


Hazelwood School District



High Expectations For All!

Advanced Placement (AP)
Environmental Science
Grades 11-12

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Approved by the Hazelwood School District Board of Education on June 19, 2018

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Hazelwood School District

Mission Statement

We are a collaborative learning community guided by a relentless focus to ensure each student achieves maximum growth

Vision Statement

HSD will foster lifelong learners, productive citizens, and responsible leaders for an ever-evolving society.

Board of Education on January 5, 2010

Goals

Goal #1: Hazelwood students will meet or exceed state standards in all curricular area with emphasis in reading, writing, mathematics, science and social studies.

Goal #2: Hazelwood staff will acquire and apply skills necessary for improving student achievement.

Goal #3: Hazelwood School District, the community, and all families will support the learning of all children.

Curriculum Overview

The Advanced Placement (AP) Environmental Science course is designed to be the equivalent of a one-semester, introductory college course in environmental science. Unlike most other introductory-level college science courses, environmental science is offered from a wide variety of departments, including geology, biology, environmental studies, environmental science, chemistry, and geography. Depending on the department offering the course, different emphases are placed on various topics. Some courses are rigorous science courses that stress scientific principles and analysis and that often include a laboratory component; other courses emphasize the study of environmental issues from a sociological or political perspective rather than a scientific one. The AP Environmental Science course has been developed to be most like the former; as such, it is intended to enable students to undertake, as first-year college students, a more advanced study of topics in environmental science or, alternatively, to fulfill a basic requirement for a laboratory science and thus free time for taking other courses.

The AP Course Description and AP Exam have been prepared by environmental scientists and educators who serve as members of the AP Environmental Science Development Committee. In both breadth and level of detail, the content of the course reflects what is found in many introductory college courses in environmental science. The exam is representative of such a course and therefore is considered appropriate for the measurement of skills and knowledge in the field of environmental science.

The goal of the AP Environmental Science course is 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 or preventing them.

Environmental science is interdisciplinary; it embraces a wide variety of topics from different areas of study. Yet there are several major unifying constructs, or themes, that cut across the many topics included in the study of environmental science. The following themes provide a foundation for the structure of the AP Environmental Science course.

- Science is a process.
- 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.

<https://apcentral.collegeboard.org/pdf/ap-environmental-science-course-description.pdf?course=ap-environmental-science>

COURSE TITLE: Advanced Placement Environmental Science

GRADE LEVEL: 11-12

CONTENT AREA: Science

Course Description:

This course will provide students with the scientific principles and concepts required to understand the interrelationships of the natural world. Students will analyze and interpret information and data; identify and analyze environmental problems; evaluate the ecological and human health risks associated with these problems; and critically examine various solutions for resolving or preventing them. This course will include laboratory and field investigation. The course includes the following six content areas: Earth Systems and Resources; The Living World; Population; Land and Water Use; Energy Resources; and Consumption. Students taking this course are strongly encouraged to take the Advanced Placement exam. Students taking the Advanced Placement exam may receive college credit if they receive a qualifying score.

Course Rationale:

The Advanced Placement program enables willing and academically prepared students to pursue college-level studies - with the opportunity to earn college credit, advanced placement, or both - while still in high school. AP Environmental Science uses scientific inquiry for investigation throughout the course. This requires students to reason scientifically about scientific principles, theories and processes in order to establish their own understanding of relevant environmental scientific information.

Course Scope and Sequence		
UNIT 1: INTRODUCTION AND CONCEPTS IN ENVIRONMENTAL SCIENCE (2 weeks)	UNIT 2: SCIENCE, SYSTEMS, MATTER AND ENERGY (4 weeks)	UNIT 3: LIVING WORLD - ECOSYSTEMS, EVOLUTION, BIODIVERSITY, BIOGEOGRAPHY AND AQUATIC ECOLOGY (4 weeks)
UNIT 4: POPULATION - COMMUNITY ECOLOGY, POPULATION DYNAMICS, CONSERVATION ECOLOGY AND HUMAN POPULATION (5 weeks)	UNIT 5: LAND USE - SUSTAINING WILD SPECIES, TERRESTRIAL BIODIVERSITY AND FOOD RESOURCES (3 weeks)	UNIT 6: WATER USE (3 weeks)
UNIT 7: POLLUTION (3 weeks)	UNIT 8: EARTH RESOURCES, AND ENERGY RESOURCES AND CONSUMPTION (3 weeks)	UNIT 9: GLOBAL CHANGE (3 weeks)
UNIT 10: ECOLOGICAL AND HUMAN HEALTH (3 weeks)	AP Exam Review (2 weeks)	

