AP ENVIRONMENTAL SCIENCE |Curriculum Map and Pacing Guide

COURSE DESCRIPTION: This course is equivalent to lab-based college introductory course in environmental science. Laboratory work occur in and outside the classroom. Students learn scientific principles, concepts and methodologies required to understand the interrelationships of the natural world and required to identify and analyze environmental problems (natural and man-made), to evaluate the relative risk associated with these problems, and required to examine alternative solutions for resolving or preventing problems.	**Course SCI371** **1 year, 1 credit** **Grades 11-12** **Prerequisite:** Completion of Chemistry, Biology and Algebra II; teacher recommendation based on grade B or better in Chemistry

QUARTER 1

Topic: Water Resources; Water Pollution; Soil; Geology and Nonrenewable Mineral Resources

Key Terms:

Water Resources: Aral Sea, Dam, drought, aquifers, California Water Project, Desalination, distillation, drainage basin, flood irrigation, floodplain, gray water, groundwater, hydrologic cycle, hydrological poverty, land subsidence, lateral recharge, natural recharge, Reservoir, non-consumptive use, Ogallala aquifer, reliable surface runoff, reverse osmosis, sinkholes, surface runoff, surface water, Three Gorges Dam, user-pays approach, water table, watershed, xeriscaping, zone of saturation; Water Pollution: advanced (tertiary) sewage, treatment, biological pollution, bio-solids, bleaching, chemical analysis, Chesapeake Bay, chlorination, crude oil, cultural eutrophication, dissolved oxygen, Escherichia coli, eutrophication, Exxon Valdez, fecal coliform bacteria, harmful alga, blooms, (HABs), indicator species, integrated coastal management, living machines, nitrate ions, nonpoint sources, oligotrophic lake, oxygen sag curve, oxygen-depleted zone, point sources, plume, primary sewage treatment, refined oil, secondary sewage treatment, septic tank, sludge, wastewater, (sewage) treatment plants, water pollution; Soil: abiotic, bedrock, biotic, clay, humus , hydrothermal vents, infiltration , leaching , mature soils, parent material (C horizon), salinity, sand , silt , soil, soil horizons , soil profile , soil texture , subsoil , surface litter , layer (O horizon) , topsoil layer (A horizon) , weathering , Salinization, agrobiodiversity , agroforestry, agroforestry , alley cropping, alley cropping , compost, conservation-tillage farming, contour farming, crop rotation, desertification , rill erosion, salinization, sheet erosion , shelterbelts, soil conservation, soil erosion, strip cropping, terracing, waterlogging, windbreaks, organic fertilizer gully erosion; Geology and Nonrenewable Mineral Resources: acid mine drainage, area strip mining, asthenosphere, biological weathering, biomimicry, bio-mining, brownfields , chemical weathering, continental crust, continental glaciers , contour strip , mining, convection cells, convergent plate boundary, core , crust, currents , cyanide heap extraction, depletion time, divergent plate boundary, earthquakes , economically depleted, erosion , fossil fuels, frost wedging, gangue, geology, glaciers, high-grade ore , high-wall, igneous rock, lithosphere, low-grade ore , magma, manganese nodules , mantle, mass wasting , materials revolution , metallic minerals , metamorphic rock, mineral resource , molecular economy, mountaintop removal, nanotechnology, nanotubes , nonmetallic minerals ,nonrenewable resources, oceanic crust ,oceanic , ridges, open-pit mining, ore, ore mineral, overburden, physical (mechanical) weathering, rock, rock cycle, , sedimentary rock, smelting, spoil banks, spoils, strategic metal resources, strip mining, subduction,

subduction zone, subsidence, subsurface mining, surface mining, Surface Mining Control and Reclamation Act, Tailings, tectonic plates, transform fault, trench, tsunamis, volcanoes, weathering		
Measurable Skills: making predictions, problem solving, investigating, collecting, interpreting and recording data, concluding and presenting data in a lab report		
AP College Board Essential Knowledge	**Student Learning Targets (AP Learning Objectives and Science Practices)**	**Learning Activities/Investigations**
Earth Systems and Resources C. Global Water Resources and Use (Freshwater/saltwater; ocean circulation; agricultural, industrial, and domestic use; surface and groundwater issues; global problems; conservation)	▪ Summarize a key lesson learned from the following case studies: The Colorado River ▪ Briefly describe Earth's water supply and how water is a source of health, economic, social, security and environmental issues. ▪ Distinguish between surface water and groundwater ▪ Summarize water use in the United States and the world. ▪ List causes of water scarcity and assess the significance of water shortages in certain areas of the world. ▪ Describe the role of groundwater in supplying fresh water and assess our current use of groundwater. ▪ List ways to increase the water supply along with the advantages and disadvantages of each strategy. ▪ Summarize a key lesson learned from the following case studies: the Colorado River; Egypt's Aswan. ▪ High Dam; the California Water Project; the Aral Sea disaster. ▪ State the percentage of water wasted throughout the world and briefly. ▪ Describe measures to take in reducing water losses through irrigation, industry, and home use. ▪ Describe solutions to using water more sustainably. ▪ List ways that humans contribute to flooding and list strategies humans employ to minimize the risks of flooding. ▪ Analyze the water problems of Bangladesh, and identify key principles illustrated in this case study. ▪ List and describe ways humans control flooding and evaluate which of these strategies is likely to have the best long-term results.	▪ Tragedy of the Commons simulation ▪ PBS NewsHour video on water shortages in the Middle East ▪ Calculate water consumption/Water loos ▪ Video Clips on “Three Gorges,” “Modern Marvels – Dams,” “Water Pollution – China from the Inside”/PBS and “The Aral Sea” ▪ WQI Lab at Alum Creek ▪ Coliform Water Test ▪ Macro-invertebrae Water Quality Assessment Lab at Alum Creek ▪ Sewage Treatment Video Clip ▪ Chesapeake Bay – Poisoned Waters Video Clip

	▪ List various types of water pollutants and give an example of each. ▪ Describe several biological and chemical tests to determine water quality. ▪ Distinguish between and give examples of point and nonpoint sources of pollution. ▪ Summarize the major sources of water pollution in developed and less developed countries. ▪ Draw an oxygen sag curve to illustrate what happens to dissolved oxygen levels in streams below points where degradable oxygen-demanding wastes are added. ▪ Compare problems of lake water pollution to those of stream pollution. ▪ Describe the difference between eutrophication and cultural eutrophication. ▪ Explain how to prevent and make clean cultural eutrophication. ▪ List the major pollutants of groundwater and explain why cleanup of groundwater is so difficult. ▪ List ways to prevent and ways to cleanup groundwater pollution. ▪ List and describe laws to protect water quality in the United States. ▪ List alternative sources of freshwater in areas where there are shortages of clean water or little water ▪ Describe what is happening to the quality of coastal waters and how coastal waters can be protected, and cite specific locations where there are problems, listing ways to prevent and cleanup coastal water pollution. ▪ Compare sewage treatment in urban and rural areas. Describe and distinguish among primary, secondary, and tertiary sewage treatment. ▪ List ways that individuals can contribute to a reduction in water pollution.	

