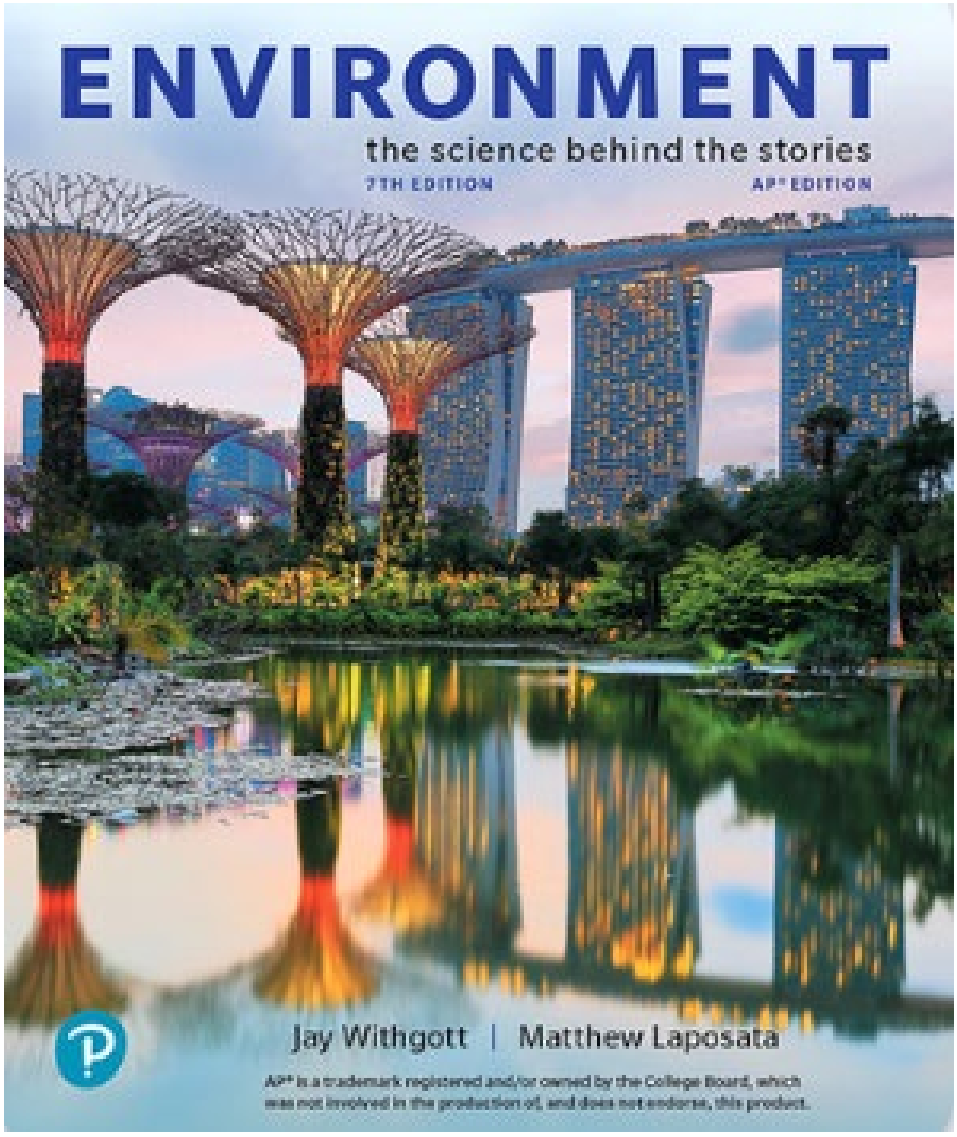
# Correlation of
# AP® Environmental Science Standards to
# *Environment: The Science Behind the Stories 7e*, AP Edition
# (Withgott)



Correlation of
College Board's AP® Environmental Science
Environment*: The Science Behind the Stories, Seventh Edition, AP® Edition,* (Jay Withgott, Matthew Laposata)

| AP® Environmental Science Topic Title | Learning Objective | Essential Knowledge | Withgott/ Laposata Module Title |
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| **Unit 1: The Living World: Ecosystems** | | | |
| 1.1 Introduction to Ecosystems | ERT-1.A Explain how the availability of resources influences species interactions. | ERT-1.A.1 In a predator-prey relationship, the predator is an organism that eats another organism (the prey). | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 111) |
| | | ERT-1.A.2 Symbiosis is a close and long-term interaction between two species in an ecosystem. Types of symbiosis include mutualism, commensalism, and parasitism. | Ch. 4 Species Interactions and Community Ecology (pg. 80) |
| | | ERT-1.A.3 Competition can occur within or between species in an ecosystem where there are limited resources. Resource partitioning— using the resources in different ways, places, or at different times— can reduce the negative impact of competition on survival. | Ch. 4 Species Interactions and Community Ecology (pg. 82) |
| 1.2 Terrestrial Biomes | ERT-1.B Describe the global distribution and principal environmental aspects of terrestrial biomes. | ERT-1.B.1 A biome contains characteristic communities of plants and animals that result from, and are adapted to, its climate. | Ch. 4 Species Interactions and Community Ecology (pg. 94) |

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| | | ERT-1.B.2 Major terrestrial biomes include taiga, temperate rainforests, temperate seasonal forests, tropical rainforests, shrubland, temperate grassland, savanna, desert, and tundra. | Ch. 4 Species Interactions and Community Ecology (pg. 95) |
| | | ERT-1.B.3 The global distribution of nonmineral terrestrial natural resources, such as water and trees for lumber, varies because of some combination of climate, geography, latitude and altitude, nutrient availability, and soil. | Ch. 4 Species Interactions and Community Ecology (pg. 97) |
| | | ERT-1.B.4 The worldwide distribution of biomes is dynamic; the distribution has changed in the past and may again shift as a result of global climate changes. | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 323) |
| 1.3 Aquatic Biomes | ERT-1.C Describe the global distribution and principal environmental aspects of aquatic biomes. | ERT-1.C.1 Freshwater biomes include streams, rivers, ponds, and lakes. These freshwater biomes are a vital resource for drinking water. | Ch. 4 Species Interactions and Community Ecology (pg. 101) |

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| | | ERT-1.C.2 Marine biomes include oceans, coral reefs, marshland, and estuaries. Algae in marine biomes supply a large portion of the Earth's oxygen, and also take in carbon dioxide from the atmosphere. | Ch. 4 Species Interactions and Community Ecology (pg. 101) |
| | | ERT-1.C.3 The global distribution of nonmineral marine natural resources, such as different types of fish, varies because of some combination of salinity, depth, turbidity, nutrient availability, and temperature. | Ch. 16 Marine and Coastal Systems and Resources (pg. 424) |
| 1.4 The Carbon Cycle | ERT-1.D Explain the steps and reservoir interactions in the carbon cycle. | ERT-1.D.1 The carbon cycle is the movement of atoms and molecules containing the element carbon between sources and sinks. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 122) |
| | | ERT-1.D.2 Some of the reservoirs in which carbon compounds occur in the carbon cycle hold those compounds for long periods of time, while some hold them for relatively short periods of time. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 122) |
| | | ERT-1.D.3 Carbon cycles between photosynthesis and cellular respiration in living things. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 123) |

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| | | ERT-1.D.4 Plant and animal decomposition have led to the storage of carbon over millions of years. The burning of fossil fuels quickly moves that stored carbon into atmospheric carbon, in the form of carbon dioxide. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 124) |
| 1.5 The Nitrogen Cycle | ERT-1.E Explain the steps and reservoir interactions in the nitrogen cycle. | ERT-1.E.1 The nitrogen cycle is the movement of atoms and molecules containing the element nitrogen between sources and sinks. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 124) |
| | | ERT-1.E.2 Most of the reservoirs in which nitrogen compounds occur in the nitrogen cycle hold those compounds for relatively short periods of time. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 126) |
| | | ERT-1.E.3 Nitrogen fixation is the process in which atmospheric nitrogen is converted into a form of nitrogen (primarily ammonia) that is available for uptake by plants and that can be synthesized into plant tissue. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 125) |
| | | ERT-1.E.4 The atmosphere is the major reservoir of nitrogen. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 126) |
| 1.6 The Phosphorus Cycle | ERT-1.F Explain the steps and reservoir interactions in the phosphorus cycle. | ERT-1.F.1 The phosphorus cycle is the movement of atoms and molecules containing the element phosphorus between sources and sinks. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 127) |

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| | | ERT-1.F.2 The major reservoirs of phosphorus in the phosphorus cycle are rock and sediments that contain phosphorus-bearing minerals. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 127) |
| | | ERT-1.F.3 There is no atmospheric component in the phosphorus cycle, and the limitations this imposes on the return of phosphorus from the ocean to land make phosphorus naturally scarce in aquatic and many terrestrial ecosystems. In undisturbed ecosystems, phosphorus is the limiting factor in biological systems. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 127) |
| 1.7 The Hydrologic Cycle | ERT-1.G Explain the steps and reservoir interactions in the hydrologic cycle. | ERT-1.G.1 The hydrologic cycle, which is powered by the sun, is the movement of water in its various solid, liquid, and gaseous phases between sources and sinks. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 121) |
| | | ERT-1.G.2 The oceans are the primary reservoir of water at the Earth's surface, with ice caps and groundwater acting as much smaller reservoirs. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 121) |

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| 1.8 Primary Productivity | ENG-1.A Explain how solar energy is acquired and transferred by living organisms. | ENG-1.A.1 Primary productivity is the rate at which solar energy (sunlight) is converted into organic compounds via photosynthesis over a unit of time. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 111) |
| | | ENG-1.A.2 Gross primary productivity is the total rate of photosynthesis in a given area. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 111) |
| | | ENG-1.A.3 Net primary productivity is the rate of energy storage by photosynthesizers in a given area, after subtracting the energy lost to respiration. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 111) |
| | | ENG-1.A.4 Productivity is measured in units of energy per unit area per unit time (e.g., kcal/m2/yr). | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 114) |
| | | ENG-1.A.5 Most red light is absorbed in the upper 1m of water, and blue light only penetrates deeper than 100m in the clearest water. This affects photosynthesis in aquatic ecosystems, whose photosynthesizers have adapted mechanisms to address the lack of visible light. | Ch. 15 Freshwater, Systems and Resources (pg. 398) |