Approved Course Materials and Resources:

Friedland, A., Relyea, R. (2015). Environmental Science for AP. 2nd Edition. Bedford, Freeman & Worth.

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Essential Terminology/Vocabulary

UNIT 1: INTRODUCTION AND CONCEPTS IN ENVIRONMENTAL SCIENCE
 agricultural revolution, biocapacity, control, controlled experiment, correlation, data, dependent variable, descriptive science, ecological footprint, ecosystem services, environment, environmentalism, environmental literacy, environmental science, environmental studies, experiment, fossil fuels, hypothesis, hypothesis-driven science, independent variable, industrial revolution, natural capital, natural resources, natural sciences, nonrenewable natural resources, overshoot, paradigm, peer review, predictions,

renewable natural resources, science, scientific method, social sciences, sustainability, theory, treatment, and variables.

UNIT 2: SCIENCE, SYSTEMS, MATTER AND ENERGY

acidic, alkaline, asthenosphere, atmosphere, atoms, basic, biosphere, carbohydrates, carbon, carbon dioxide, cellular respiration, chemistry, chemosynthesis, compound, convergent plate boundaries, core, continental collision, covalent bonds, divergent plate boundaries, dynamic equilibrium, earthquake, ecosystem, electrons, element, emergent properties, energy, energy conservation, energy conversion efficiency, feedback loop, first law of thermodynamics, geology, gross primary production, half-life, heterotrophs, homeostasis, hydrocarbons, hydrogen, hydrogen bonds, hydrosphere, hydrothermal vents, igneous rock, ions, ionic bonds, ionizing radiation, isotopes, kinetic energy, law of conservation of matter, lava, lipids, lithosphere, macromolecules, macronutrients, magma, mantle, mass wasting, matter, metamorphic rock, mineral, molecules, negative feedback loop, net primary production, neutrons, nitrogen, nucleic acids, nutrients, organic compounds, oxygen, pH, plastics, plate tectonics, positive feedback loop, potential energy, primary production, productivity, proteins, protons, radioactive, radioisotopes, rock, rock cycle, secondary production, second law of thermodynamics, sedimentary rock, sediments, silicon, subduction, transform plate boundary, water, and work.

UNIT 3: LIVING WORLD - ECOSYSTEMS, EVOLUTION, BIODIVERSITY, BIOGEOGRAPHY AND AQUATIC ECOLOGY

adaptation, age structure, aquifers, artificial selection, background extinction rate, biogeochemical cycles, biological diversity (biodiversity), biosphere, carbon cycle, carrying capacity, community, community ecology, convergent evolution, demographers, denitrifying bacteria, density dependent, density independent, ecological modeling, ecological processes, ecology, ecosystems, ecosystem ecology, ecotourism, endemic, evaporation, evolution, exponential growth, extinction, flux, fossil, fossil record, generalist, groundwater, Haber-Bosch process, habitat, habitat use, habitat selection, hydrologic cycle, landscape ecology, life history theory, limiting factors, logistic growth, mass extinction events, mutations, natural selection, niche, nitrification, nitrogen cycle, nitrogen fixation, nitrogen fixing bacteria, nutrient cycles, phosphorus cycle, phylogenetic tree, population, population ecology, population density, population distribution, population growth rate, population size, precipitation, rate of natural increase, reservoir, sex ratio, sink, source, specialist, speciation, species, transpiration, and water table.

