HIGH SCHOOL ELECTIVE
AP ENVIRONMENTAL SCIENCE (USED AS A YEAR-LONG OR BLOCK-SCHEDULED COURSE)
Life Sciences Standard (LS)
Earth and Space Sciences Standard (ES)

11-12 Benchmarks	Grade Level Indicators and Sub-Objectives	Teaching Strategies/Resources
By the end of the 11-12 program, the student will: **<u>Life Sciences</u>** ✶ **Explain how humans are connected to and impact natural systems. (LS-B)** ✶ **Relate how biotic and abiotic global changes have occurred in the past and will continue to do so in the future. (LS-D)** ✶ **Explain the interconnectedness of the components of a natural system. (LS-E)** ✶ **Explain how human choices today will affect the quality and quantity of life on earth. (LS-F)** ✶ **Summarize the historical development of scientific theories and ideas within the study of life sciences. (LS-G)**	**By the end of Eleventh/Twelfth Grades, the student will:** **<u>Characteristics and Structure of Life</u>** ✶ **Describe how the maintenance of a relatively stable internal environment is required for the continuation of life, and explain how stability is challenged by changing physical, chemical and environmental conditions as well as the presence of pathogens. (LS-11-1)** ✶ **Relate how birth rates, fertility rates and death rates are affected by various environmental factors. (LS-11-3)** ✶ **Examine the contributing factors of human population growth that impact natural systems such as levels of education, children in the labor force, education and employment of women, infant mortality rates, costs of raising children, birth control methods, and cultural norms. (LS-11-4)** ✶ **Investigate the impact on the structure and stability of ecosystems due to changes in their biotic and abiotic components as a result of human activity. (LS-11-5)** ✶ **Explain that the sun is essentially the primary source of energy for life. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules. (LS-12-3)** ✶ **Explain that carbon-containing molecules can be used to assemble larger molecules with biological activity (including proteins, DNA, sugars and fats). In addition, the energy stored in bonds between the**	

Earth and Space Sciences ✶ **Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems. (ES-B)** ✶ **Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future. (ES-C)** ✶ **Summarize the historical development of scientific theories and ideas and describe emerging issues in the study of Earth and space sciences. (ES-D)**	**atoms (chemical energy) can be used as sources of energy for life processes. (LS-12-4)** **Diversity and Interdependence of Life** ✶ **Predict some possible impacts on an ecosystem with the introduction of a non-native species. (LS-11-6)** ✶ **Show how populations can increase through linear or exponential growth with corresponding effects on resource use and environmental pollution. (LS-11-7)** ✶ **Recognize that populations can reach or temporarily exceed the carrying capacity of a given environment. Show that the limitation is not just the availability of space but the number of organisms in relation to resources and the capacity of earth systems to support life. (LS-11-8)** ✶ **Give examples of how human activity can accelerate rates of natural change and can have unforeseen consequences. (LS-11-9)** ✶ **Explain how environmental factors can influence heredity or development of organisms. (LS-11-10)** ✶ **Investigate issues of environmental quality at local, regional, national and global levels such as population growth, resource use, population distribution, over-consumption, the capacity of technology to solve problems, poverty, the role of economics, politics and different ways humans view the earth. (LS-11-11)** ✶ **Relate diversity and adaptation to structures and functions of living organisms at various levels of organization. (LS-12-7)** ✶ **Based on the structure and stability of ecosystems and their nonliving components, predict the biotic and abiotic changes in such systems when disturbed (e.g., introduction of non-native species, climatic change, etc.). (LS-12-8)** ✶ **Explain why and how living systems require a continuous input of energy to maintain their chemical and physical organization. Explain that with death and the cessation of energy input, living systems rapidly disintegrate toward more disorganized states. (LS-12-9)** **Evolutionary Theory** ✶ **Recognize that ecosystems change when significant climate changes occur or when one or more new species appear as a result of immigration or speciation. (LS-11-12)**	

	Historical Perspectives and Scientific Revolutions ✶ **Trace the historical development of a biological theory or idea (e.g., genetics, cytology and germ theory). (LS-12-11)** ✶ **Describe advances in life sciences that have important, long-lasting effects on science and society (e.g., biotechnology). (LS-12-12)** **Earth Systems** ✶ **Describe the normal adjustments of Earth, which may be hazardous for humans. Recognize that humans live at the interface between the atmosphere driven by solar energy and the upper mantle where convection creates changes in Earth's solid crust. Realize that as societies have grown, become stable and come to value aspects of the environment, vulnerability to natural processes of change has increased. (ES-11-8)** ✶ **Explain the effects of biomass and human activity on climate (e.g., climatic change and global warming). (ES-11-9)** ✶ **Analyze how materials from human societies (e.g., radioactive waste and air pollution) affect both physical and chemical cycles of Earth. (ES-11-11)** ✶ **Explain ways in which humans have had a major effect on other species (e.g., the influence of humans on other organisms occurs through land use, which decreases space available to other species and pollution, which changes the chemical composition of air, soil and water). (ES-11-12)** ✶ **Explain how human behavior affects the basic processes of natural ecosystems and the quality of the atmosphere, hydrosphere and lithosphere. (ES-11-13)** ✶ **Conclude that Earth has finite resources and explain that humans deplete some resources faster than they can be renewed. (ES-11-14)** ✶ **Describe how scientists estimate how much of a given resource is available on Earth. (ES-12-6)** **Historical Perspectives and Scientific Revolutions** ✶ **Use historical examples to show how new ideas are limited by the context in which they are conceived; are often rejected by the social establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., global warming, Heliocentric Theory and Theory**	