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| 1.9 Trophic Levels | ENG-1.B Explain how energy flows and matter cycles through trophic levels. | ENG-1.B.1 All ecosystems depend on a continuous inflow of high-quality energy in order to maintain their structure and function of transferring matter between the environment and organisms via biogeochemical cycles. | Ch. 4 Species Interactions and Community Ecology (pg. 81) |
| | | ENG-1.B.2 Biogeochemical cycles are essential for life and each cycle demonstrates the conservation of matter. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 111) |
| | | ENG-1.B.3 In terrestrial and near-surface marine communities, energy flows from the sun to producers in the lowest trophic levels and then upward to higher trophic levels. | Ch. 4 Species Interactions and Community Ecology (pg. 82) |
| 1.10 Energy Flow and 10% Rule | ENG-1.C Determine how the energy decreases as it flows through ecosystems. | ENG-1.C.1 The 10% rule approximates that in the transfer of energy from one trophic level to the next, only about 10% of the energy is passed on. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 111) |
| | | ENG-1.C.2 The loss of energy that occurs when energy moves from lower to higher trophic levels can be explained through the laws of thermodynamics. | Ch. 4 Species Interactions and Community Ecology (pg. 82) |
| 1.11 Food Chains and | ENG-1.D Describe | ENG-1.D.1 A food web | Ch. 4 Species |

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| Food Webs | food chains and food webs, and their constituent members by trophic level. | is a model of an interlocking pattern of food chains that depicts the flow of energy and nutrients in two or more food chains. | Interactions and Community Ecology (pg. 81) |
| | | ENG-1.D.2 Positive and negative feedback loops can each play a role in food webs. When one species is removed from or added to a specific food web, the rest of the food web can be affected. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 108) |
| **Unit 2: The Living World: Biodiversity** | | | |
| 2.1 Introduction to Biodiversity | ERT-2.A Explain levels of biodiversity and their importance to ecosystems. | ERT-2.A.1 Biodiversity in an ecosystem includes genetic, species, and habitat diversity | Ch. 11 Biodiversity and Its Conservation (pg. 275) |
| | | ERT-2.A.2 The more genetically diverse a population is, the better it can respond to environmental stressors. Additionally, a population bottleneck can lead to a loss of genetic diversity | Ch. 11 Biodiversity and Its Conservation (pg. 275) |
| | | ERT-2.A.3 Ecosystems that have a larger number of species are more likely to recover from disruptions. | Ch. 11 Biodiversity and Its Conservation (pg. 276) |
| | | ERT-2.A.4 Loss of habitat leads to a loss of specialist species, followed by a loss of generalist species. It also leads to reduced numbers of species that have large territorial requirements. | Ch. 11 Biodiversity and Its Conservation (pg. 291) |

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| | | ERT-2.A.5 Species richness refers to the number of different species found in an ecosystem. | Ch. 11 Biodiversity and Its Conservation (pg. 277) |
| 2.2 Ecosystem Services | ERT-2.B Describe ecosystem services. | ERT-2.B.1 There are four categories of ecosystem services: provisioning, regulating, cultural, and supporting. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 120) |
| | ERT-2.C Describe the results of human disruptions to ecosystem services. | ERT-2.C.1 Anthropogenic activities can disrupt ecosystem services, potentially resulting in economic and ecological consequences. | Ch. 7 Environmental Policy; Making Decisions and Solving Problems (pg. 163) |
| 2.3 Island Biography | ERT-2.D Describe island biogeography | ERT-2.D.1 Island biogeography is the study of the ecological relationships and distribution of organisms on islands, and of these organisms' community structures. | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 329) |
| | | ERT-2.D.2 Islands have been colonized in the past by new species arriving from elsewhere. | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 332) |

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| | ERT-2.E Describe the role of island biogeography in evolution. | ERT-2.E.1 Many island species have evolved to be specialists versus generalists because of the limited resources, such as food and territory, on most islands. The long-term survival of specialists may be jeopardized if and when invasive species, typically generalists, are introduced and outcompete the specialists | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 329) |
| 2.4 Ecological Tolerance | ERT-2.F Describe ecological tolerance. | ERT-2.F.1 Ecological tolerance refers to the range of conditions, such as temperature, salinity, flow rate, and sunlight that an organism can endure before injury or death results. | Ch. 11 Biodiversity and Its Conservation (pg. 283) |
| | | ERT-2.F.2 Ecological tolerance can apply to individuals and to species. | Ch. 11 Biodiversity and Its Conservation (pg. 283) |
| 2.5 Natural Disruption to Ecosystems | ERT-2.G Explain how natural disruptions, both shortand long-term, impact an ecosystem. | ERT-2.G.1 Natural disruptions to ecosystems have environmental consequences that may, for a given occurrence, be as great as, or greater than, many human-made disruptions. | Ch. 4 Species Interactions and Community Ecology (pg. 87) |
| | | ERT-2.G.2 Earth system processes operate on a range of scales in terms of time. Processes can be periodic, episodic, or random. | Ch. 4 Species Interactions and Community Ecology (Pg. 87) |
| | | ERT-2.G.3 Earth's climate has changed over geological time for many reasons. | Ch. 2 Earth's Physical Systems: Matter, Energy, and Geology (pg. 39) |

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| | | ERT-2.G.4 Sea level has varied significantly as a result of changes in the amount of glacial ice on Earth over geological time. | Ch. Global Climate Change (pg. 502) |
| | | ERT-2.G.5 Major environmental change or upheaval commonly results in large swathes of habitat changes. | Ch. 2 Earth's Physical Systems: Matter, Energy, and Geology (pg. 37) |
| | | ERT-2.G.6 Wildlife engages in both short- and long-term migration for a variety of reasons, including natural disruptions. | Ch. 11 Biodiversity and its Conservation (pg. 274) |
| 2.6 Adaptations | ERT-2.H Describe how organisms adapt to their environment. | ERT-2.H.1 Organisms adapt to their environment over time, both in short- and long-term scales, via incremental changes at the genetic level. | Ch. 3 Evolution and Population Ecology (pg. 52) |
| | | ERT-2.H.2 Environmental changes, either sudden or gradual, may threaten a species' survival, requiring individuals to alter behaviors, move, or perish. | Ch. 4 Species Interactions and Community Ecology (Pg. 87) |
| 2.7 Ecological Succession | ERT-2.I Describe ecological succession. | ERT-2.I.1 There are two main types of ecological succession: primary and secondary succession. | Ch. 4 Species Interactions and Community Ecology (pg. 87) |

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| | | ERT-2.I.2 A keystone species in an ecosystem is a species whose activities have a particularly significant role in determining community structure. | Ch. 4 Species Interactions and Community Ecology (Pg. 86) |
| | | ERT-2.I.3 An indicator species is a plant or animal that, by its presence, abundance, scarcity, or chemical composition, demonstrates that some distinctive aspect of the character or quality of an ecosystem is present. | Ch. 4 Species Interactions and Community Ecology (Pg. 87) |
| | ERT-2.J Describe the effect of ecological succession on ecosystems. | ERT-2.J.1 Pioneer members of an early successional species commonly move into unoccupied habitat and over time adapt to its particular conditions, which may result in the origin of new species. | Ch. 4 Species Interactions and Community Ecology (Pg. 87) |
| | | ERT-2.J.2 Succession in a disturbed ecosystem will affect the total biomass, species richness, and net productivity over time. | Ch. 4 Species Interactions and Community Ecology (Pg. 87) |
| **Unit 3: Populations** | | | |
| 3.1 Generalist and Specialist Species | ERT-3.A Identify differences between generalist and specialist species. | ERT-3.A.1 Specialist species tend to be advantaged in habitats that remain constant, while generalist species tend to be advantaged in habitats that are changing. | Ch. 11 Biodiversity and Its Conservation (pg. 282) |

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| 3.2 K-Selected r-selected Species | ERT-3.B Identify differences between K- and r-selected species. | ERT-3.B.1 K-selected species tend to be large, have few offspring per reproduction event, live in stable environments, expend significant energy for each offspring, mature after many years of extended youth and parental care, have long life spans/life expectancy, and reproduce more than once in their lifetime. Competition for resources in K-selected species' habitats is usually relatively high. | Ch. 3 Evolution and Population Ecology (pg. 68) |
| | | ERT-3.B.2 r-selected species tend to be small, have many offspring, expend or invest minimal energy for each offspring, mature early, have short life spans, and may reproduce only once in their lifetime. Competition for resources in r-selected species' habitats is typically relatively low. | Ch. 11 Biodiversity and Its Conservation (pg. 283) |
| | | ERT-3.B.3 Biotic potential refers to the maximum reproductive rate of a population in ideal conditions. | Ch. 3 Evolution and Population Ecology (pg. 63) |

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| | | ERT-3.B.4 Many species have reproductive strategies that are not uniquely r-selected or K-selected, or they change in different conditions at different times. | Ch. 3 Evolution and Population Ecology (pg. 68) |
| | | ERT-3.B.5 K-selected species are typically more adversely affected by invasive species than r-selected species, which are minimally affected by invasive species. Most invasive species are r-selected species. | Ch. 3 Evolution and Population Ecology (pg. 69) |
| 3.3 Survivorship Curves | ERT-3.C Explain survivorship curves | ERT-3.C.1 A survivorship curve is a line that displays the relative survival rates of a cohort—a group of individuals of the same age—in a population, from birth to the maximum age reached by any one cohort member. There are Type I, Type II, and Type III curves. | Ch. 3 Evolution and Population Ecology (pg. 68) |
| | | ERT-3.C.2 Survivorship curves differ for K-selected and r-selected species, with K-selected species typically following a Type I or Type II curve and r-selected species following a Type III curve. | Ch. 3 Evolution and Population Ecology (pg. 68) |