UNIT 4: POPULATION - COMMUNITY ECOLOGY, POPULATION DYNAMICS, CONSERVATION ECOLOGY AND HUMAN POPULATION

biocapacity, biodiversity, biodiversity hotspots, biomass, biophilia, birth control, captive breeding, character displacement, climax community, coevolution, community, community-based conservation, competitive exclusion, conservation biology, contraceptives, decomposers, demographic fatigue, demographic transition, demography, detritivores, disturbance, ecological restoration, endangered, Endangered Species Act, extinction, extirpation, family planning, food chain, food web, forensic science, fundamental niche, gentrification, greenbelts, green buildings, greenways, growth boundaries, habitat fragmentation, habitat loss, herbivory, infant mortality rate, IPAT model, introduced species, invasive species, keystone species, LEED, life expectancy, mutualism, new urbanism, non-analog communities, noise pollution, overharvesting, parasitism, pathogen, pioneer species,

predation, primary consumers, primary succession, poaching, pollination, post-industrial stage, pre-industrial stage, producers, rate of natural increase, realized niche, regime shift, replacement fertility, reproductive window, resilience, resistance, resource partitioning, restoration ecology, secondary consumers, secondary succession, smart growth, species coexistence, suburbs, sprawl, succession, symbiosis, tertiary consumers, threatened, transitional stage, transit-oriented development, total fertility rate, trophic cascade, trophic level, urban ecology, urban heat island effect, urban planning, and zoning.

UNIT 5: LAND USE - SUSTAINING WILD SPECIES, TERRESTRIAL BIODIVERSITY AND FOOD RESOURCES

adaptive management, agriculture, aquaculture, bedrock, biological control, biosphere reserves, biotechnology, canopy, clay, clear cutting, colony collapse disorder, conservation tillage, contour farming, crop rotation, debt for nature swap, deposition, desertification, ecosystem based management, edge effects, feedlots, fertilizer, food security, forest types, genetically modified foods, genetic engineering, Green Revolution, industrial agriculture, inorganic fertilizer, integrated pest management, intercropping, irrigation, island biogeography theory, land degradation, land trusts, leaching, loam, malnutrition, maximum sustainable yield, monoculture, national wildlife refuge, neonicotinoids, no-till, organic agriculture, organic fertilizer, overgrazing, overnutrition, parent material, pesticides, pollination, polyculture, primary forest, rangeland, resource management, salinization, sand, salvage logging, secondary forest, seed banks, shelterbelts, silt, slash-and-burn, soil, soil degradation, soil horizon, soil profile, sustainable agriculture, terracing, topsoil, traditional agriculture, transgene, transgenic, undernutrition, understory, waterlogging, weathering, wildland-urbana interface, wilderness areas, and world heritage sites.

UNIT 6: WATER USE

algal bloom, aquifer, benthic, confined aquifer, consumptive use, continental shelves, coral, coral reef, dam, desalination, desalinization, downwelling, El Nino-Southern Oscillation (ENSO), estuaries, eutrophic, flooding, floodplain, freshwater, Great Pacific Garbage Patch, groundwater, heat capacity, intertidal, kelp, La Nina, levees, mangroves, marine protected areas, marine reserves, nonconsumptive use, nonpoint sources, North Atlantic Deep Water (NADW), ocean acidification, oligotrophic, pathogen, pelagic, photic zone, point sources, primary treatment, pycnocline, zone, red tides, reservoir, runoff, salt marshes, secondary treatment, septic systems, sinkholes, surface water, thermohaline circulation, tides, unconfined aquifer, upwelling, wastewater, water pollution, watershed, water table, wetlands, xeriscaping, and zooxanthellae.

UNIT 7: POLLUTION

acid deposition, acid rain, air pollutant, air pollution, atmosphere, atmospheric deposition, atmospheric pressure, carbon monoxide, catalytic converter, chlorofluorocarbons, climate, cold front, convective circulation, Clean Air Act, Coriolis effect, front, halocarbons, high-pressure system, hurricanes, indoor air pollution, industrial smog, inversion layer, lead, low-pressure system, nitrogen dioxide, nitrogen oxides, outdoor air pollution (ambient air pollution), ozone depleting substances, ozone hole, ozone layer, particulate matter, photochemical smog, primary pollutants, relative humidity, residence time, scrubbers, secondary pollutants, sick building syndrome, smog, stratosphere, sulfur dioxide, temperature inversion, tornadoes, toxic air pollutants, troposphere, tropospheric ozone, volatile organic compounds, warm front, and weather.

