to time constraints.

## Semester Assignments:

At the beginning of each semester, students will be assigned a long term project. These projects are designed to keep students up to date with relevant news and the local environment

### *First Semester Assignment (due after winter break)*

- Current event notebook - students will curate 15 relevant, current articles from newspapers, magazines, or reputable internet news sources.
- For each article, students will write a minimum of 150 words to summarize the relevance of the article to the course, the author's claim(s), perspectives, and assumptions, and at least one occasion in which the author uses evidence to support a claim (supports Science Practice 3: Text Analysis)
- This will be submitted electronically to check for plagiarism

### *Second Semester Assignment (due after the AP exam)*

*This assignment is subject to change depending on student interests*

- Public outreach campaign - Each student will develop a public outreach campaign that is designed to incite change in behaviors to support the environment. Topics will be provided.
- The campaign should either be a poster, infographic, PSA video, or other form of media that can be easily shared with the public

- A minimum of a 2 page written report will accompany the campaign explaining why this topic is of environmental importance (supports Science Practice 7: Environmental Solutions)

**Breakdown of Grades:**

Homework	15%
Assessments	40%
Labs	30%
Semester Assignments	15%

**Preliminary Course Outline** - Labs are subject to change and are not in order of when they are done

***Unit 1: Earth Systems and Resources***

**Key Concepts:** Earth's systems interact, resulting in a state of balance over time. Most of the Earth's atmospheric processes are driven by input of energy from the sun.

- Earth Science Concepts (Plate tectonics; Solar Radiation and Earth's Seasons)
- The Atmosphere (Earth's Atmosphere, Global wind patterns, Earth's Geography and
- Climate, El Nino Southern Oscillation, Pacific Decadal Oscillation)
- Global Water Resources and Use (Watersheds, droughts)
- Soil and Soil Dynamics (Soil Formation and erosion; Soil Composition and Properties)

**Possible Labs:**

- **ENSO Prediction Simulation** - Review of Kelvin wave data over years to determine indications of ENSO positive conditions. Students will also analyze previous impacts from at least three major ENSO events (Science Practice 5: Data Analysis)
- **Soil Characteristics and Plant Growth** - Students design an experiment to test the characteristics of five different types of soils, in relation to water holding capacity and plant growth. This is an ongoing lab, to observe the rate of growth of the plants in each soil type, with and without fertilizers (Science Practice 4: Scientific Experiments)
- **Plate Tectonics Investigation** - Students assessed data online from the USGS about recent earthquakes to help determine plate boundaries. Students were also asked to assess the increase in magnitude between historic earthquakes (Science Practice 5: Data Analysis)

***Unit 2: The Living World***

**Key Concepts:** Ecosystems are the result of biotic and abiotic interactions. Energy can be converted from one form to another.

- Ecosystems have structure and diversity that change over time.
- Ecosystem Structure (Introduction to ecosystems; Terrestrial biomes and Aquatic biomes; marine life zones)
- Energy Flow (Primary Productivity; trophic levels; energy flow and the 10% rule' food chains and food webs)
- Ecosystem Diversity (Introduction to Biodiversity; Ecosystem Services)

- Natural Ecosystem Change (Island biogeography; ecological tolerance; natural disruptions to ecosystems; Adaptations; Ecological Succession)
- Natural Biogeochemical Cycles (The carbon cycle; The nitrogen cycle; the phosphorous cycle; the water cycle)

**Possible Labs:**

- **Biome Poster** - Students will create posters of terrestrial and aquatic biomes. Students must include information about the climate/water environment, vegetation, soil, ecosystem services, animals, adaptations and human impacts. All posters will be displayed and students must categorize the biomes based on factors including biodiversity, sensitivity to disruptions, and human impacts (Science practice 2: Visual Representations, Science Practice 5: Data Analysis)
- **Dissolved Oxygen and Biochemical Oxygen Demand Lab** - Students will perform a test to determine the dissolved oxygen content of water samples, determine the percent saturation of oxygen in the samples and determine the BOD of a water sample (Practice 5: Data Analysis)
- **Habitat and Niche Investigation** - Field activity where students are asked to relate the abiotic factors observed in a habitat to the kinds of plants and animals found in the habitat, discuss the implications of broad and narrow niches and identify factors that may restrict the distribution of species (Science Practice 1: Concept Application)
- **Natural Selection and Adaptation Lab** - Students simulate predator and prey relationships in various habitats and with additions of predator adaptations. Observations about changes in prey population, predator and prey adaptations, and distribution are assessed (Science Practice 4: Scientific Experiments; Science Practice 5: Data Analysis; Science Practice 6: Mathematical Routines)

***Unit 3: Population***

**Key Concepts:** Populations change over time in reaction to a variety of factors. Human populations change in reaction to a variety of factors, including social and cultural factors.