Earth Systems and Resources D. Soil and Soil Dynamics (Rock cycle; formation; composition; physical and chemical properties; main soil types; erosion and other soil problems; soil conservation) **Earth Systems and Resources** A. Earth Science Concepts (Geologic time scale; plate tectonics, earthquakes, volcanism; seasons; solar intensity and latitude) **Earth and and Water Use** E. Mining (Mineral formation; extraction; global reserves; relevant laws and treaties)	▪ Define soil horizon. Briefly describe six soil layers. ▪ Compare soil profiles of five important soil types. ▪ Describe a fertile soil. In doing so, be sure to refer to soil texture, porosity, loam, and acidity. ▪ Describe the problems of soil erosion and desertification, including both world and U.S. situations, and explain why most people are unaware of these problems. ▪ Describe the problems of salinization and waterlogging of soils, and describe how to control these problems. ▪ Define soil conservation. ▪ List ways to approach the problem of soil erosion, distinguishing between conventional-tillage and conservation-tillage farming. ▪ Describe a plan to maintain soil fertility. ▪ Distinguish between organic and inorganic fertilizers. <u>Chapter 14</u> ▪ Describe the layers of the earth's interior. ▪ Describe the internal and external earth processes responsible for forming earth's landscape. ▪ Distinguish between three different tectonic plate boundaries and the geologic features often found at each, and explain how this knowledge is significant for understanding mineral deposits and evolution. ▪ List and define three broad classes of rock. Briefly describe the rock cycle and indicate interrelationships among these classes. ▪ Distinguish between internal (heat from the earth) and external (wind/water) geologic processes, and discuss how these processes affect human activities and natural ecosystems. ▪ Describe how earthquakes and tsunamis occur, including the role of volcanoes in the rock recycling process.	▪ Salinization Lab ▪ Soil Testing Lab ▪ Dust Bowl Video ▪ Plate Tectonics Lab ▪ Rock Cycle Activity ▪ Cookie Mining Lab ▪ Conservation Tillage Article ▪ “Poison in the Rockies” video ▪ Copper Extraction Lab ▪ Colorado Mining Law

	▪ List three types of mineral resources, and give one example of each, clarifying the relationship between identified resources and reserves. ▪ Define rock, ore and minerals. ▪ Distinguish between subsurface and surface mining. Briefly describe the environmental impacts of mining. ▪ List the advantages and disadvantages of each type of surface mining. Identify methods of extracting minerals from ore and list the environmental impacts. ▪ Describe the process of reclamation. ▪ Draw a hypothetical depletion curve, and project how various assumptions affect this curve: (a) increased recycling of the resource, (b) discoveries of new deposits of the resource, (c) prices rise sharply, and (d) a discovered substitute for the resource. ▪ Describe the economics of nonrenewable minerals. Compare high grade to low grade ores. Explain the limitations of mining lower-grade ores. ▪ Discuss the option of getting more minerals from the ocean. ▪ Describe how to use mineral resources more sustainably, and summarize the nanotechnology revolution and its implications.	

QUARTER 1
Topic: Biodiversity, Species Interactions, and Population Control; Human Population and Its Impact
Key Terms: Biodiversity, Species Interactions, and Population Control: age structure, asexual reproduction, biotic potential, boom-and-bust cycles, bottom-up control, population regulation, carrying capacity, clumping, constant loss curves, cyclic fluctuations, density-dependent population controls, density-independent population, controls, early loss curves, environmental resistance, exponential growth, intrinsic rate of increase, irregular fluctuations, irruptive population fluctuations , K-selected species, late loss curves, life expectancies, logistic growth, opportunists, overshoots, population density, population distribution, population dynamics, post-reproductive stage , pre-reproductive stage, random dispersion , reproductive stage, reproductive time lag, r-selected species, sexual reproduction, stable population fluctuations , survivorship curve, top-down control population regulation , uniform dispersion , succession, primary and secondary succession, pioneer species, climax community

Human Population and Its Impact: age structure, baby-boom period , birth rate , crude birth rate , crude death rate , cultural carrying capacity , death rate , demographic transition, demographic trap, emigration, family planning, fertility, gender imbalance, immigration, industrial stage , infant mortality rate, life expectancy, migration, mortality, optimum sustainable population , population change , postindustrial stage , post-reproductive , preindustrial stage, pre-reproductive , replacement-level fertility, reproductive, total fertility rate (TFR), transitional stage , urbanization		
Measurable Skills: model/construct, investigate, analyze, compare/contrast, differentiate, explain, and describe		
AP College Board Essential Knowledge	**Student Learning Targets (AP Learning Objectives and Science Practices)**	**Learning Activities/Investigations**
A. Population Biology Concepts (Population ecology; carrying capacity; reproductive strategies; survivorship) B. Human Population 1. Human population dynamics (Historical population sizes; distribution; fertility rates; growth rates and doubling times; demographic transition; age-structure diagrams) 2. Population size (Strategies for sustainability; case studies; national policies) 3. Impacts of population growth (Hunger; disease; economic effects; resource use; habitat destruction)	▪ List, give examples, and describe the five major ways species interact. ▪ Describe the various types of population distribution patterns that can occur in nature and comment on which is most common and why. ▪ Define limiting factor, and give an example of a resource that would be limiting in an ecosystem, describing ways to reduce or avoid competition for a resource. ▪ Discuss the relationships between predators and prey and the possible interactions that can drive coevolution. ▪ Define the four rates that determine a population's size, and write an equation to describe mathematically the relationship between these rates and the rate of population change. ▪ Compare a J-shaped growth curve with an S-shaped growth curve and comment on the factors that produce the logistic and exponential growth. ▪ Define carrying capacity and explain what the limiting factor principle and environmental resistance in determining the carrying capacity. ▪ Explain and give examples density-dependent population controls and density-independent population controls. ▪ Describe the three different types of survivorship curves in nature and example of organisms for each. Explain how a survivorship curve can change.	▪ Lemna Minor Lab ▪ Keystone species video ▪ Survivorship curve lab ▪ Carbon footprint ▪ Population pyramids ▪ World in Balance Video ▪ Carrying Capacity math problems ▪ Fires and biomes