UNIT 8: EARTH RESOURCES , AND ENERGY RESOURCES AND CONSUMPTION

active solar energy collection, biodiesel, bioenergy, biofuels, biomass, biopower, carbon capture and storage, cellulosic ethanol, clean coal technologies, coal, cogeneration, concentrated solar power, directional drilling, electricity, eminent domain, energy conservation, energy efficiency, energy intensity, EROI (energy returned on investment), enhanced geothermal systems, ethanol, fossil fuels, fuel cells, green-collar jobs, geothermal energy, ground-source heat pumps, hydraulic fracturing (fracking), hydroelectric power, hydropower, meltdown, methane hydrate, mountaintop removal mining, natural gas, net energy, nuclear fission, nuclear fusion, nuclear power, nuclear reactors, ocean thermal energy conversion, oil, oil shale, OPEC (Organization of Petroleum Exporting Countries), passive solar energy collection, peak oil, petroleum, photovoltaic cell, proven recoverable reserve, pumped storage, rebound effect, refining, reserves-to-production ratio, run-of-river technique, shale oil, solar energy, storage technique, thin-film solar cells, tidal energy, wave energy, wind farms, wind power, and wind turbines.

UNIT 9: GLOBAL CHANGE

adaptation, aerosols, carbon cap-and-trade, carbon footprint, carbon offsets, carbon pricing, carbon tax, carbon trading, capture and storage, climate models, fee-and-dividend, geoengineering, global climate change, global warming, greenhouse effect, greenhouse gases, Milankovitch cycles, mitigation, ocean acidification, paleoclimate, proxy indicators, radiative forcing, and revenue-neutral carbon tax.

UNIT 10: ECOLOGICAL AND HUMAN HEALTH

biocapacity, birth control, bottle bills, brownfields, composting, contraception, cradle-to-cradle approach, deep-well injection, demographic fatigue, demography, electronic waste, family planning, hazardous waste, incineration, industrial ecology, industrial solid waste, infant mortality rates, landfill gas, life expectancy, life cycle analysis, materials recovery facility, municipal solid waste, post-industrial stage, pre-industrial stage, rate of natural increase, recovery, recycling, replacement fertility, reproductive window, sanitary landfills, source reduction, surface impoundments, total fertility rate, transitional stage, waste, waste management, waste stream, and waste-to-energy facilities.

Unit Objectives:

UNIT 1: INTRODUCTION AND CONCEPTS IN ENVIRONMENTAL SCIENCE

1. Describe the field of environmental science
2. Compare renewable and nonrenewable resources, and explain the importance of natural resources and ecosystem services to our lives
3. Discuss population growth, resource consumption, and their consequences
4. Explain what is meant by an ecological footprint
5. Describe the scientific method and the process of science
6. Identify and illustrate major pressures on the global environment
7. Discuss the concept of sustainability, and cite sustainable solutions being pursued at a variety of levels in the wider world

UNIT 2: SCIENCE, SYSTEMS, MATTER AND ENERGY

1. Explain the fundamentals of matter and chemistry and apply them to real-world situations
2. Distinguish among photosynthesis, cellular respiration, and chemosynthesis and summarize their importance to living things
3. Explain how plate tectonics and the rock cycle shape the landscape around us
4. Identify major types of geologic hazards and describes ways to minimize their impacts
5. Define ecosystems and discuss how living and nonliving entities interact in ecosystem-level ecology
6. Discuss the fundamentals of landscape ecology, GIS, and ecological modeling
7. Explain ecosystem services and discuss how they benefit our lives
8. Describe environmental systems
9. Compare and contrast how water, carbon, nitrogen and phosphorus cycle through the environment
10. Explain how human activities affect biogeochemical cycles
11. Differentiate among forms of energy and explain the first and second laws of thermodynamics