	of Continental Drift). (ES-11-15) ✶ **Describe advances in Earth and space science that have important long-lasting effects on science and society (e.g., global warming, Heliocentric Theory and Plate Tectonics Theory). (ES-11-16)** **<u>Sub-Objectives to Meet Indicators:</u>** **Interdependence of the Earth's Systems** • Compare and contrast the forms of energy (electrical, thermal, chemical, nuclear, and mechanical). • Explain the transformation and conservation of the various forms of energy. • Trace the cyclic movement and recycling of materials in an ecosystem, including carbon, oxygen, and major nutrients, such as nitrogen and phosphates. • Compare and contrast the cycling of major and trace elements. • Trace the history of the earth using the geologic time scale. • Explain the theory of plate tectonics. • Investigate relationships between volcanoes and earthquakes to land formation and deformation. • Illustrate the steps of the rock cycle. • Explain how various types of soil are formed. • Describe the origin, evolution, composition, and structure of the atmosphere. • Differentiate between weather and climate. • Infer the influences on weather and climate (e.g., atmospheric, various landforms, etc.). • Compare and contrast convection currents in magma, water, and air. • Distinguish among biomes by describing major biotic and abiotic factors. • Describe limiting factors of ecosystems. • Label organisms as producers, consumers, and/or decomposers. • Graph how populations grow exponentially. • Examine and draw a predator-prey response lag graph. • Compare and contrast physical and behavioral adaptations that organisms have in order to survive. • Examine differences in generalists and specialists populations. • Distinguish between types of symbiotic relationships (i.e., predator-prey,	

	mutualism, parasitism, and commensalism).
	• Construct ecological pyramids and describe how energy is transferred and conserved through the trophic levels of an ecosystem.
	• List and explain geographical barriers and their importance to populations.
	• Explain biomass, productivity and carrying capacity.
	• Describe changes that take place in an ideal succession to a climax.
	• Explain the concept of biological magnification with true-to-life examples.
	• Research the most popular evolutionary theories regarding the natural selection and extinction.
	
	Human Population Dynamics
	• Investigate the history of the distribution of global populations.
	• Describe stages in population growth and decline.
	• Recognize relationships among demographic trends, birth rates, death rates, survival curves, and local, regional, and global carrying capacities of populations.
	• Identify problems associated with human population growth (e.g., urban sprawl, transportation, resource utilization, heat islands, etc.).
	• Research cultural and economic influences on human population dynamics.
	
	Renewable and Nonrenewable Resources
	• Compare and contrast the distribution, ownership, use, and degradation of the following renewable and nonrenewable resources:
	  ° Water
	  ° Minerals
	  ° Soil and Land
	  ° Biological Resources
	  ° Energy
	• Describe the agricultural, industrial, and domestic use of fresh water.
	• Explain the importance of ocean (salt) water for fisheries and industrial use.
	• Identify mineral samples using diagnostic techniques and a key.
	• Compare and contrast various soil types and profiles.
	• Predict the cause and effect of eroding agents (e.g., mining, farming, construction, etc.) and propose methods for controlling erosion.	

	• Identify examples of biological resources, including natural areas, genetic diversity, and food and other agricultural products. • Compare and contrast energy sources (solar, wind, biomass, propane, natural gas, petroleum, hydropower, nuclear, geothermal, coal). • Compare and contrast coal, petroleum, and propane as the fossil fuels that are used to produce energy. • Describe natural examples of sinks, where energy sources are found. • Determine which energy sources are conventional and which are alternative. • Describe the benefits and hazards associated with each energy source. • Convert energy units from one unit of measurement to an equivalent value in a different measuring system. • Examine the cost efficiency of using energy sources for practical purposes. • Investigate the availability and use of renewable and nonrenewable resources. • Differentiate between renewable and nonrenewable resources and strategies for managing and conserving them. • Compare and contrast the trade-offs (risks and benefits) represented as humans act to consume and/or conserve resources, while differentiating this analysis from how social pressure and advertising may impact actions. • Apply appropriate management strategies, such as conservation and recycling, for existing resource supplies. • Prepare a plan for residential and/or commercial use of land keeping in mind a variety of factors (e.g., water supply, waste transport, earthquakes, flood zones, etc.). • Debate the potential use of property for agricultural use, forestry, recreational use, and conservation as a wilderness area. • Discuss policies of the various levels of government for land use (e.g., national parks, national recreation areas, etc.). **Environmental Quality** • Identify major sources of air, water, and soil pollution, such as sulfur dioxide, nitrates, and pesticides. • Explain thermal pollution. • Obtain measurements of ppm, pH, and micrograms per liter. • Collect qualitative and quantitative measurements of lab solutions and	

	substrates gathered from field research. • Distinguish between point and nonpoint sources of pollution. • Identify examples of domestic, industrial, and agricultural point and nonpoint sources of pollution. • Explain how both individuals and industries pollute. • Describe effects of pollutants on aquatic systems, vegetation, natural features, buildings and other manmade structures, and wildlife. • Formulate plans for pollution reduction, control, and remediation. • Describe solid waste management in terms of types, sources, and amounts. • Research current methods of solid waste disposal and discuss their limitations, especially regarding landfills. • Compare and contrast strengths and drawbacks to alternative practices for solid waste management (e.g., incineration, recycling, etc.) • Research ecological issues to develop a position on problems (e.g., water pollution and its cost, urban sprawl, zebra mussels in the Great Lakes, etc.).	