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| 3.4 Carrying Capacity | ERT-3.D Describe carrying capacity. | ERT-3.D.1 When a population exceeds its carrying capacity (carrying capacity can be denoted as K), overshoot occurs. There are environmental impacts of population overshoot, including resource depletion. | Ch. 3 Evolution and Population Ecology (pg. 67) |
| | ERT-3.E Describe the impact of carrying capacity on ecosystems. | ERT-3.E.1 A major ecological effect of population overshoot is dieback of the population (often severe to catastrophic) because the lack of available resources leads to famine, disease, and/or conflict. | Ch. 3 Evolution and Population Ecology (pg. 68) |
| 3.5 Population Growth and Resource Availability | ERT-3.F Explain how resource availability affects population growth. | ERT-3.F.1 Population growth is limited by environmental factors, especially by the available resources and space. | Ch. 3 Evolution and Population Ecology (pg. 67) |
| | | ERT-3.F.2 Resource availability and the total resource base are limited and finite over all scales of time. | Ch. 12 (Forests, Forest Management, and Protected Areas (pg. 317) |
| | | ERT-3.F.3 When the resources needed by a population for growth are abundant, population growth usually accelerates. | Ch. 3 Evolution and Population Ecology (pg. 66) |
| | | ERT-3.F.5 When the resource base of a population shrinks, the increased potential for unequal distribution of resources will ultimately result in increased mortality, decreased fecundity, | Ch. 3 Evolution and Population Ecology (pg. 66) |

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| | | or both, resulting in population growth declining to, or below, carrying capacity | |
| 3.6 Age Structure Diagram | EIN-1.A Explain age structure diagrams. | EIN-1.A.1 Population growth rates can be interpreted from age structure diagrams by the shape of the structure. | Ch. 8 Human Population (pg. 195) |
| | | EIN-1.A.2 A rapidly growing population will, as a rule, have a higher proportion of younger people compared to stable or declining populations. | Ch. 3 Evolution and Population Ecology (pg. 66) |
| 3.7 Total Fertility Rate | EIN-1.B Explain factors that affect total fertility rate in human populations. | EIN-1.B.1 Total fertility rate (TFR) is affected by the age at which females have their first child, educational opportunities for females, access to family planning, and government acts and policies. | Ch. 8 Human Population (pg. 198) |
| | | EIN-1.B.2 If fertility rate is at replacement levels, a population is considered relatively stable. | Ch. 8 Human Population (pg. 198) |
| | | EIN-1.B.3 Factors associated with infant mortality rates include whether mothers have access to good healthcare and nutrition. Changes in these factors can lead to changes in infant mortality rates over time. | Ch. 8 Human Population (pg. 199) |

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| 3.8 Human Population Dynamics | EIN-1.C.1 Explain how human populations experience growth and decline. | EIN-1.C.1 Birth rates, infant mortality rates, and overall death rates, access to family planning, access to good nutrition, access to education, and postponement of marriage all affect whether a human population is growing or declining. | Ch. 8 Human Population (pg. 202) |
| | | EIN-1.C.2 Factors limiting global human population include the Earth's carrying capacity and the basic factors that limit human population growth as set forth by Malthusian theory. | Ch. 8 Human Population (pg. 209) |
| | | EIN-1.C.3 Population growth can be affected by both density-independent factors, such as major storms, fires, heat waves, or droughts, and density-dependent factors, such as access to clean water and air, food availability, disease transmission, or territory size. | Ch. 3 Evolution and Population Ecology (pg. 67) |
| | | EIN-1.C.4 The rule of 70 states that dividing the number 70 by the percentage population growth rate approximates the population's doubling time. | Ch. 8 Human Population (pg. 209) |

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| 3.9 Demographic Transition | EIN-1.D Define the demographic transition. | EIN-1.D.1 The demographic transition refers to the transition from high to lower birth and death rates in a country or region as development occurs and that country moves from a preindustrial to an industrialized economic system. This transition is typically demonstrated through a four-stage demographic transition model (DTM). | Ch. 8 Human Population (pg. 199) |
| | | EIN-1.D.2 Characteristics of developing countries include higher infant mortality rates and more children in the workforce than developed countries. | Ch. 8 Human Population (pg. 197) |
| **Unit 4: Earth Systems and Resources** | | | |
| 4.1 Tectonic Plates | ERT-4.A Describe the geological changes and events that occur at convergent, divergent, and transform plate boundaries. | ERT-4.A.1 Convergent boundaries can result in the creation of mountains, island arcs, earthquakes, and volcanoes. | Ch. 2 Earth's Physical Systems: Matter, Energy, and Geology (pg. 35) |
| | | ERT-4.A.2 Divergent boundaries can result in seafloor spreading, rift valleys, volcanoes, and earthquakes. | Ch. 2 Earth's Physical Systems: Matter, Energy, and Geology (pg. 36) |
| | | ERT-4.A.3 Transform boundaries can result in earthquakes. | Ch. 2 Earth's Physical Systems: Matter, Energy, and Geology (pg. 36) |

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| | | ERT-4.A.4 Maps that show the global distribution of plate boundaries can be used to determine the location of volcanoes, island arcs, earthquakes, hot spots, and faults. | Ch. 2 Earth's Physical Systems: Matter, Energy, and Geology (pg. 36) |
| | | ERT-4.A.5 An earthquake occurs when stress overcomes a locked fault, releasing stored energy. | Ch. 2 Earth's Physical Systems: Matter, Energy, and Geology (pg. 50) |
| 4.2 Soil Formation and Erosion | ERT-4.B Describe the characteristics and formation of soil. | ERT-4.B.1 Soils are formed when parent material is weathered, transported, and deposited. | Ch. 9 The Understanding of Agriculture (pg. 217) |
| | | ERT-4.B.2 Soils are generally categorized by horizons based on their composition and organic material. | Ch. 9 The Understanding of Agriculture (pg. 217) |
| | | ERT-4.B.3 Soils can be eroded by winds or water. Protecting soils can protect water quality as soils effectively filter and clean water that moves through them. | Ch. 9 The Understanding of Agriculture (pg. 217) |
| 4.3 Soil Composition and Properties | ERT-4.C Describe similarities and differences between properties of different soil types. | ERT-4.C.1 Water holding capacity—the total amount of water soil can hold—varies with different soil types. Water retention contributes to land productivity and fertility of soils. | Ch. 9 The Understanding of Agriculture (pg. 217) |
| | | ERT-4.C.2 The particle size and composition of each soil horizon can affect the porosity, permeability, and fertility of the soil. | Ch. 9 The Understanding of Agriculture (pg. 219) |
| | | ERT-4.C.3 There are a variety of methods to test the chemical, | Ch. 9 The Understanding of Agriculture (pg. 221) |

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| | | physical, and biological properties of soil that can aid in a variety of decisions, such as irrigation and fertilizer requirements. | |
| | | ERT-4.C.4 A soil texture triangle is a diagram that allows for the identification and comparison of soil types based on their percentage of clay, silt, and sand. | Ch. 9 The Understanding of Agriculture (pg. 219) |

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| 4.4 Earth's Atmosphere | ERT-4.D Describe the structure and composition of the Earth's atmosphere. | ERT-4.D.1 The atmosphere is made up of major gases, each with its own relative abundance. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 452) |
| | | ERT-4.D.2 The layers of the atmosphere are based on temperature gradients and include the troposphere, stratosphere, mesosphere, thermosphere, and exosphere. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 453) |
| 4.5 Global Wind Patterns | ERT-4.E Explain how environmental factors can result in atmospheric circulation. | ERT-4.E.1 Global wind patterns primarily result from the most intense solar radiation arriving at the equator, resulting in density differences and the Coriolis effect. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 455) |
| 4.6 Watersheds | ERT-4.F Describe the characteristics of a watershed. | ERT-4.F.1 Characteristics of a given watershed include its area, length, slope, soil, vegetation types, and divides with adjoining watersheds. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 109) |

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| 4.7 Solar Radiation and Earth's Seasons | ENG-2.A Explain how the sun's energy affects the Earth's surface. | ENG-2.A.1 Incoming solar radiation (insolation) is the Earth's main source of energy and is dependent on season and latitude. | Ch. 18 Global Climate Change (pg. 490) |
| | | ENG-2.A.2 The angle of the sun's rays determines the intensity of the solar radiation. Due to the shape of the Earth, the latitude that is directly horizontal to the solar radiation receives the most intensity. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 455) |
| | | ENG-2.A.3 The highest solar radiation per unit area is received at the equator and decreases toward the poles. | Not found |
| | | ENG-2.A.4 The solar radiation received at a location on the Earth's surface varies seasonally, with the most radiation received during the location's longest summer day and the least on the shortest | Not found |
| | | ENG-2.A.5 The tilt of Earth's axis of rotation causes the Earth's seasons and the number of hours of daylight in a particular location on the Earth's surface. | Not found |
| 4.8 Earth's Geography and Climate | ENG-2.B Describe how the Earth's geography affects weather and climate. | ENG-2.B.1 Weather and climate are affected not only by the sun's energy but by geologic and geographic factors, such as mountains and ocean temperature. | Ch. 18 Global Climate Change (pg. 487) |

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| | | ENG-2.B.2 A rain shadow is a region of land that has become drier because a higher elevation area blocks precipitation from reaching the land. | Ch. 4 Species Interactions and Community Ecology (pg. 96) |
| 4.9 El Nino and La Nina | ENG-2.C Describe the environmental changes and effects that result from El Niño or La Niña events (El Niño–Southern Oscillation). | ENG-2.C.1 El Niño and La Niña are phenomena associated with changing ocean surface temperatures in the Pacific Ocean. These phenomena can cause global changes to rainfall, wind, and ocean circulation patterns. | Ch. 16 Maine and Coastal Resources (pg. 427) |
| | | ENG-2.C.2 El Niño and La Niña are influenced by geological and geographic factors and can affect different locations in different ways. | Ch. 16 Maine and Coastal Resources (pg. 427) |
| **Unit 5: Land and Water Use** | | | |
| 5.1 The Tragedy of the Commons | EIN-2.A Explain the concept of the tragedy of the commons. | EIN-2.A.1 The tragedy of the commons suggests that individuals will use shared resources in their own self-interest rather than in keeping with the common good, thereby depleting the resources | Ch. 7 Environmental Policy: Making Decisions and Solving Problems (pg. 164) |
| 5.2 Clearcutting | EIN-2.B Describe the effect of clearcutting on forests. | EIN-2.B.1 Clearcutting can be economically advantageous but leads to soil erosion, increased soil and stream temperatures, and flooding. | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 320) |