UNIT 3: LIVING WORLD - ECOSYSTEMS, EVOLUTION, BIODIVERSITY, BIOGEOGRAPHY AND AQUATIC ECOLOGY

1. Explain natural selection and cited evidence for this process
2. Describe how evolution generates and shapes biodiversity
3. List the levels of ecological organization
4. Describe the characteristics of population that help predict population growth
5. Explain how logistic growth, limiting factors, carrying capacity, and other fundamental concepts affect population ecology
6. Identify and discuss challenges and current efforts in conserving biodiversity
7. Characterize the scope of biodiversity on Earth
8. Specify the benefits that biodiversity brings us
9. Discuss today's extinction crisis in geological context
10. Evaluate the primary causes of biodiversity loss
11. Assess the science and practice of conservation biology
12. Analyze efforts to conserve threatened and endangered species
13. Compare and contrast conservation efforts above the species level

UNIT 4: POPULATION - COMMUNITY ECOLOGY, POPULATION DYNAMICS, CONSERVATION ECOLOGY AND HUMAN POPULATION

1. Summarize and compare the major types of species interactions
2. Describe feeding relationships and energy flow, and use them to identify trophic levels and to navigate food webs
3. Discuss characteristics of a keystone species
4. Characterize disturbance, succession, and notions of community change
5. Predict the potential impacts of invasive species in communities, and suggest responses to biological invasions
6. Explain the goals and methods of restoration ecology
7. Identify and describe the terrestrial biomes of the world
8. Describe the scope of human population growth
9. Discuss divergent views on population growth

10. Explain how human population, affluence, and technology affect the environment
11. Explain the fundamentals of demography
12. Describe the concept of demographic transition
13. Explain how family planning, the status of women, and affluence affect population growth

UNIT 5: LAND USE - SUSTAINING WILD SPECIES, TERRESTRIAL BIODIVERSITY AND FOOD RESOURCES

1. Outline broad developments in the history of agriculture
2. Explain the importance of soils to agriculture
3. Discuss the fundamentals of soil science, including soil formation and soil properties
4. Describe how farmers supply water to crops, and explain why sustainable alternatives are important
5. Describe how farmers supply nutrients to crops, and assess sustainable alternatives
6. Explain the importance of pollinators to crop success
7. Analyze the causes and impacts of soil erosion and land degradation and discuss solutions
8. Summarize major policy approaches for conservation in agriculture
9. Explain the challenge of feeding a growing human population
10. Identify the goals, methods, and consequences of the Green Revolution
11. Discuss how we raise animals for food, and assess the impacts that result
12. Describe reasons and approaches for preserving crop diversity
13. Discuss threats to pollinators and identify potential solutions
14. Explore strategies for pest and weed management
15. Describe the science behind genetic engineering
16. Compare the benefits and costs of genetically modified foods, and assess the public debate over them
17. Analyze the nature, growth and potential of organic agriculture
18. Contrast conventional industrial, organic, and biotech approaches to agriculture, and summarize potential pathways toward sustainable agriculture
19. Summarize the ecological and economic contributions of forests
20. Outline the history and current scale of deforestation
21. Assess dynamics of timber management
22. Discuss forest management in relation to fire, pests, and climate change, and evaluate sustainable forestry certification
23. Name federal land management agencies and the lands they manage
24. Discuss types of parks and protected areas and evaluate issues involved in their design

UNIT 6: WATER USE

1. Describe the distribution of freshwater on Earth and the major types of freshwater systems
2. Discuss how we use water and alter freshwater systems
3. Assess problems of water supply and propose solutions to address depletion of freshwater
4. Describe the major classes of water pollution and propose solutions to address water pollution
5. Explain how we treat drinking water and wastewater
6. Identify physical, geographic, and chemical aspects of the marine environment

7. Describe major types of marine ecosystems
8. Assess impacts from marine pollution
9. Review the state of ocean fisheries and identify reasons for their decline
10. Evaluate marine protected areas and reserves as solutions for conserving biodiversity