	▪ Differentiate between r-selected and K-selected species and give examples of each. ▪ List the four general types of population fluctuations in nature. Indicate which of these is most common. ▪ Define and list the causes of succession and compare the two types of succession. ▪ Compare rates of population growth in developed countries and developing countries. Explain the differences you find. ▪ Define birth rate, death rate, emigration rate, and immigration rate, and write an equation to describe mathematically the relationship between these rates and the rate of population change. ▪ Distinguish between replacement-level fertility and total fertility rate, and describe how total fertility rate affects population growth. ▪ List factors that affect birth and fertility rates and five factors that affect death rate. ▪ Compare and evaluate the population policies of other countries (e.g., China), and summarize what we have learned from decades of trying to influence human population growth. ▪ Summarize changes over time in the U.S. population growth rate. ▪ Define infant mortality rate, and explain how this rate is a good indicator of quality of life. ▪ Explain how the age structure of a country creates population growth momentum, using population-age structure diagrams. ▪ Summarize problems associated with a baby boom and a declining population. ▪ Summarize key factors used to influence population size: immigration policy, family planning, economic rewards and penalties, empowering women.	

	▪ List the four stages of the demographic transition. ▪ List social, biological, political, and economic issues to help developing countries undergo a demographic transition.	

QUARTER 2

Topic: Non-renewable Energy; Energy Efficiency and Renewable Energy

Key Terms:
Non-renewable Energy: advanced light-water reactors, ALWRs, Arctic National Wildlife Refuge (ANWR) , area strip mining, bitumen, breeder nuclear fission reactor, Chernobyl , coal, coal bed methane gas , coal gasification, coal liquefaction, commercial energy, containment vessel, contour strip mining, control rods, conventional (light) oil, conventional natural gas, coolant core, crude oil, decommissioned, fuel assembly , fuelwood shortage , heavy crude oil, high-level radioactive wastes, high-quality energy, high-temperature gas-cooled reactors, (HTGCs), kerogen, light-water reactors, LWRs, liquefied petroleum gas, LPG, methane hydrate, moderator, natural gas, net energy, net energy ratio, nonrenewable mineral resources , nuclear fuel cycle, nuclear fission, nuclear fusion, Nuclear Regulatory Commission (NRC), oil sand, oil shales , petrochemicals, petroleum, pressurized water reactors, refinery, reserves , shale oil, solar capital, synfuels, synthetic natural gas, SNG, tar sand, Three Mile Island, unconventional natural gas, unnecessarily wasted, uranium oxide fuel, useful energy, water-filled pools; Energy Efficiency and Renewable Energy*:* active solar heating system, animal manure, biodiesel, biofuels , biomass , biomass plantations , cellulosic ethanol, central receiver system, coal-burning power plant, cogeneration , combined cycle turbines , combined heat and power systems (CHP), Corporate Average Fuel Economy (CAFE) standards , crop residues, dry steam , earth tubes , energy and environmental design , energy conservation , energy efficiency, energy-efficient diesel car , ethanol, fuel cells , fuelwood crisis , gasohol , geothermal energy, geothermal heat pump, green roofs, heat bulb, hot water , hybrid car , hydropower, hydrothermal reservoirs , incandescent light bulb , internal combustion engine, large-scale hydropower, Living roofs, Methanol, methanol economy, micro-hydrogenerators, net energy, net energy , efficiency , nuclear power plant, ocean thermal energy

Measurable Skills: model, solve, compare, contrast, describe, explain, identify

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
A. Energy Concepts (Energy forms; power; units; conversions; Laws of Thermodynamics)	▪ Compare the energy from nonrenewable and renewable energy sources used in both the US and world. ▪ Define net energy and state its significance in evaluating energy resources, and compare the net energy for heating, industry, and transportation.	▪ Wattmeter Activity ▪ Energy problems ▪ Coal Power Plant Tour ▪ “Fracking” video clip ▪ Tar Sands Lab

B. Energy Consumption 1. History (Industrial Revolution; exponential growth; energy crisis) 2. Present global energy use 3. Future energy needs C. Fossil Fuel Resources and Use (Formation of coal, oil, and natural gas; extraction/purification methods; world reserves and global demand; synfuels; environmental advantages/ disadvantages of sources) D. Nuclear Energy (Nuclear fission process; nuclear fuel; electricity production; nuclear reactor types; environmental advantages/disadvantages; safety issues; radiation and human health; radioactive wastes; nuclear fusion) E. Hydroelectric Power (Dams; flood control; salmon; silting; other impacts) F. Energy Conservation (Energy efficiency; CAFE	▪ Explain how the first and second law of thermodynamics are demonstrated in energy production and consumption ▪ Explain refinement of crude, and list products made from oil and conventional and unconventional sources of oil. ▪ List the advantages and disadvantages of using conventional oil and unconventional sources. ▪ Explain the process and controversy of hydraulic fracking. ▪ List OPEC countries, and explain their contribution to the global supply of oil. ▪ List and describe consequences of rising oil prices. ▪ Explain the "Hubbard Peak" and oil consumption over time in the U.S. ▪ Explain the importance of ANWAR and the pros and cons of extracting oil from this region. ▪ Distinguish among natural gas, liquefied petroleum gas, liquefied natural gas, and synthetic natural gas. ▪ List the advantages and disadvantages of using natural gas as an energy source. ▪ List regions with major sources of natural gas. ▪ Describe the formation of cola and list the three types of coal, indicating Indicate which is preferred for burning and which is most available. ▪ List regions rich in coal resources. ▪ List and briefly describe methods for extracting coal and cleaning coal. ▪ List advantages and disadvantages of using coal as a fuel source. ▪ Explain and give examples of synfuel, providing advantages and disadvantages of using synfuel. ▪ Describe the operation of a coal power plant and the production of energy. ▪ Describe the components of a conventional nuclear reactor. ▪ List advantages and disadvantages of using conventional nuclear fission to create electricity.	▪ PBS – clean coal Technology video clip ▪ Modern Marvels – Renewable Energy ▪ Radiation exposure sheet ▪ Coal Ash video clip ▪ Half-Life Problems ▪ Energy Efficiency Scavenger Hunt ▪ Vampire Power Article ▪ FRQ Math Practice ▪ Nuclear Option video clip ▪ Wind and solar math problems ▪ Switch Grass Article ▪ Fuel Cell Lab