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| | | EIN-2.B.2 Forests contain trees that absorb pollutants and store carbon dioxide. The cutting and burning of trees releases carbon dioxide and contributes to climate change. | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 322) |
| 5.3 The Green Revolution | EIN-2.C Describe changes in agricultural practices. | EIN-2.C.1 The Green Revolution started a shift to new agricultural strategies and practices in order to increase food production, with both positive and negative results. Some of these strategies and methods are mechanization, genetically modified organisms (GMOs), fertilization, irrigation, and the use of pesticides | Ch. 10 Making Agriculture Sustainable (pg. 245) |
| | | EIN-2.C.2 Mechanization of farming can increase profits and efficiency for farms. It can also increase reliance on fossil fuels. | Ch. 10 Making Agriculture Sustainable (pg. 245) |
| 5.4 Impacts of Agricultural Practices | EIN-2.D Describe agricultural practices that cause environmental damage. | LOR-2.D.1 Agricultural practices that can cause environmental damage include tilling, slash and-burn farming, and the use of fertilizers. | Ch. 10 Making Agriculture Sustainable (pg. 246) |
| 5.5 Irrigation Methods | EIN-2.E Describe different methods of irrigation. | EIN-2.E.1 The largest human use of freshwater is for irrigation (70%). | Ch. 9 The Underpinnings of Agriculture (pg. 219) |
| | | EIN-2.E.2 Types of irrigation include drip irrigation, flood irrigation, furrow irrigation, drip irrigation, and spray irrigation. | Ch. 9 The Underpinnings of Agriculture (pg. 220) |

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| | EIN-2.F Describe the benefits and drawbacks of different methods of irrigation. | EIN-2.F.1 Waterlogging occurs when too much water is left to sit in the soil, which raises the water table of groundwater and inhibits plants'ability to absorb oxygen through their roots. | Ch. 9 The Underpinnings of Agriculture (pg. 220) |
| | | EIN-2.F.2 Furrow irrigation involves cutting furrows between crop rows and filling them with water. This system is inexpensive, but about 1/3 of the water is lost to evaporation and runoff. | Ch. 9 The Underpinnings of Agriculture (pg. 220) |
| | | EIN-2.F.3 Flood irrigation involves flooding an agricultural field with water. This system sees about 20% of the water lost to evaporation and runoff. This can also lead to waterlogging of the soil. | Ch. 9 The Underpinnings of Agriculture (pg. 220) |
| | | EIN-2.F.4 Spray irrigation involves pumping ground water into spray nozzles across an agricultural field. This system is more efficient than flood and furrow irrigation, with only 1/4 or less of the water lost to evaporation or runoff. However, spray systems are more expensive than flood and furrow irrigation, and also requires energy to run. | Ch. 9 The Underpinnings of Agriculture (pg. 221) |

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| | | EIN-2.F.5 Drip irrigation uses perforated hoses to release small amounts of water to plant roots. This system is the most efficient, with only about 5% of water lost to evaporation and runoff. However, this system is expensive and so is not often used. | Ch. 9 The Underpinnings of Agriculture (pg. 221) |
| | | EIN-2.F.6 Salinization occurs when the salts in groundwater remain in the soil after the water evaporates. Over time, salinization can make soil toxic to plants | Ch. 9 The Underpinnings of Agriculture (pg. 220) |
| | | EIN-2.F.7 Aquifers can be severely depleted if overused for agricultural irrigation, as has happened to the Ogallala Aquifer in the central United States. | Ch. 9 The Underpinnings of Agriculture (pg. 220) |
| 5.7 Pest Control Methods | EIN-2.G Describe the benefits and drawbacks of different methods of pest control. | EIN-2.G.1 One consequence of using common pest-control methods such as pesticides, herbicides, fungicides, rodenticides, and insecticides is that organisms can become resistant to them through artificial selection. Pest control decreases crop damage by pest and increases crop yields. | Ch. 10 Making Agriculture Sustainable (pg. 251) |

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| | | EIN-2.G.2 Crops can be genetically engineered to increase their resistance to pests and diseases. However, using genetically engineered crops in planting or other ways can lead to loss of genetic diversity of that particular crop. | Ch. 10 Making Agriculture Sustainable (pg. 255) |
| 5.7 Meat Production Methods | EIN-2.H Identify different methods of meat production. | EIN-2.H.1 Methods of meat production include concentrated animal feeding operations (CAFOs), also called feedlots, and free-range grazing. | Ch. 10 Making Agriculture Sustainable (pg. 247) |
| | EIN-2.I Describe the benefits and drawbacks of different methods of meat production. | EIN-2.I.1 Meat production is less efficient than agriculture; it takes approximately 20 times more land to produce the same amount of calories from meat as from plants. | Ch. 10 Making Agriculture Sustainable (pg. 248) |
| | | EIN-2.1.2 Concentrated animal feeding operation (CAFOs) are used as a way to quickly get livestock ready for slaughter. They tend to be crowded, and animals are fed grains or feed that are not as suitable as grass. Additionally, feedlots generate a large amount of organic waste, which can contaminate ground and surface water. The use of feedlots are less expensive than other methods, which can keep costs to consumers down. | Ch. 10 Making Agriculture Sustainable (pg. 248) |
| | | EIN-2.1.3 Free range grazing allows animals to graze on grass | Ch. 10 Making Agriculture Sustainable (pg. 250) |

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| | | during their entire lifecycle. Meat from free range animals tends to be free from antibiotics and other chemicals used in feedlots. Organic waste from these animals acts as fertilizer. Free range grazing requires large areas of land and the meat produced is more expensive for consumers. | |
| | | EIN-2.I.4 Overgrazing occurs when too many animals feed on a particular area of land. Overgrazing causes loss of vegetation, which leads to soil erosion. | Ch. 9 The Understanding of Agriculture (pg. 234) |
| | | EIN-2.I.5 Overgrazing can cause desertification. Desertification is the degradation of low precipitation regions toward being increasingly arid until they become deserts. | Ch. 9 The Understanding of Agriculture (pg. 234) |
| | | EIN-2.I.6 Less consumption of meat could reduce CO2, methane, and N2O emissions; conserve water; reduce the use of antibiotics and growth hormones; and improve topsoil. | Ch. 10 Making Agriculture Sustainable (pg. 249) |

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| 5.8 Impacts of Overfishing | EIN-2.J Describe causes of and problems related to overfishing. | EIN-2.J.1 Overfishing has led to the extreme scarcity of some fish species, which can lessen biodiversity in aquatic systems and harm people who depend on fishing for food and commerce. | Ch. 9 The Understanding of Agriculture (pg. 219) |
| 5.9 Impacts of Mining | EIN-2.K Describe natural resource extraction through mining. | EIN-2.K.1 As the more accessible ores are mined to depletion, mining operations are forced to access lower grade ores. Accessing these ores requires increased use of resources that can cause increased waste and pollution. | Ch. 23 Minerals and Mining (pg. 649) |
| | | EIN-2.K.2 Surface mining is the removal of large portions of soil and rock, called overburden, in order to access the ore underneath. An example is strip mining, which removes the vegetation from an area, making the area more susceptible to erosion. | Ch. 23 Minerals and Mining (pg. 649) |

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| | EIN-2.L Describe ecological and economic impacts of natural resource extraction through mining. | EIN-2.L.1 Mining wastes include the soil and rocks that are moved to gain access to the ore and the waste, called slag and tailings that remain when the minerals have been removed from the ore. Mining helps to provide low cost energy and material necessary to make products. The mining of coal can destroy habitats, contaminate ground water, and release dust particles and methane. | Ch. 23 Minerals and Mining (pg. 649) |
| | | EIN-2.L.2 As coal reserves get smaller, due to a lack of easily accessible reserves, it becomes necessary to access coal through subsurface mining, which is very expensive. | Ch. 23 Minerals and Mining (pg. 650) |
| 5.10 Impacts of Urbanization | EIN-2.M Describe the effects of urbanization on the environment. | EIN-2.M.1 Urbanization can lead to depletion of resources and saltwater intrusion in the hydrologic cycle. | Ch. 13 The Urban Environment: Creating sustainable Cities (pg. 338) |
| | | EIN-2.M.2 Urbanization, through the burning of fossil fuels and landfills, affects the carbon cycle by increasing the amount of carbon dioxide in the atmosphere. | Ch. 18 Global Climate Change (pg. 488) |
| | | EIN-2.M.3 Impervious surfaces are human-made structures—such as roads, buildings, sidewalks, and parking lots—that do not allow water to reach the soil, leading to flooding. | Ch. 13 The Urban Environment: Creating sustainable Cities (pg. 353) |
| | | EIN-2.M.4 Urban sprawl is the change in population | Ch. 13 The Urban Environment: Creating sustainable |

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| | | distribution from high population density areas to low density suburbs that spread into rural lands, leading to potential environmental problems. | Cities (pg. 341) |
| 5.11 Ecological Footprints | EIN-2.N Explain the variables measured in an ecological footprint. | EIN-2.N.1 Ecological footprints compare resource demands and waste production required for an individual or a society. | Ch. 1 Science and Sustainability: An introduction to Environmental Science (pg. 5) |
| 5.12 Intro to Sustainability | STB-1.A Explain the concept of sustainability. | STB-1.A.1 Sustainability refers to humans living on Earth and their use of resources without depletion of the resources for future generations. Environmental indicators that can guide humans to sustainability include biological diversity, food production, average global surface temperatures and CO2 concentrations, human population, and resource depletion. | Ch. 1 Science and Sustainability: An introduction to Environmental Science (pg. 16) |
| | | STB-1.A.2 Sustainable yield is the amount of a renewable resource that can be taken without reducing the available supply | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 318) |