UNIT 7: POLLUTION

1. Describe the composition, structure, and function of Earth's atmosphere
2. Relate weather and climate to atmospheric conditions
3. Identify major outdoor air pollutants and outline the scope of air pollution
4. Assess strategies and solutions for control of outdoor air pollution
5. Explain stratospheric ozone depletion and identify steps taken to address it
6. Describe acid deposition, discuss its consequences, and explain how we are addressing it
7. Characterize the scope of indoor air pollution and assess solutions

UNIT 8: THE EARTH'S RESOURCES , ENERGY RESOURCES AND CONSUMPTION

1. Identify the energy sources that we use
2. Discuss the value of the EROI concept
3. Describe the formation of major types of fossil fuels
4. Explain how we extract, process, and use fossil fuels
5. Assess concerns over the future decline of conventional oil supplies
6. Outline ways in which we are extending our reach for fossil fuels
7. Examine environmental impacts of fossil fuel use, and explore ways to minimize these impacts
8. Assess political, social, and economic aspects of fossil fuel use
9. Discuss strategies for conserving energy and enhancing efficiency
10. Discuss the reasons for seeking energy alternatives to fossil fuels
11. Summarize the contributions to world energy supplies of conventional alternatives to fossil fuels
12. Describe nuclear energy and explain how we harness it for electrical power
13. Assess the benefits and drawbacks of nuclear power, and discuss the societal debate over this energy source
14. Describe established and emerging sources and techniques involved in harnessing bioenergy, and assess the benefits and shortcomings of bioenergy
15. Outline the scale, methods, and impacts of hydroelectric power
16. Identify the major sources of renewable energy and assess their recent growth and future potential
17. Describe solar energy and how we harness it, and evaluate its advantages and disadvantages
18. Describe wind power and how we harness it, and evaluate its advantages and disadvantages
19. Describe geothermal energy and how we harness it, and evaluate its advantages and disadvantages
20. List ocean energy sources and describe their potential
21. Explain hydrogen fuel cells and weigh options for energy storage and transportation
22. Describe the types of mineral resources and their uses

23. Explain how minerals are processed prior to use
24. Describe the major methods of mining
25. Discuss the environmental and social impacts of mining
26. Explain reclamation efforts and mining policy
27. Evaluate ways to encourage sustainable use of mineral resources

UNIT 9: GLOBAL CHANGE

1. Describe Earth's climate system and explain the factors that influence global climate
2. Identify greenhouse gases and characterize human influences on the atmosphere and on climate
3. Summarize how researchers study climate
4. Outline current and expected future trends and impacts of climate change in the United States and around the world
5. Suggest and assess ways we may respond to climate change

UNIT 10: ECOLOGICAL AND HUMAN HEALTH

1. Summarize major approaches to managing wastes, and compare and contrast the types of waste we generate
2. Discuss the nature and scale of the waste dilemma
3. Evaluate source reduction, reuse, composting, and recycling as approaches for reducing waste
4. Describe landfills and incineration as conventional waste disposal methods
5. Discuss industrial solid waste and principles of industrial ecology
6. Assess issues in managing hazardous waste
7. Describe approaches being taken to promote sustainability
8. Explain the concept of sustainable development and discuss how environment protection can enhance economic well-being
9. Explain how time is limited yet human potential to solve problems is tremendous
10. Describe the scale of urbanization
11. Define sprawl and discuss its causes and effects
12. Outline city and regional planning and land use strategies
13. Evaluate transportation options, urban parks, and green buildings
14. Analyze environmental impacts and advantages of urban centers
15. Discuss urban ecology and the pursuit of sustainable cities
16. Explain the goals of environment health and identify major environmental health hazards
17. Describe the types of toxic substances in the environment, the factors that affect their toxicity, and the defenses that organisms have against them
18. Explain the movement of toxic substances and how they affect organisms and ecosystems
19. Discuss the approaches used to study the effects of toxic chemicals on organisms
20. Summarize risk assessment and risk management
21. Compare philosophical approaches to risk and how they relate to regulatory policy