standards; hybrid electric vehicles; mass transit) G. Renewable Energy (Solar energy; solar electricity; hydrogen fuel cells; biomass; wind energy; small-scale hydroelectric; ocean waves and tidal energy; geothermal; environmental advantages/disadvantages)	▪ List methods of disposal of low-level and high-level radioactive wastes. ▪ Cite locations where nuclear accidents have occurred and their causes. ▪ Explain the life cycle of nuclear power and briefly describe ways to decommission a nuclear power plant. ▪ List source of radiation. ▪ Calculate half-lives of radioactive substances. ▪ List ways to reduce energy waste and improve energy efficiency. ▪ Compare the net energy of incandescent/CFL/LED bulbs and Nuclear/Coal electricity. ▪ Cogeneration and describe their potential for saving energy. ▪ Describe possible changes in industry, transportation, buildings, lights, buildings, and appliances that would improve energy efficiency. ▪ Give examples of energy efficient vehicles and list the pros and cons. ▪ List incentives toward renewable energy sources ▪ List the advantages and disadvantages of using direct solar energy to heat air and water for buildings. ▪ Distinguish between active and passive solar heating. ▪ Compare various solar technologies and evaluate the advantages and disadvantages of each. ▪ List examples and compare the advantages and disadvantages of using water in the forms of hydropower from oceans and rivers ▪ List the advantages and disadvantages of using wind to produce electricity. ▪ List sources of biomass for energy. ▪ List the advantages and disadvantages of using biomass to heat space and water, produce electricity, and propel vehicles. ▪ Describe the conversion of biomass to biofuels. ▪ List alternative sources of ethanol. ▪ Distinguish among dry steam, wet steam, and hot water sources of geothermal energy.	

	▪ List the advantages and disadvantages of using geothermal energy for space heating, high-temperature industrial heating, and electricity production. ▪ List the advantages and disadvantages of using hydrogen gas to heat space and water, produce electricity, and propel vehicles. ▪ State the energy source needed to produce hydrogen to create a truly sustainable future, and describe constraints to using hydrogen as a fuel source. ▪ Describe the trend in energy sources used and the shift in energy use in the future. ▪ Analyze the interactions of economic policy and energy resources, considering the results of using free-market competition, keeping energy prices low, and keeping energy prices high. ▪ List ways that the United States could build a more sustainable energy future.	

QUARTER 2

Topic: Climate and Biodiversity; Ecosystems; Sustaining Biodiversity; Biodiversity and Evolution

Key Terms:

Ecosystems: abiotic, acid deposition, acid rain, aerobic respiration, aerobic respiration, ammonification, anaerobic respiration, aquifers, autotrophs, Biological community, biological diversity (biodiversity), biomass, biomes, biosphere, biotic, carbon cycle, chemosynthesis, community, consumers, decomposers, denitrification, detritivores, dissolved oxygen (DO) content, ecology, ecosystem, fermentation, genetic diversity, greenhouse gases, gross primary productivity (GPP), hydrologic (water) cycles, hydrothermal vents, limiting factor, lithosphere, mantle, natural greenhouse effect, net primary productivity (NPP), nitrate ions, nitrification, nitrite ions, nitrogen cycle, nitrogen fixation, nitrogen-fixing bacteria, nutrient (biogeochemical) cycles, nutrients, permafrost, phosphorous cycle, photosynthesis, phytoplankton, population, primary consumers, producers, pyramid of energy flow, range , range of tolerance, salinity, secondary consumers, species, stratosphere , sulfur cycle, third and higher level consumers, topsoil layer (A horizon), trophic level, troposphere

Climate and Biodiversity: alpine tundra, arctic tundra , average precipitation , average temperature , biomes , boreal forests , broadleaf deciduous trees , broadleaf evergreen plants , canopy , chaparral , climate , coastal coniferous forests , cold deserts , coniferous evergreen trees , convection , Coriolis effect , desert , elevation , evergreen coniferous forests , forest , global warming , grasslands , grazing , greenhouse effect , greenhouse gases , Gulf Stream , islands of biodiversity , latitude , microclimates , monsoons , permafrost , polar grasslands , prairies , prevailing winds , savanna , short-grass prairies , southern pine forests , succulent plants , taigas , tall-grass prairies , temperate deciduous

forests , temperate deserts , temperate grasslands , temperate rain forests , temperate shrubland , tropical deserts , tropical dry forests , tropical rain forests , weather , El Nino, La Nina, Hadley Cells, Low Pressure, High Pressure
Sustaining Biodiversity: biological extinction, biotic pollution , botanical gardens, captive breeding, Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species (CITES), ecological extinction, ecotourism, endangered species, Endangered Species Act of 1973, Endemic species, feral cats, gene (seed) banks, habitat conservation plans (HCPs), Habitat fragmentation, Habitat island, HIPPCO, hot spots, kudzu vine, local extinction, microorganisms, Precautionary approach, reconciliation ecology, red lists, theory of island biogeography, threatened (vulnerable) species, wild (feral) boars, biomagnification, bioaccumulation, Chytrid, DDT, Indicator species, Keystone species, Emerald ash borer
Biodiversity and Evolution: adaptation, Artificial Selection, background extinction, biological evolution, biopharming, chemical evolution, coevolution, ecological niche, endemic species, fundamental niche, generalist species, genetic engineering, GMOs, mass extinction, mutagens, natural selection, realized niche, recombinant DNA, selective breeding, specialist species, speciation, non-native species, invasive species, exotic species, keystone species, foundation species, endemic species, biodiversity, conjugation, species richness, species evenness.

Measurable Skills: solve, support, differentiate, describe, explain, demonstrate, investigate, explain, describe, differentiate, organize, compare, classify, state, identify

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
The Living World A. Ecosystem Structure (Biological populations and communities; ecological niches; interactions among species; keystone species; species diversity and edge effects; major terrestrial and aquatic biomes) The Living World B. Energy Flow (Photosynthesis and cellular respiration; food webs and trophic levels; ecological pyramids) The Living World D. Natural Ecosystem Change (Climate shifts; species movement; ecological succession)	▪ Define ecology, listing and distinguishing among five levels of organization of matter that are the focus of the realm of ecology. ▪ List the characteristics of life. ▪ Distinguish among lithosphere, hydrosphere, atmosphere, and ecosphere, and describe how the sun, gravity, and nutrient cycles sustain life on Earth. ▪ Compare the flow of matter and the flow of energy through the biosphere. ▪ Distinguish between an open system and a closed system. ▪ Name and describe three types of biogeochemical cycles. ▪ Define abiotic component of an ecosystem. ▪ List three important physical factors and three important chemical factors that have large effects on ecosystems. ▪ Summarize the law of tolerance.	▪ Biome Packet ▪ Photosynthesis and cellular respiration Carbon cycle lab part I with bromothymol blue ▪ Desert Packet ▪ Biome video ▪ Essay analysis ▪ Ecosystem Video clip (American Prairie and African Savannah ▪ Nutrient Cycle packet ▪ Chaparral Video clip ▪ Carbon cycle lab Part II ▪ Gross and Net Primary productivity problems ▪ Methane video clip ▪ “Eating at a Lower Trophic Level” Packet ▪ Endangered Species Video