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| 5.13 Methods to Reduce Urban Runoff | STB-1.B Describe methods for mitigating problems related to urban runoff. | STB-1.B.1 Methods to increase water infiltration include replacing traditional pavement with permeable pavement, planting trees, increased use of public transportation, and building up, not out. | Ch. 13 The Urban Environment: Creating sustainable Cities (pg. 342) |
| 5.14 Integrated Pest Management | STB-1.C Describe integrated pest management. | STB-1.C.1 Integrated pest management (IPM) is a combination of methods used to effectively control pest species while minimizing the disruption to the environment. These methods include biological, physical, and limited chemical methods such as biocontrol, intercropping, crop rotation, and natural predators of the pests. | Ch. 10 Making Agriculture Sustainable (pg. 254) |
| | STB-1.D Describe the benefits and drawbacks of integrated pest management (IPM). | STB-1.D.1 The use of integrated pest management (IPM) reduces the risk that pesticides pose to wildlife, water supplies, and human health. | Ch. 10 Making Agriculture Sustainable (pg. 254) |
| | | STB-1.D.2 Integrated pest management (IPM) minimizes disruptions to the environment and threats to human health but can be complex and expensive. | Ch. 10 Making Agriculture Sustainable (pg. 254) |

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| 5.15 Sustainable Agriculture | STB-1.E Describe sustainable agricultural and food production practices. | STB-1.E.1 The goal of soil conservation is to prevent soil erosion. Different methods of soil conservation include contour plowing, windbreaks, perennial crops, terracing, no-till agriculture, and strip cropping. | Ch. 9 The Understanding of Agriculture (pg. 215) |
| | | STB-1.E.2 Strategies to improve soil fertility include crop rotation and the addition of green manure and limestone. | Ch. 9 The Understanding of Agriculture (pg. 215) |
| | | STB-1.E.3 Rotational grazing is the regular rotation of livestock between different pastures in order to avoid overgrazing in a particular area. | Ch. 9 The Understanding of Agriculture (pg. 234) |
| 5.16 Aquaculture | STB-1.F Describe the benefits and drawbacks of aquaculture. | STB-1.F.1 Aquaculture has expanded because it is highly efficient, requires only small areas of water, and requires little fuel. | Ch. 10 Making Agriculture Sustainable (pg. 250) |
| | | STB-1.F.2 Aquaculture can contaminate wastewater, and fish that escape may compete or breed with wild fish. The density of fish in aquaculture can lead to increases in disease incidences, which can be transmitted to wild fish. | Ch. 10 Making Agriculture Sustainable (pg. 250) |

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| 5.17 Sustainable Forestry | STB-1.G Describe methods for mitigating human impact on forests. | STB-1.G.1 Some of the methods for mitigating deforestation include reforestation, using and buying wood harvested by ecologically sustainable forestry techniques, and reusing wood. | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 324) |
| | | STB-1.G.2 Methods to protect forests from pathogens and insects include integrated pest management (IPM) and the removal of affected trees. | Ch. 10 Making Agriculture Sustainable (pg. 254) |
| | | STB-1.G.3 Prescribed burn is a method by which forests are set on fire under controlled conditions in order to reduce the occurrence of natural fires. | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 324) |
| **Unit 6: Energy Resources and Consumption** | | | |
| 6.1 Renewable and Nonrenewable Resources | ENG-3.A Identify differences between nonrenewable and renewable energy sources. | ENG-3.A.1 Nonrenewable energy sources are those that exist in a fixed amount and involve energy transformation that cannot be easily replaced. | Ch. 21 New Renewable Energy Sources (pg. 591) |
| | | ENG-3.A.2 Renewable energy sources are those that can be replenished naturally, at or near the rate of consumption, and reused. | Ch. 21 New Renewable Energy Sources (pg. 591) |
| 6.2 Global Energy Consumption | ENG-3.B Describe trends in energy consumption. | ENG-3.B.1 The use of energy resources is not evenly distributed between developed and developing countries. | Ch. 20 Conventional Energy Alternatives (pg. 564) |

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| | | ENG-3.B.2 The most widely used sources of energy globally are fossil fuels. | Ch. 20 Conventional Energy Alternatives (pg. 563) |
| | | ENG-3.B.3 As developing countries become more developed, their reliance on fossil fuels for energy increases. | Ch. 478 The Atmosphere, Air Quality, and Air Pollution Control (pg. 478 |
| | | ENG-3.B.4 As the world becomes more industrialized, the demand for energy increases. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 527) |
| | | ENG-3.B.5 Availability, price, and governmental regulations influence which energy sources people use and how they use them. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 528) |
| 6.3 Fuel Types and Uses | ENG-3.C Identify types of fuels and their uses. | ENG-3.C.1 Wood is commonly used as fuel in the forms of firewood and charcoal. It is often used in developing countries because it is easily accessible. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 525) |
| | | ENG-3.C.2 Peat is partially decomposed organic material that can be burned for fuel. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 530) |
| | | ENG-3.C.3 Three types of coal used for fuel are lignite, bituminous, and anthracite. Heat, pressure, and depth of burial contribute to the development of various coal types and their qualities. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 529) |
| | | ENG-3.C.4 Natural gas, the cleanest of the fossil fuels, is mostly methane. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 535) |

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| | | ENG-3.C.5 Crude oil can be recovered from tar sands, which are a combination of clay, sand, water, and bitumen. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 523) |
| | | ENG-3.C.6 Fossil fuels can be made into specific fuel types for specialized uses (e.g., in motor vehicles). | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 526) |
| | | ENG-3.C.7 Cogeneration occurs when a fuel source is used to generate both useful heat and electricity | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 526) |
| 6.4 Distribution of Natural Resources | ENG-3.D Identify where natural energy resources occur. | ENG-3.D.1 The global distribution of natural energy resources, such as ores, coal, crude oil, and gas, is not uniform and depends on regions' geologic history. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 526) |
| 6.5 Fossil Fuels | ENG-3.E Describe the use and methods of fossil fuels in power generation. | ENG-3.E.1 The combustion of fossil fuels is a chemical reaction between the fuel and oxygen that yields carbon dioxide and water and releases energy. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 529) |
| | | ENG-3.E.2 Energy from fossil fuels is produced by burning those fuels to generate heat, which then turns water into steam. That steam turns a turbine, which generates electricity. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 535) |
| | | ENG-3.E.3 Humans use a variety of methods to extract fossil fuels from the earth for energy generation. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 538) |

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| | ENG-3.F Describe the effects of fossil fuels on the environment. | ENG-3.F.1 Hydrologic fracturing (fracking) can cause groundwater contamination and the release of volatile organic compounds. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 539) |
| 6.6 Nuclear Power | ENG-3.G Describe the use of nuclear energy in power generation. | ENG-3.G.1 Nuclear power is generated through fission, where atoms of Uranium-235, which are stored in fuel rods, are split into smaller parts after being struck by a neutron. Nuclear fission releases a large amount of heat, which is used to generate steam, which powers a turbine and generates electricity. | Ch. 20 Conventional Energy Alternatives (pg. 564) |
| | | ENG-3.G.2 Radioactivity occurs when the nucleus of a radioactive isotope loses energy by emitting radiation. | Ch. 20 Conventional Energy Alternatives (pg. 567) |
| | | ENG-3.G.3 Uranium-235 remains radioactive for a long time, which leads to the problems associated with the disposal of nuclear waste. | Ch. 20 Conventional Energy Alternatives (pg. 572) |

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| | | ENG-3.G.4 Nuclear power generation is a nonrenewable energy source. Nuclear power is considered a cleaner energy source because it does not produce air pollutants, but it does release thermal pollution and hazardous solid waste. | Ch. 20 Conventional Energy Alternatives (pg. 566) |
| | ENG-3.H Describe the effects of the use of nuclear energy on the environment | ENG-3.H.1 Three Mile Island, Chernobyl, and Fukushima are three cases where accidents or natural disasters led to the release of radiation. These releases have had short- and long-term impacts on the environment | Ch. 20 Conventional Energy Alternatives (pg. 567) |
| | | ENG-3.H.2 A radioactive element's half-life can be used to calculate a variety of things, including the rate of decay and the radioactivity level at specific points in time. | Ch. 20 Conventional Energy Alternatives (pg. 565) |
| 6.7 Energy from Biomass | ENG-3.I Describe the effects of the use of biomass in power generation on the environment. | ENG-3.I.1 Burning of biomass produces heat for energy at a relatively low cost, but it also produces carbon dioxide, carbon monoxide, nitrogen oxides, particulates, and volatile organic compounds. The overharvesting of trees for fuel also causes deforestation | Ch. 21 New Renewable Energy Sources (pg. 575) |

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| | | ENG-3.I.2 Ethanol can be used as a substitute for gasoline. Burning ethanol does not introduce additional carbon into the atmosphere via combustion, but the energy return on energy investment for ethanol is low. | Ch. 20 Conventional Energy Alternatives (pg. 575) |
| 6.8 Solar Energy | ENG-3.J Describe the use of solar energy in power generation. | ENG-3.J.1 Photovoltaic solar cells capture light energy from the sun and transform it directly into electrical energy. Their use is limited by the availability of sunlight | Ch. 21 New Renewable Energy Sources (pg. 597) |
| | | ENG-3.J.2 Active solar energy systems use solar energy to heat a liquid through mechanical and electric equipment to collect and store the energy captured from the sun. | Ch. 21 New Renewable Energy Sources (pg. 597) |
| | | ENG-3.J.3 Passive solar energy systems absorb heat directly from the sun without the use of mechanical and electric equipment, and energy cannot be collected or stored. | Ch. 21 New Renewable Energy Sources (pg. 597) |
| | ENG-3.K Describe the effects of the use of solar energy in power generation on the environment. | ENG-3.K.1 Solar energy systems have low environmental impact and produce clean energy, but they can be expensive. Large solar energy farms may negatively impact desert ecosystems. | Ch. 21 New Renewable Energy Sources (pg. 597) |

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| 6.9 Hydroelectric Power | ENG-3.L Describe the use of hydroelectricity in power generation. | ENG-3.L.1 Hydroelectric power can be generated in several ways. Dams built across rivers collect water in reservoirs. The moving water can be used to spin a turbine. Turbines can also be placed in small rivers, where the flowing water spins the turbine. | Ch. 20 Conventional Energy Alternatives (pg. 582) |
| | | ENG-3.L.2 Tidal energy uses the energy produced by tidal flows to turn a turbine. | Ch. 21 New Renewable Energy Sources (pg. 611) |
| | ENG-3.M Describe the effects of the use of hydroelectricity in power generation on the environment. | ENG-3.M.1 Hydroelectric power does not generate air pollution or waste, but construction of the power plants can be expensive, and there may be a loss of or change in habitats following the construction of dams. | Ch. 20 Conventional Energy Alternatives (pg. 582) |
| 6.10 Geothermal Energy | ENG-3.N Describe the use of geothermal energy in power generation. | ENG-3.N.1 Geothermal energy is obtained by using the heat stored in the Earth's interior to heat up water, which is brought back to the surface as steam. The steam is used to drive an electric generator. | Ch. 21 New Renewable Energy Sources (pg. 608) |