- Population Biology Concepts (Generalist and specialists species; K-selected and r-selected species; survivorship curves; carrying capacity; Population growth and resource availability)
- Human Population (Age structure diagrams; total fertility rate; human population dynamics; demographic transition)

**Possible Labs:**

- **Population Lab** - Students observe the growth of duckweed, an aquatic floating plant, and how its growth rate yields a logistic curve, illustrating concepts of population growth rates, carrying capacity, and limiting factors (Science Practice 5: Data Analysis)
- **Mark and Recapture Lab** - Students conduct a mark and recapture study on a container of mealworms and Lincoln-Petersen calculations to determine the population size (Science Practice 6: Mathematical Routines)
- **Historical Changes in Human Population Characteristics** - Students collected data from cemetery and obituary records over the last hundred years to create survivorship curves, age pyramids, death per age group graphs, etc (Science Practice 6: Mathematical Routines; Science Practice 5 Data Analysis)
- **Human Population Dynamics** - Students collected demographic data from several countries and calculated the estimated population growth over 50 and 100 years. Students then compared the projected growths of each country with the lifestyle information collected on each country to discuss the impacts of growing populations based on resource use (Science Practice 6: Mathematical Routines; Science Practice 5: Data Analysis)

#### ***Unit 4: Land and Water Use***

**Key Concepts:** When humans use natural resources, they alter natural systems. Humans can mitigate their impact on land and water resources through sustainable use.

- Land Use (Tragedy of the Commons, clearcutting, the green revolution, impacts of agricultural practices, irrigation methods, pest control methods, meat production methods) • Other Land Use (mining, urbanization, ecological footprints)
- Fishing
- Sustainability (reduction of urban impacts, pest management, agriculture, aquaculture, and forestry)

#### **Possible Labs:**

- **Tragedy of the Commons** - Students will simulate the use of a common resource, such as a lake for fishing. Students will then discuss the implications of such common use for resources and determine possible solutions. Local fishing communities and regulations will be used as a basis for the discussion (Science Practice 7: Environmental Solutions)
- **Surface Mining** - Students will simulate surfacing mining to observe the environmental impacts and resource deletion associated with this type of mining. (Science Practice 2: Visual Representations)
- **Agricultural Land Use** - Students will research the 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. (Science Practice 5: Data Analysis; Science Practice 6: Mathematical Routines)

#### ***Unit 5: Energy Resources and Consumption***

**Key Concepts:** Humans use energy from a variety of sources, resulting in positive and negative consequences.

- Energy Concepts (renewable and nonrenewable resources, global energy consumption, fuel types and uses, distribution of natural energy resources, fossil fuels, nuclear power) • Renewable Energy (Energy from biomass, solar energy, hydroelectric energy, geothermal energy, hydrogen fuel cell, wind energy)
- Energy conservation.

#### **Possible Labs:**

- **Personal Energy Consumption** - Students will calculate energy savings from various window choices, interpret the R-values, calculate the energy loss from a dripping faucet, determine the energy used by specific electronics, and evaluate the long term costs of energy consuming products (Science Practice 6: Mathematical Routines)
- **Renewable Energy Sources** - Students will research various renewable energy sources and rank their energy efficiency compared to fossil fuels. Students will also discuss the advantages and disadvantages of each. Their research will be presented in infographic style posters. Students will then discuss and vote on the energy sources that would be the best to be widely adopted for San Diego (Science Practice 7: Environmental Solutions)

#### ***Unit 6: Pollution***

**Key Concepts:** Human activities have physical, chemical, and biological consequences for the atmosphere. Human activities, including the use of resources, have physical, chemical, and biological consequences for ecosystems. Pollutants can have both direct and indirect impacts on the health of organisms, including humans.

- Pollution Types

- Air pollution (Photochemical smog, thermal inversion, atmospheric CO<sub>2</sub> and particulates, indoor air pollutants, acid rain)
- Noise pollution
- Water pollution (wetland impacts, Thermal, eutrophication, persistent organic pollutants)
- Solid waste (solid waste disposal, waste reduction, sewage treatment)
- Impacts on the Environment and Human Health
  - Hazards to human health (Lethal dose 50%, dose response curve, pathogens and infectious disease)
  - Hazardous chemicals in the environment (Bioaccumulation and biomagnification)
- Economic Impacts

**Possible Labs:**

- **Air Pollution** - Students will measure the concentration of gases released from motor vehicles, examine ozone levels (using the EPA Air Quality Index) and analyze the impacts from the composition efficiency of motor vehicles. (Science Practice 5: Data Analysis)
- **Solid Waste Assessment** - Students will examine the type and amount of solid waste they each produce, determine the proportion that could be recycled, and evaluate changes in their waste behaviors and methods to reduce wastes. (Science Practice 7: Environmental Solutions)

***Unit 7: Global Change***

**Key Concepts:** Local and regional human activities can have impacts at the global level. The health of a species is closely related to its ecosystem, and minor environmental changes can have a large impact.

- Stratospheric Ozone Depletion
- Climate Change (Ocean acidification, Ocean Warming, Greenhouse Gas Levels and impacts)
- Loss of Biodiversity (Invasive Species, Endangered Species, Human impacts)

**Possible Labs:**

- **Ozone Gumdrop Lab** - Students will simulate the chemical reactions that lead to ozone depletion in the stratosphere. They will then use the simulation to draw a diagram modeling these processes. (Science Practice 2: Visual representation)
- **Global Indicators of Climate Change** - Students will analyze data from various government agencies to examine global indicators of climate change, including analyzing graphical data on sea surface temperatures, sea level and ice concentrations to draw conclusions from the trends. Students will also evaluate changes in their personal habits to reduce greenhouse gas emissions. (Science Practice 5: Data Analysis; Science Practice 7: Environmental Solutions)
- **Oil Spill Activity** - Various abiotic and biotic materials will be used to simulate an oil spill, students will test the effectiveness of a variety of clean up and containment methods.

There will be additional lab and field activities following the AP exam. The topics of those activities will focus on the interests of the class, could include visiting a local waste treatment plant or recycling center, beach trash surveys, assessing endangered species habitat in local wetlands, and meeting with local scientists researching climate change.