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
The Living World E. Natural Biogeochemical Cycles (Carbon, nitrogen, phosphorus, sulfur, water, conservation of matter) Global Change C. Loss of Biodiversity 1. Habitat loss; overuse; pollution; introduced species; endangered and extinct species 2. Maintenance through conservation 3. Relevant laws and treaties	▪ Compare limiting factors in terrestrial and aquatic ecosystems. ▪ Define biotic component of an ecosystem. ▪ Distinguish between producers and consumers, and list and distinguish between four types of consumers. ▪ Distinguish among scavengers, detritus feeders and decomposers. ▪ Distinguish between photosynthesizers and chemosynthesizers and aerobic respiration and anaerobic respiration. ▪ Distinguish between food chains and food webs; grazing food web and detrital food web. ▪ Apply the second law of energy to food chains and pyramids of energy, which describe energy flow in ecosystems. ▪ Explain how there may be exceptions to pyramids of numbers and biomass, but not energy. ▪ Evaluate which ecosystems show the highest average net primary productivity and which contribute most to global net primary productivity. ▪ Briefly describe the historical development and distinguishing features of three approaches ecologists use to learn about ecosystems: field research, laboratory research, and systems analysis. ▪ Define ecosystem service. ▪ List five examples of ecosystem services. ▪ Distinguish among three types of biodiversity. ▪ State two principles to sustain ecosystems. ▪ Distinguish between weather and climate. ▪ Summarize how warm fronts, cold fronts, high-pressure air masses, and low-pressure air masses affect weather.	▪ Biomass lab (grass) ▪ Invasive Species Online Research Packet ▪ Migratory Bird Mortality Article

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
	▪ Describe at least five different factors that contribute to global air-circulation patterns. ▪ Describe how ocean currents generally redistribute heat. ▪ Define greenhouse effect. ▪ Name greenhouse gases. ▪ State the significance of the greenhouse effect. ▪ Describe the general effects of the following microclimates: windward and leeward sides of a mountain, forests, and cities. ▪ Describe how climate affects the distribution of plant life on Earth. ▪ Draw connections between biomes and the following plants, which are particularly adapted for different biomes: succulent plants, broadleaf evergreen plants, broadleaf deciduous plants, coniferous evergreen plants. ▪ Compare the climate and adaptations of plants and animals in deserts, grasslands, and forests. ▪ Describe the distinctive qualities of a chaparral ecosystem, and distinguish among the three major kinds of forests. ▪ Compare the biodiversity and stratification in the three major kinds of forests. ▪ Compare a mountain ecosystem to an artic ecosystem. ▪ Relate altitude to latitude. ▪ Describe how humans have altered or changed each biome. ▪ Explain the events of El Nino and the effects on climate. ▪ Describe the economic, medical, scientific, ecological, aesthetic, recreational, and ethical significance of wild species. ▪ Define biophilia.	

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
	▪ Summarize your position toward protection of different species. ▪ Describe the general process of extinction. ▪ Compare past extinctions to present extinctions. ▪ Explain what is happening to the current rate of extinction and the causes. ▪ Distinguish and give examples among local extinction, ecological extinction, and biological extinction. ▪ Distinguish between threatened and endangered species, and give examples of both. ▪ List characteristics that make species extinction prone. ▪ Explain why birds are especially prone to extinction ▪ List root causes of extinction of wildlife (HIPPCO) including bioaccumulation and biomagnification ▪ Explain the importance of protecting wild species ▪ Explain how habitat loss, degradation, and fragmentation have caused the loss of biodiversity. ▪ Define Invasive species and give examples of exotic species purposely introduced and those accidentally introduces and the effects of each on the biodiversity and decrease in biodiversity of an ecosystem. ▪ List several human activities, which directly increase the wildlife extinction rate. ▪ Summarize the condition of the world's fisheries and the causes of those conditions, and explain how this problem represents “the tragedy of the commons.” ▪ State and briefly describe the organizations and efforts to protect threatened and endangered species nationally and internationally. ▪ List several strategies used recently to weaken the Endangered Species Act, and list recommendations for strengthening the Endangered Species Act. State	

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
	guidelines that conservation biologists would use to set determine "priority species." ▪ Assess the advantages and disadvantages of using wildlife refuges, gene banks, botanical gardens, and zoos to protect wildlife. ▪ Describe freshwater and marine fishery management, and describe how to improve both. ▪ Analyze the lessons learned from the decline of the whaling industry.	
The Living World C. Ecosystem Diversity (Biodiversity; natural selection; evolution; ecosystem services)	▪ Describe the importance of diversity at a genetic, species, ecosystem, and functional level ▪ Describe the tools available to researchers for learning the evolutionary history of life. ▪ Describe the evolution of life from chemical evolution to the development of eukaryotic cells. ▪ Explain Wallace's and Darwin's contributions to the theory of natural selection ▪ Describe the theory of evolution, being sure to include the roles played by variation within the gene pool, mutations, and natural selection, extinction, speciation, and adaptive radiation. ▪ Define natural selection and the three conditions that are necessary for evolution of a population by natural selection. Compare the various types of natural selection (Stabilizing, disruptive, and directional). ▪ Describe how coevolution develops and give examples ▪ Explain unique ways in which some organisms are able to increase genetic variability (hybridization and conjugation). ▪ Explain limitations to natural selection and misconceptions.	▪ Natural Selection Packet (Frogs) ▪ Mass Extinction Video clip ▪ Shannon diversity Index - Car Lab ▪ Biodiversity Handout ▪ Wild Predator Invasion Video ▪ GMO Debate

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
	▪ Explain how evolution is affected by geological processes, climate change., and catastrophes (ex. meteor) ▪ Explain the events that lead to speciation. Define speciation and compare Geographic isolation (allopatric speciation) with reproductive isolation (sympatric speciation). Indicate which of these mechanisms is more common. ▪ Distinguish between background extinction, mass extinction, and mass depletion and explain how this can lead to the formation of new species.. ▪ Describe the extinction rates for endemic species. ▪ Discuss the pros and cons of artificial selection and genetic engineering. ▪ Explain genetic engineering and examples of uses. ▪ Define species diversity and explain how species evenness and richness determine the biodiversity of a community. ▪ Apply the theory of island biogeography/species equilibrium model in determining a community's biodiversity. ▪ Define ecological niche, comparing fundamental and realized niche and listing the factors that determine the realized niche. ▪ Distinguish between a specialist and a generalist, and evaluate the conditions that favor these two approaches. ▪ List the possible roles of organisms in an ecosystem and give examples ▪ List causes for the amphibian decline.	