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| | ENG-3.O Describe the effects of the use of geothermal energy in power generation on the environment. | ENG-3.O.1 The cost of accessing geothermal energy can be prohibitively expensive, as is not easily accessible in many parts of the world. In addition, it can cause the release of hydrogen sulfide. | Ch. 21 New Renewable Energy Sources (pg. 608) |
| 6.11 Hydrogen Fuel Cell | ENG-3.P Describe the use of hydrogen fuel cells in power generation. | ENG-3.P.1 Hydrogen fuel cells are an alternate to nonrenewable fuel sources. They use hydrogen as fuel, combining the hydrogen and oxygen in the air to form water and release energy (electricity) in the process. Water is the product (emission) of a fuel cell. | Ch. 21 New Renewable Energy Sources (pg. 613) |
| | ENG-3.Q Describe the effects of the use of hydrogen fuel cells in power generation on the environment. | ENG-3.Q.1 Hydrogen fuel cells have low environmental impact and produce no carbon dioxide when the hydrogen is produced from water. However, the technology is expensive and energy is still needed to create the hydrogen gas used in the fuel cell. | Ch. 21 New Renewable Energy Sources (pg. 613) |
| 6.12 Wind Energy | ENG-3.R Describe the use of wind energy in power generation. | ENG-3.R.1 Wind turbines use the kinetic energy of moving air to spin a turbine, which in turn converts the mechanical energy of the turbine into electricity. | Ch. 21 New Renewable Energy Sources (pg. 602) |

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| | ENG-3.S Describe the effects of the use of wind energy in power generation on the environment. | ENG-3.S.1 Wind energy is a renewable, clean source of energy. However, birds and bats may be killed if they fly into the spinning turbine blades. | Ch. 21 New Renewable Energy Sources (pg. 602) |
| 6.13 Energy Conservation | ENG-3.T Describe methods for conserving energy. | ENG-3.T.1 Some of the methods for conserving energy around a home include adjusting the thermostat to reduce the use of heat and air conditioning, conserving water, use of energy-efficient appliances, and conservation landscaping. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 552) |
| | | ENG-3.T.2 Methods for conserving energy on a large scale include improving fuel economy for vehicles, using BEVs (battery electric vehicles) and hybrid vehicles, using public transportation, and implementing green building design features. | Ch. 19 Fossil Fuels and Energy Efficiency (pg. 552) |
| **Unit 7: Atmospheric Pollution** | | | |
| 7.1 Introduction to Air Pollution | STB-2.A Identify the sources and effects of air pollutants. | STB-2.A.1 Coal combustion releases air pollutants including carbon dioxide, sulfur dioxide, toxic metals, and particulates. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 456) |

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| | | STB-2.A.2 The combustion of fossil fuels releases nitrogen oxides into the atmosphere. They lead to the production of ozone, formation of photochemical smog, and convert to nitric acid in the atmosphere, causing acid rain. Other pollutants produced by fossil fuel combustion include carbon monoxide, hydrocarbons, and particulate matter | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 475) |
| | | STB-2.A.3 Air quality can be affected through the release of sulfur dioxide during the burning of fossil fuels, mainly diesel fuels. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 475) |
| | | STB-2.A.4 Through the Clean Air Act, the Environmental Protection Agency (EPA) regulated the use of lead, particularly in fuels, which dramatically decreased the amount of lead in the atmosphere. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 458) |
| | | STB-2.A.5 Air pollutants can be primary or secondary pollutants. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 458) |
| 7.2 Photochemical Smog | STB-2.B Explain the causes and effects of photochemical smog and methods to reduce it. | STB-2.B.1 Photochemical smog is formed when nitrogen oxides and volatile organic hydrocarbons react with heat and sunlight to produce a variety of pollutants. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 467) |

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| | | STB-2.B.2 Many environmental factors affect the formation of photochemical smog. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 468) |
| | | STB-2.B.3 Nitrogen oxide is produced early in the day. Ozone concentrations peak in the afternoon and are higher in the summer because ozone is produced by chemical reactions between oxygen and sunlight. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 468) |
| | | STB-2.B.4 Volatile Organic Compounds (VOCs), such as formaldehyde and gasoline, evaporate or sublimate at room temperature. Trees are a natural source of VOCs. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 459) |
| | | STB-2.B.5 Photochemical smog often forms in urban areas because of the large number of motor vehicles there. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 468) |
| | | STB-2.B.6 Photochemical smog can be reduced through the reduction of nitrogen oxide and VOCs. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 468) |
| | | STB-2.B.7 Photochemical smog can harm human health in several ways, including causing respiratory problems and eye irritation. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 468) |

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| 7.3 Thermal Inversion | STB-2.C Describe thermal inversion and its relationship with pollution. | STB-2.C.1 During a thermal inversion, the normal temperature gradient in the atmosphere is altered as the air temperature at the Earth's surface is cooler than the air at higher altitudes. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 454) |
| | | STB-2.C.2 Thermal inversion traps pollution close to the ground, especially smog and particulates. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 455) |
| 7.4 Atmospheric CO2 and Particulates | STB-2.D Describe natural sources of CO2 and particulates. | STB-2.D.1 CO2 appears naturally in the atmosphere from sources such as respiration, decomposition, and volcanic eruptions. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 457) |
| | | STB-2.D.2 There are a variety of natural sources of particulate matter. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 457) |
| 7.5 Indoor Air Pollutants | STB-2.E Identify indoor air pollutants. | STB-2.E.1 Carbon monoxide is an indoor air pollutant that is classified as an asphyxiant. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 477) |
| | | STB-2.E.2 Indoor air pollutants that are classified as particulates include asbestos, dust, and smoke. | Ch. 14 Environmental Health and Toxicology )pg. 366) |
| | | STB-2.E.3 Indoor air pollutants can come from natural sources, human-made sources, and combustion. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 478) |
| | | STB-2.E.4 Common natural source indoor air pollutants include radon, mold, and dust. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 478) |

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| | | STB-2.E.5 Common human-made indoor air pollutants include insulation, Volatile Organic Compounds (VOCs) from furniture, paneling and carpets; formaldehyde from building materials, furniture, upholstery, and carpeting; and lead from paints. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 479) |
| | | STB-2.E.6 Common combustion air pollutants include carbon monoxide, nitrogen oxides, sulfur dioxide, particulates, and tobacco smoke. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 480) |
| | | STB-2.E.7 Radon-222 is a naturally occurring radioactive gas that is produced by the decay of uranium found in some rocks and soils. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 479) |
| | STB-2.F Describe the effects of indoor air pollutants. | STB-2.F.1 Radon gas can infiltrate homes as it moves up through the soil and enters homes via the basement or cracks in the walls or foundation. It is also dissolved in groundwater that enters homes through a well. | Ch. 14 Environmental Health and Toxicology (pg. 366) |
| | | STB-2.F.2 Exposure to radon gas can lead to radoninduced lung cancer, which is the second leading cause of lung cancer in America. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 480) |
| 7.6 Reduction of Air Pollutants | STB-2.G Explain how air pollutants can be reduced at the source. | STB-2.G.1 Methods to reduce air pollutants include regulatory practices, conservation practices, and alternative fuels | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 456) |
| | | STB-2.G.2 A vapor recovery nozzle is an | Not Found |

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| | | air pollution control device on a gasoline pump that prevents fumes from escaping into the atmosphere when fueling a motor vehicle. | |
| | | STB-2.G.3 A catalytic converter is an air pollution control device for internal combustion engines that converts pollutants (CO, NOx, and hydrocarbons) in exhaust into less harmful molecules ($CO_2$, $N_2$, $O_2$, and $H_2O$). | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 475) |
| | | STB-2.G.4 Wet and dry scrubbers are air pollution control devices that remove particulates and/or gases from industrial exhaust streams. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 475) |
| | | STB-2.G.5 Methods to reduce air pollution from coalburning power plants include scrubbers and electrostatic precipitators. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 475) |
| 7.7 Acid Rain | STB-2.H Describe acid deposition. | STB-2.H.1 Acid rain and deposition is due to nitrogen oxides and sulfur oxides from anthropogenic and natural sources in the atmosphere. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 475) |
| | | STB-2.H.2 Nitric oxides that cause acid deposition come from motor vehicles and coal-burning power plants. Sulfur dioxides that cause acid deposition come from coal-burning power plants. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 475) |

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| | STB-2.I Describe the effects of acid deposition on the environment. | STB-2.I.1 Acid deposition mainly affects communities that are downwind from coal-burning power plants. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 475) |
| | | STB-2.I.2 Acid rain and deposition can lead to the acidification of soils and bodies of water and corrosion of human-made structures | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 476) |
| | | STB-2.I.3 Regional differences in soils and bedrock affect the impact that acid deposition has on the region—such as limestone bedrock's ability to neutralize the effect of acid rain on lakes and ponds. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 476) |
| 7.8 Noise Pollution | STB-2.J Describe human activities that result in noise pollution and its effects. | STB-2.J.1 Noise pollution is sound at levels high enough to cause physiological stress and hearing loss. | Ch. 16. Marine and Coastal Systems and Resources (pg. 437) |
| | | STB-2.J.2 Sources of noise pollution in urban areas include transportation, construction, and domestic and industrial activity. | Ch. 13 The Urban Environment: Creating sustainable Cities (pg. 352) |
| | | STB-2.J.3 Some effects of noise pollution on animals in ecological systems include stress, the masking of sounds used to communicate or hunt, damaged hearing, and causing changes to migratory routes. | Ch. 13 The Urban Environment: Creating sustainable Cities (pg. 353) |

| Unit 8: Aquatic and Terrestrial Pollution | | | |
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| 8.1 Sources of Pollution | STB-3.A Identify differences between point and nonpoint sources of pollution. | STB-3.A.1 A point source refers to a single, identifiable source of a pollutant, such as a smokestack or waste discharge pipe. | Ch. 13 The Urban Environment: Creating sustainable Cities (pg. 342) |
| | | STB-3.A.2 Nonpoint sources of pollution are diffused and can therefore be difficult to identify, such as pesticide spraying or urban runoff. | Ch. 15 Freshwater Systems and Resources (pg. 408) |
| 8.2 Human Impacts on Ecosystems | STB-3.B Describe the impacts of human activities on aquatic ecosystems. | STB-3.B.1 Organisms have a range of tolerance for various pollutants. Organisms have an optimum range for each factor where they can maintain homeostasis. Outside of this range, organisms may experience physiological stress, limited growth, reduced reproduction, and in extreme cases, death. | Ch. 19 Fossil Fuel and Energy Efficiency (pg. 541) |
| | | STB-3.B.2 Coral reefs have been suffering damage due to a variety of factors, including increasing ocean temperature, sediment runoff, and destructive fishing practices. | Ch. 16 Marine and Coastal Systems and Resources (pg. 431) |