QUARTER 3

Topic: Air Pollution; Environmental Hazards and Human Health; Solid and Hazardous Waste

Key Terms: Air Pollution: acid deposition, acid rain, air pollution, Asian Brown Cloud, atmosphere, atmospheric pressure, brown-air smog , buffer , cap-and-trade program, carbon dioxide (CO_2) , carbon monoxide (CO), carbon oxides , chronic bronchitis , cilia , Clean Air Acts , climate , coal gasification , dry deposition , electrostatic precipitator , emissions trading policy , emphysema , fine particles , formaldehyde , grasshopper effect, gray-air smog , hazardous air pollutants (HAPs) , hybrid-electric vehicles , industrial smog , , lung cancer , mobile sources , national ambient air quality standards (NAAQS) , nitric acid (HNO_3) , nitrogen dioxide (NO2) , nitrogen oxide (NO) , nitrogen oxides , ozone (O_3) , ozone layer , partial zero-emission vehicles (PZEVs) , photochemical oxidants , photochemical reaction , photochemical smog , primary pollutants , primary standard, Radon-222 , secondary pollutants , secondary standard , sick-building syndrome , stationary sources, stratosphere, sulfur dioxide (SO_2) , sulfuric acid (H_2SO_4) , suspended particulate matter , temperature inversion , tobacco smoke, Toxic Release Inventory (TRI), troposphere , ultrafine particles , volatile organic compounds (VOCs) , weather , wet deposition , wet scrubber Environmental Hazards and Human Health: acquired immune deficiency syndrome (AIDS), acute effect, anopheles mosquito, antagonistic interaction, bioaccumulation, biological hazards, biomagnification, bioterrorism, carcinogens, chemical hazards, chemical interactions, chronic effect, comparative risk analysis, cultural hazards , degree of control , dirty dozen , dose , ecological medicine , endocrine system , epidemic , gender benders , genetic makeup, hazardous chemical , hepatitis B virus (HBV) . hormonally active agents (HAAs) , hormone blockers , hormone disrupters , hormone mimics , hormones , human immunodeficiency virus (HIV), immune system, infectious disease , influenza (flu) , Kaposi's sarcoma , metastasis , methyl isocyanate (MIC), multiple chemical sensitivity (MCS) , mutagens , mutations , nervous system , neurotoxins , non-transmissible disease , oil (fat) soluble toxins , , oral rehydration therapy , pandemic , persistence , persistent organic pollutants (POPs) , , phthalates , physical hazards , , Plasmodium ,poison , pollution prevention , precautionary , principle , probability , response , risk , risk analysis , risk assessment , risk assessment , risk communication , risk management , Severe acute respiratory syndrome , virus , synergistic interaction , teratogens , thyroid disrupters , toxic chemical , toxicity , toxicology , toxin , transmissible (infectious) disease , water-soluble toxins , West Nile virus Solid and Hazardous Waste: Bioremediation, brownfield, composting, Comprehensive Environmental Response, Compensation, and Liability Act, cradle-to-grave responsibility, deep-well disposal, dioxins, dirty dozen, electronic waste, environmental justice, hazardous (toxic) waste, industrial solid waste, integrated waste management, materials-recovery facilities (MRFs), persistent organic pollutants (POPs), phytodegradation, phytoextraction, phytoremediation, phytostabilization, plasma torch, primary (closed-loop) recycling, Resource Conservation and Recovery Act (RCRA), rhizofiltration, sanitary landfills, secure hazardous-waste landfills, Superfund program, Love Canal

Measurable Skills: making predictions, problem solving, investigating, collecting, interpreting and recording data, concluding and presenting data in a lab report

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
Pollution A. Pollution Types	Chapter 21	▪ Recycling Problems ▪ Trash Video

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
4. Solid waste (Types; disposal; reduction) B. Impacts on the Environment and Human Health 2. Hazardous chemicals in the environment (Types of hazardous waste; treatment/disposal of hazardous waste; cleanup of contaminated sites; biomagnification; relevant laws) C. Economic Impacts (Cost-benefit analysis; externalities; marginal costs; sustainability)	▪ Explain how E-waste has become a problem and suggest possible solutions. ▪ State the differences between the various types of waste produced. ▪ Compare the amount of waste produced in the United States to the rest of the world and explain why there is a difference. ▪ List the major components of MSW. ▪ Explain the problems associated with the disposal of tires ▪ Compare waste management and pollution prevention approaches to solid and hazardous waste. ▪ Describe each of the elements and priorities in an Integrated Waste Management system. ▪ List the hierarchy of goals for a low-waste approach, and evaluate which approach makes the most sense to you, giving reasons for your choice. ▪ List several ways to reduce waste and pollution. ▪ List reuse strategies (refillable containers, grocery bags, and tires, etc.). ▪ Compare the economic and environmental Savings of reusing various containers. ▪ Describe the two types of recycling, and give examples of each. ▪ List the pros and cons of recycling. ▪ Explain the pros and cons of a MRF. ▪ Describe the benefits and problems of composting and recycling. ▪ Discuss the variety of environmental management methods to deal with solid waste and describe the attributes and drawbacks of each of these methods. ▪ Describe a modern sanitary landfill.	▪ Tire Problems ▪ Tracking E-Waste ▪ Love Canal Video Clip ▪ Plastic in the Ocean ▪ MRF ▪ Landfill FRQ

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
	▪ Summarize the benefits and drawbacks of burying solid wastes in sanitary landfills. ▪ Assess the pros and cons of incineration of solid wastes. ▪ Explain what happened in Love Canal and the repercussions that followed and led to the current regulations of hazardous waste. ▪ Identify components of Hazardous waste. ▪ Name and briefly describe U.S. hazardous-waste laws. ▪ Describe Superfund and state how to improve this. ▪ Define brownfields and the possible uses of such areas. ▪ Describe methods used in various countries to dispose of hazardous waste. ▪ Summarize the benefits and drawbacks of deep-well disposal of hazardous wastes. ▪ Summarize the goals of the eco-justice movement. ▪ Give examples of POPs, their risks, and their future use. ▪ Describe ways to create a low-waste society.	