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| | | STB-3.B.3 Oil spills in marine waters cause organisms to die from the hydrocarbons in oil. Oil that floats on the surface of water can coat the feathers of birds and fur of marine mammals. Some components of oil sink to the ocean floor, killing some bottom-dwelling organisms. | Ch. 16 Marine and Coastal Systems and Resources (pg. 435) |
| | | STB-3.B.4 Oil that washes up on the beach can have economic consequences on the fishing and tourism industries. | Ch. 16 Marine and Coastal Systems and Resources (pg. 435) |
| | | STB-3.B.5 Oceanic dead zones are areas of low oxygen in the world's oceans caused by increased nutrient pollution. | Ch. 16 Marine and Coastal Systems and Resources (pg. 436) |
| | | STB-3.B.6 An oxygen sag curve is a plot of dissolved oxygen levels versus the distance from a source of pollution, usually excess nutrients and biological refuse. | Not found |
| | | STB-3.B.7 Heavy metals used for industry, especially mining and burning of fossil fuels, can reach the groundwater, impacting the drinking water supply | Ch. 15 Freshwater Systems and Resources (pg. 414) |

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| | | STB-3.B.8 Litter that reaches aquatic ecosystems, besides being unsightly, can create intestinal blockage and choking hazards for wildlife and introduce toxic substances to the food chain. | Ch. 15 Freshwater Systems and Resources (pg. 411) |
| | | STB-3.B.9 Increased sediment in waterways can reduce light infiltration, which can affect primary producers and visual predators. Sediment can also settle, disrupting habitats. | Ch. 15 Freshwater Systems and Resources (pg. 410) |
| | | STB-3.B.10 When elemental sources of mercury enter aquatic environments, bacteria in the water convert it to highly toxic methylmercury | Ch. 14 Environmental Health and Toxicity (pg. 373) |
| 8.3 Endocrine Disruptors | STB-3.C Describe endocrine disruptors. | STB-3.C.1 Endocrine disruptors are chemicals that can interfere with the endocrine system of animals. | Ch. 14 Environmental Health and Toxicity (pg. 371) |
| | STB-3.D Describe the effects of endocrine disruptors on ecosystems. | STB-3.D.1 Endocrine disruptors can lead to birth defects, developmental disorders, and gender imbalances in fish and other species. | Ch. 14 Environmental Health and Toxicity (pg. 371) |
| 8.4 Human Impacts on Wetlands and Mangroves | STB-3.E Describe the impacts of human activity on wetlands and mangroves. | STB-3.E.1 Wetlands are areas where water covers the soil, either part or all of the time. | Ch. 16. Marine and Coastal Systems and Resources (pg. 430) |
| | | STB-3.E.2 Wetlands provide a variety of ecological services, including water purification, flood protection, water filtration, and habitat. | Ch. 6 Ethics, Economics, and Sustainable Development (pg. 149) |

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| | | STB-3.E.3 Threats to wetlands and mangroves include commercial development, dam construction, overfishing, and pollutants from agriculture and industrial waste | Ch. 15 Freshwater Systems and Resources (pg. 399) |
| 8.5 Eutrophication | STB-3.F Explain the environmental effects of excessive use of fertilizers and detergents on aquatic ecosystems. | STB-3.F.1 Eutrophication occurs when a body of water is enriched in nutrients. | Ch. 16. Marine and Coastal Systems and Resources (pg. 436) |
| | | STB-3.F.2 The increase in nutrients in eutrophic aquatic environments causes an algal bloom. When the algal bloom dies, microbes digest the algae, along with the oxygen in the water, leading to a decrease in the dissolved oxygen levels in the water. The lack of dissolved oxygen can result in large die-offs of fish and other aquatic organisms. | Ch. 16. Marine and Coastal Systems and Resources (pg. 436) |
| | | STB-3.F.3 Hypoxic waterways are those bodies of water that are low in dissolved oxygen. | Ch. 5 Environmental Systems and Ecosystem Ecology (pg. 106) |
| | | STB-3.F.4 Compared to eutrophic waterways, oligotrophic waterways have very low amounts of nutrients, stable algae populations, and high dissolved oxygen. | Ch. 15 Freshwater Systems and Resources (pg. 398) |
| | | STB-3.F.5 Anthropogenic causes of eutrophication are agricultural runoff and wastewater release. | Ch. 15 Freshwater Systems and Resources (pg. 408) |
| 8.6 Thermal Pollution | STB-3.G Describe the effects of thermal | STB-3.G.1 Thermal pollution occurs when | Ch. 15 Freshwater Systems and |

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| | pollution on aquatic ecosystems. | heat released into the water produces negative effects to the organisms in that ecosystem. | Resources (pg. 411) |
| | | STB-3.G.2 Variations in water temperature affect the concentration of dissolved oxygen because warm water does not contain as much oxygen as cold water. | Ch. 15 Freshwater Systems and Resources (pg. 411) |
| 8.7 Persistent Organic Pollutants (POPS) | STB-3.H Describe the effect of persistent organic pollutants (POPs) on ecosystems. | STB-3.H.1 Persistent organic pollutants (POPs) do not easily break down in the environment because they are synthetic, carbon-based molecules (such as DDT and PCBs). | Ch. 14 Environmental Health and Toxicity (pg. 384) |
| | | STB-3.H.2 Persistent organic pollutants (POPs) can be toxic to organisms because they are soluble in fat, which allows them to accumulate in organisms' fatty tissues. | Ch. 14 Environmental Health and Toxicity (pg. 384) |
| | | STB-3.H.3 Persistent organic pollutants (POPs) can travel over long distances via wind and water before being redeposited. | Ch. 14 Environmental Health and Toxicity (pg. 384) |
| 8.8 Bioaccumulation and Biomagnification | STB-3.I Describe bioaccumulation and biomagnification. | STB-3.I.1 Bioaccumulation is the selective absorption and concentration of elements or compounds by cells in a living organism, most commonly fat-soluble compounds. | Ch. 14 Environmental Health and Toxicity (pg. 373) |

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| | | STB-3.I.2 Biomagnification is the increase in concentration of substances per unit of body tissue that occurs in successively higher trophic levels of a food chain or in a food web. | Ch. 14 Environmental Health and Toxicity (pg. 373) |
| | STB-3.J Describe the effects of bioaccumulation and biomagnification. | STB-3.J.1 Some effects that can occur in an ecosystem when a persistent substance is biomagnified in a food chain include eggshell thinning and developmental deformities in top carnivores of the higher trophic levels | Ch. 14 Environmental Health and Toxicity (pg. 374) |
| | | STB-3.J.2 Humans also experience harmful effects from biomagnification, including issues with the reproductive, nervous, and circulatory systems. | Ch. 14 Environmental Health and Toxicity (pg. 374) |
| | | STB-3.J.3 DDT, mercury, and PCBs are substances that bioaccumulate and have significant environmental impacts. | Ch. 14 Environmental Health and Toxicity (pg. 374) |
| 8.9 Solid Waste Disposal | STB-3.K Describe solid waste disposal methods. | STB-3.K.1 Solid waste is any discarded material that is not a liquid or gas. It is generated in domestic, industrial, business, and agricultural sectors. | Ch. 22 Managing Our Waste (pg. 621) |
| | | STB-3.K.2 Solid waste is most often disposed of in landfills. Landfills can contaminate groundwater and release harmful gases. | Ch. 22 Managing Our Waste (pg. 621) |

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| | | STB-3.K.3 Electronic waste, or e-waste, is composed of discarded electronic devices including televisions, cell phones, and computers. | Ch. 22 Managing Our Waste (pg. 635) |
| | | STB-3.K.4 A sanitary municipal landfill consists of a bottom liner (plastic or clay), a storm water collection system, a leachate collection system, a cap, and a methane collection system. | Ch. 22 Managing Our Waste (pg. 637) |
| | STB-3.L Describe the effects of solid waste disposal methods. | STB-3.L.1 Factors in landfill decomposition include the composition of the trash and conditions needed for microbial decomposition of the waste. | Ch. 22 Managing Our Waste (pg. 624) |
| | | STB-3.L.2 Solid waste can also be disposed of through incineration, where waste is burned at high temperatures. This method significantly reduces the volume of solid waste but releases air pollutants. | Ch. 22 Managing Our Waste (pg. 631) |
| | | STB-3.L.3 Some items are not accepted in sanitary landfills and may be disposed of illegally, leading to environmental problems. One example is used rubber tires, which when left in piles can become breeding grounds for mosquitoes that can spread disease. | Ch. 22 Managing Our Waste (pg. 635) |

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| | | STB-3.L.4 Some countries dispose of their waste by dumping it in the ocean. This practice, along with other sources of plastic, has led to large floating islands of trash in the oceans. Additionally, wildlife can become entangled in the waste, as well as ingest it. | Ch. 16 Marine and Coastal Systems and Resources (pg. 422) |
| 8.10 Waste Reduction Methods | STB-3.M Describe changes to current practices that could reduce the amount of generated waste and their associated benefits and drawbacks. | STB-3.M.1 Recycling is a process by which certain solid waste materials are processed and converted into new products. | Ch. 22 Managing Our Waste (pg. 623) |
| | | STB-3.M.2 Recycling is one way to reduce the current global demand on minerals, but this process is energy-intensive and can be costly | Ch. 22 Managing Our Waste (pg. 624) |
| | | STB-3.M.3 Composting is the process of organic matter such as food scraps, paper, and yard waste decomposing. The product of this decomposition can be used as fertilizer. Drawbacks to composting include odor and rodents. | Ch. 22 Managing Our Waste (pg. 624) |