QUARTER 4

Topic: Aquatic Biodiversity; Sustaining Aquatic Biodiversity; Sustaining Terrestrial Biodiversity; Food, Soil and Pest Management

Key Terms: Aquatic Biodiversity: abyssal zone, arctic tundra, barrier beaches, barrier islands, bathyal zone, benthic zone, benthos, coastal wetland, coastal zone, continental shelf , coral bleaching, coral reefs, cultural eutrophication, decomposers, deposit feeders, drainage basin, estuary, euphotic zone, eutrophic lake, filter feeders, floodplain zone, floodplains, flowing (lotic), freshwater , freshwater life zones, inland wetlands, intertidal zone, lakes, limnetic zone, littoral zone, mangrove forests, marshes, mesotrophic lake, nekton, oligotrophic lake, open sea, overturns, phytoplankton, plankton, polyps, prairie potholes, profundal zone, rocky shores, runoff, salinity, saltwater (marine), sandy shores, seasonal wetlands, source zone, standing (lentic), surface water, swamps, tides, transition zone, ultraplankton, watershed, xooxanthellae , zooplankton Sustaining Aquatic Biodiversity: bycatch, commercial extinction, high seas, integrated coastal management, marine protected areas, marine reserves, maximum sustained yield (MSY), mitigation banking, optimum sustained yield (OSY) Sustaining Terrestrial Biodiversity: Deforestation, wild-fires, fire suppression, sustainable forestry Food, Soil and Pest Management: malnutrition, undernutrition, interplanting, polyculture, desertification, waterlogging, soil conservation, conventional tillage, organic and inorganic fertilizer, organic farming, blue revolution, green revolution, pesticide treadmill, integrated pest management

Measurable Skills: investigate, identify, describe, explain, locate, recognize, examine		
AP College Board Essential Knowledge	**Student Learning Targets (AP Learning Objectives and Science Practices)**	**Learning Activities/Investigations**
Land and Water Use F. Fishing (Fishing techniques; overfishing; aquaculture; relevant laws and treaties) G. Global Economics (Globalization; World Bank; Tragedy of the Commons; relevant laws and treaties)	▪ Describe the relationship coral have with algae and list problems associated with the disappearance of coral reefs. ▪ Summarize the distribution of light, salt, and temperature in different aquatic life zones. ▪ Describe and give examples of organisms living in different aquatic life zones. ▪ List and describe the different life zones. ▪ Compare and contrast the characteristics and organisms living in coastal zones, estuaries, coastal wetlands, and intertidal zones. ▪ Describe the economic/ecological functions performed by wetlands. ▪ Describe environmental problems associated with coastal and inland wetlands. ▪ Describe the characteristics and ecological significance of coral reefs. ▪ Describe environmental and economic problems of coral reefs. ▪ Evaluate the significance of the ecological contributions of the oceans. ▪ List the biological zones of the open ocean and the organisms and characteristics associated with each. ▪ List and describe the impacts by humans on marine and coral reef ecosystems. ▪ Give examples of freshwater life zones and compare the percentage of freshwater available to marine water. ▪ List ecological and economic services provided by freshwater. ▪ List and compare the zones of a lake. ▪ Distinguish between oligotrophic and eutrophic lakes. ▪ Describe stratification and a turnover in a lake. ▪ Define watershed. ▪ List and distinguish the three zones of a river system.	▪ Question Packet ▪ Fishing Video ▪ Fish Farming ▪ Kissimmee River Restoration ▪ Mangrove Destruction

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
	▪ Give examples of different types of inland wetlands, their importance ecologically and economically, and describe the human impact. ▪ List human activities that have altered and degraded fresh water lakes, rivers, wetlands and the ecological and economic impact on each. ▪ Describe the problems associated with whales and list the regulations in place to protect them. ▪ Analyze the lessons learned from the decline of the whaling industry. ▪ List and describe the biodiversity of various aquatic ecosystems ▪ Describe the human impacts degrading aquatic habitats today ▪ Discuss the importance of each aquatic systems and its potential environmental and economic benefits. ▪ Describe the ecological services provided by aquatic systems. ▪ Describe the problems associated with overfishing ▪ List and describe the various types of industrial fishing and problems associated with each ▪ List reasons it is difficult to protect aquatic biodiversity ▪ List regulations in place to protect aquatic biodiversity (include laws and devices) ▪ Describe the problems associated with marine environment protection. ▪ Discuss the roles of legislation, regulation, and economic pressures. ▪ Describe freshwater and marine fishery management and how it to improve management. ▪ Distinguish between coastal and inland wetlands. ▪ Describe the ecological functions performed by wetlands. ▪ Describe environmental problems associated with coastal and inland wetlands. ▪ List solutions to protect wetlands	

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
	▪ Discuss the problems caused by human development of lake and river resources, including eutrophication, introduction of alien species, and management for flood control and power generation. ▪ Describe how some rivers have been protected from development. ▪ List several ecosystem approaches to sustaining aquatic biodiversity.	
Land and Water Use A. Agriculture 1. Feeding a growing population (Human nutritional requirements; types of agriculture; Green Revolution; genetic engineering and crop production; deforestation; irrigation; sustainable agriculture) 2. Controlling pests (Types of pesticides; costs and benefits of pesticide use; integrated pest management; relevant laws) B. Forestry (tree plantations; old growth forests; forest fires; forest management; national forests) C. Rangelands (overgrazing; deforestation; desertification;	▪ Distinguish between old growth and second growth forests, and give one example of each and between a second-growth forest and a tree farm. ▪ List several reasons why forests are commercially important. ▪ List several reasons forests are ecologically important. ▪ List several factors underlying causes of tropical deforestation. ▪ List several human activities that destroy the tropical forests. ▪ List the various types of tree harvesting, indicating which type of management is used. ▪ Distinguish among surface fires and crown fires. Summarize threats to forests from fires, pathogens, and air pollution and strategies for dealing with each threat. ▪ List several ways to move toward sustainable forestry management. ▪ Explain the roles that straw and kenaf can play in reducing demand for wood. ▪ List ways to help reduce the interlocking problems of tropical deforestation and the fuelwood crisis. ▪ Address scientific data collection, economic strategies, policy-making strategies, cultural strategies, and strategies to reduce demand for fuelwood. ▪ Describe one case where individual actions made a difference in helping to reduce forest destruction (Greenbelt movement). ▪ Define wilderness. Summarize the status of the national Wild and Scenic Rivers System and the National Trails System.	▪ BLM Article ▪ Reintroduction of Wolves to Yellowstone

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
rangeland management; federal rangelands) D. Other Land Use 1. Urban land development (Planned development; suburban sprawl; urbanization) 2. Transportation infrastructure (Federal highway system; canals and channels; roadless areas; ecosystem impacts) 3. Public and federal lands (Management; wilderness areas; national parks; wildlife refuges; forests; wetlands) 4. Land conservation options (Preservation; remediation; mitigation; restoration) 5. Sustainable land-use strategies	▪ Explain the advantages and disadvantages of whole ecosystem and species-by-species approaches to increasing sustainability. ▪ Compare pastures and rangelands. List ways to sustainably manage rangelands ▪ Describe the impact the gray wolves have had on the ecosystem in Yellowstone Park. ▪ Identify and define a biodiversity hotspot. ▪ Summarize the state of global food production. ▪ Define malnutrition, under nutrition, and over nutrition, and indicate how many people on Earth suffer from these problems and where these problems are most likely to occur. ▪ List several major types of agriculture (industrialized, organic, plantation, etc.). ▪ Compare the energy sources, environmental impacts, yields, and sustainability of traditional and industrial agriculture. ▪ Describe “Best Management Practices.” ▪ Define inter-planting/polyculture, and explain its advantages. ▪ Describe the problems of soil erosion and desertification, including world and U.S. situations, and state why most people are unaware of this problem. ▪ Describe the issues of salinization and waterlogging, explaining also how to control these issues. ▪ Define soil conservation. List several ways to approach the problem of soil erosion. Be sure to distinguish between conventional-tillage and conservation-tillage farming. ▪ Describe a plan to maintain soil fertility. Be sure to distinguish between organic and inorganic fertilizers. (We studied this earlier in the year) ▪ Evaluate the green revolution. What were its successes? Its failures? ▪ Summarize food distribution problems. Describe the possibilities of increasing world food production by increasing crop yields,	

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
	cultivating more land, and using unconventional foods and perennial crops. ▪ Discuss the use of genetic engineering techniques to improve the human food supply. ▪ List the several types of pesticides, comparing broad spectrum and narrow spectrum, stating the degree of persistence and giving two examples as well as determining if each undergoes bioaccumulation or biologically magnified. ▪ Give several reasons to use pesticides, and list several characteristics of the ideal pesticide. ▪ Describe the consequences of relying heavily on pesticides. ▪ Describe the pesticide treadmill. Be sure to describe biological magnification. ▪ Describe the threat of pesticides to wildlife and human health and the circle of poison. ▪ Know the U.S. law that controls pesticide regulation. ▪ List and describe nine alternative pest management strategies. ▪ Define integrated pest management, and analyze the pros and cons of using IPM. ▪ Define sustainable agriculture, and summarize how the United States could move toward creating a more sustainable agricultural system.	

QUARTER 4		
Topic: Climate Disruption and Ozone Depletion		
Key Terms: Climate Disruption and Ozone Depletion: carbon tax, CFCs, climate change, greenhouse effect, PANs, Kyoto Protocol, methane, Montreal Protocol, Stockholm Convention, Nitrous Oxide, ozone-depleting compounds		
Measurable Skills: Investigate, identify, describe, explain, locate, recognize, examine		
AP College Board Essential Knowledge	**Student Learning Targets (AP Learning Objectives and Science Practices)**	**Learning Activities/Investigations**
A. Stratospheric Ozone (Formation of stratospheric ozone; ultraviolet radiation; causes of ozone depletion; effects of ozone depletion; strategies for reducing ozone depletion; relevant laws and treaties) B. Global Warming (Greenhouse gases and the greenhouse effect; impacts and consequences of global warming; reducing climate change; relevant laws and treaties)	▪ Describe the effect volcanoes have on climate and explain how scientist use models to predict events in the future. ▪ Describe the greenhouse effect and what the Earth would be like without a greenhouse effect. ▪ Describe techniques used to estimate the temperatures of the past. ▪ Describe the pattern of the Earth's average surface-temperature fluctuation throughout geologic time. ▪ Describe the period the earth has been experiencing for the last 10,000 years. ▪ Describe the general trend of mean global temperature since 1860. ▪ List the two predominant greenhouse gases. ▪ List four greenhouse gases that have risen in the last few decades and their sources. ▪ List four human activities that contribute greenhouse gases to the atmosphere. ▪ Distinguish between greenhouse effect and global warming. ▪ List two factors other than the greenhouse effect that may have contributed to the general temperature change. ▪ State the consensus science view about the relationship between observed temperature changes and the likelihood of global climate change brought on by human activities.	▪ Ozone paper lab ▪ Sunscreen lab ▪ Tour of the Byrd Climate Research Center at OSU

AP College Board Essential Knowledge	Student Learning Targets (AP Learning Objectives and Science Practices)	Learning Activities/Investigations
	▪ Describe natural and man- made factors that can influence temperature. ▪ List and describe the effects of a warmer climate Explain why a range so seemingly small can have such major consequences. ▪ Summarize the projections of possible effects of global warming on (a) food production, (b) water supplies, (c) forests, (d) biodiversity, (e) sea levels, (f) weather extremes, (g) human health, and (h) environmental refugees. ▪ Describe the different schools of thought about global warming and how we as a human society should act ▪ List strategies which would slow potential global warming, including both prevention and cleanup approaches. ▪ List international and local efforts to control greenhouse emissions ▪ Describe the origin of stratospheric ozone and the role it plays in protecting life on Earth. ▪ Describe changes that have been occurring in stratospheric ozone. ▪ Describe the scientific work on CFCs and their relationship to ozone. ▪ Summarize the consensus science view of CFCs and stratospheric ozone. ▪ Summarize alternative views that have received much attention. ▪ Explain the significance of a critically thinking citizenry to the democratic process. ▪ Explain the potential consequences of ozone depletion, and propose three ways for slowing these changes	

District Instructional Resource:

Environmental Science for AP (2019) / Bedford Freeman & Worth (6-year online subscription (2019-2020 to 2024-2025)

Fast Track to a 5 Preparing for AP® Environmental Science (2012)

Standards Alignment:

AP College Board/Environmental Science Course Description (2013) – retrieved Jan. 2, 1029 https://apcentral.collegeboard.org/pdf/ap-environmental-science-course-description.pdf?course=ap-environmental-science