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| | | STB-3.M.4 E-waste can be reduced by recycling and reuse. E-wastes may contain hazardous chemicals, including heavy metals such as lead and mercury, which can leach from landfills into groundwater if they are not disposed of properly. | Ch. 22 Managing Our Waste (pg. 635) |
| | | STB-3.M.5 Landfill mitigation strategies range from burning waste for energy to restoring habitat on former landfills for use as parks. | Ch. 22 Managing Our Waste (pg. 631) |
| | | STB-3.M.6 The combustion of gases produced from decomposition of organic material in landfills can be used to turn turbines and generate electricity. This process reduces landfill volume. | Ch. 22 Managing Our Waste (pg. 632) |
| 8.11 Sewage Treatment | STB-3.N Describe best practices in sewage treatment. | STB-3.N.1 Primary treatment of sewage is the physical removal of large objects, often through the use of screens and grates, followed by the settling of solid waste in the bottom of a tank. | Ch. 15 Freshwater Systems and Resources (pg. 415) |

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| | | STB-3.N.2 Secondary treatment is a biological process in which bacteria break down organic matter into carbon dioxide and inorganic sludge, which settles in the bottom of a tank. The tank is aerated to increase the rate at which the bacteria break down the organic matter. | Ch. 15 Freshwater Systems and Resources (pg. 415) |
| | | STB-3.N.3 Tertiary treatment is the use of ecological or chemical processes to remove any pollutants left in the water after primary and secondary treatment. | Ch. 15 Freshwater Systems and Resources (pg. 415) |
| | | STB-3.N.4 Prior to discharge, the treated water is exposed to one or more disinfectants (usually, chlorine, ozone, or UV light) to kill bacteria. | Ch. 15 Freshwater Systems and Resources (pg. 415) |
| 8.12 Lethal Dose 50% (LD50) | EIN-3.A Define lethal dose 50% ($LD_{50}$). | EIN-3.A.1 Lethal dose 50% ($LD_{50}$) is the dose of a chemical that is lethal to 50% of the population of a particular species. | Ch. 14 Environmental Health and Toxicity (pg. 376) |
| 8.13 Dose Response Curve | EIN-3.B Evaluate dose response curves. | EIN-3.B.1 A dose response curve describes the effect on an organism or mortality rate in a population based on the dose of a particular toxin or drug. | Ch. 14 Environmental Health and Toxicity (pg. 376) |

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| 8.14 Pollution and Human Health | EIN-3.C Identify sources of human health issues that are linked to pollution. | EIN-3.C.1 It can be difficult to establish a cause and effect between pollutants and human health issues because humans experience exposure to a variety of chemicals and pollutants. | Ch. 14 Environmental Health and Toxicity (pg. 370) |
| | | EIN-3.C.2 Dysentery is caused by untreated sewage in streams and rivers. | Ch. 15 Freshwater Systems and Resources (pg. 410) |
| | | EIN-3.C.3 Mesothelioma is a type of cancer caused mainly by exposure to asbestos. | Ch. 14 Environmental Health and Toxicity (pg. 364) |
| | | EIN-3.C.4 Respiratory problems and overall lung function can be impacted by elevated levels of tropospheric ozone. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 461) |
| 8.15 Pathogens and Infectious Diseases | EIN-3.D Explain human pathogens and their cycling through the environment. | EIN-3.D.1 Pathogens adapt to take advantage of new opportunities to infect and spread through human populations. | Ch. 14 Environmental Health and Toxicity (pg. 364) |
| | | EIN-3.D.2 Specific pathogens can occur in many environments regardless of the appearance of sanitary conditions. | Ch. 14 Environmental Health and Toxicity (pg. 364) |
| | | EIN-3.D.3 As equatorial-type climate zones spread north and south in to what are currently subtropical and temperate climate zones, pathogens, infectious diseases, and any associated vectors are spreading into these areas where the disease has not previously been known to occur. | Ch. 18 Global Climate Change (pg. 506) |
| | | EIN-3.D.4 Poverty-stricken, low-income | Ch. 18 Global Climate Change (pg. 506) |

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| | | areas often lack sanitary waste disposal and have contaminated drinking water supplies, leading to havens and opportunities for the spread of infectious | |
| | | EIN-3.D.5 Plague is a disease carried by organisms infected with the plague bacteria. It is transferred to humans via the bite of an infected organism or through contact with contaminated fluids or tissues. | Ch. 14 Environmental Health and Toxicity (pg. 364) |
| | | EIN-3.D.6 Tuberculosis is a bacterial infection that typically attacks the lungs. It is spread by breathing in the bacteria from the bodily fluids of an infected person. | Ch. 14 Environmental Health and Toxicity (pg. 364) |
| | | EIN-3.D.7 Malaria is a parasitic disease caused by bites from infected mosquitoes. It is most often found in sub-Saharan Africa. | Ch. 14 Environmental Health and Toxicity (pg. 364) |
| | | EIN-3.D.8 West Nile virus is transmitted to humans via bites from infected mosquitoes. | Ch. 14 Environmental Health and Toxicity (pg. 364) |
| | | EIN-3.D.9 Severe acute respiratory syndrome (SARS) is a form of pneumonia. It is transferred by inhaling or touching infected fluids. | Ch. 14 Environmental Health and Toxicity (pg. 364) |

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| | | EIN-3.D.10 Middle East Respiratory Syndrome (MERS) is a viral respiratory illness that is transferred from animals to humans. | Ch. 14 Environmental Health and Toxicity (pg. 364) |
| | | EIN-3.D.11 Zika is a virus caused by bites from infected mosquitoes. It can be transmitted through sexual contact. | Ch. 14 Environmental Health and Toxicity (pg. 369) |
| | | EIN-3.D.12 Cholera is a bacterial disease that is contracted from infected water. | Ch. 15 Freshwater Systems and Resources (pg. 410) |
| **Unit 9: Global Change** | | | |
| 9.1 Stratospheric Ozone Depletion | STB-4.A Explain the importance of stratospheric ozone to life on Earth. | STB-4.A.1 The stratospheric ozone layer is important to the evolution of life on Earth and the continued health and survival of life on Earth. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Controll (pg. 470) |
| | | STB-4.A.2 Stratospheric ozone depletion is caused by anthropogenic factors, such as chlorofluorocarbons (CFCs), and natural factors, such as the melting of ice crystals in the atmosphere at the beginning of the Antarctic spring. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Controll (pg. 471) |
| | | STB-4.A.3 A decrease in stratospheric ozone increases the UV rays that reach the Earth's surface. Exposure to UV rays can lead to skin cancer and cataracts in humans. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Controll (pg. 471) |

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| 9.2 Reducing Ozone Depletion | STB-4.B Describe chemicals used to substitute for chlorofluorocarbons (CFCs). | STB-4.B.1 Ozone depletion can be mitigated by replacing ozone-depleting chemicals with substitutes that do not deplete the ozone layer. Hydrofluorocarbons (HFCs) are one such replacement, but some are strong greenhouse gases. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Controll (pg. 470) |
| 9.3 The Greenhouse Effect | STB-4.C Identify the greenhouse gases. | STB-4.C.1 The principal greenhouse gases are carbon dioxide, methane, water vapor, nitrous oxide, and chlorofluorocarbons (CFCs). | Ch. 18 Global Climate Change (pg. 488) |
| | | STB-4.C.2 While water vapor is a greenhouse gas, it doesn't contribute significantly to global climate change because it has a short residence time in the atmosphere | Ch. 18 Global Climate Change (pg. 488) |
| | | STB-4.C.3 The greenhouse effect results in the surface temperature necessary for life on Earth to exist. | Ch. 18 Global Climate Change (pg. 488) |
| | STB-4.D Identify the sources and potency of the greenhouse gases. | STB-4.D.1 Carbon dioxide, which has a global warming potential (GWP) of 1, is used as a reference point for the comparison of different greenhouse gases and their impacts on global climate change. Chlorofluorocarbons (CFCs) have the highest GWP, followed by nitrous oxide, then methane. | Ch. 18 Global Climate Change (pg. 488) |

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| 9.4 Increases in the Greenhouse Gases | STB-4.E Identify the threats to human health and the environment posed by an increase in greenhouse gases. | STB-4.E.1 Global climate change, caused by excess greenhouse gases in the atmosphere, can lead to a variety of environmental problems including rising sea levels resulting from melting ice sheets and ocean water expansion, and disease vectors spreading from the tropics toward the poles. These problems can lead to changes in population dynamics and population movements in response. | Ch. 18 Global Climate Change (pg. 488) |
| 9.5 Global climate Change | STB-4.F Explain how changes in climate, both short- and longterm, impact ecosystems. | STB-4.F.1 The Earth has undergone climate change throughout geologic time, with major shifts in global temperatures causing periods of warming and cooling as recorded with CO2 data and ice cores. | Ch. 18 Global Climate Change (pg. 486) |
| | | STB-4.F.2 Effects of climate change include rising temperatures, melting permafrost and sea ice, rising sea levels, and displacement of coastal populations. | Ch. 18 Global Climate Change (pg. 487) |

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| | | STB-4.F.3 Marine ecosystems are affected by changes in sea level, some positively, such as in newly created habitats on now-flooded continental shelves, and some negatively, such as deeper communities that may no longer be in the photic zone of seawater. | Ch. 18 Global Climate Change (pg. 505) |
| | | STB-4.F.4 Winds generated by atmospheric circulation help transport heat throughout the Earth. Climate change may change circulation patterns, as temperature changes may impact Hadley cells and the jet stream. | Ch. 17 The Atmosphere, Air Quality, and Air Pollution Control (pg. 455) |
| | | STB-4.F.5 Oceanic currents, or the ocean conveyor belt, carry heat throughout the world. When these currents change, it can have a big impact on global climate, especially in coastal regions. | Ch. 18 Global Climate Change (pg. 490) |
| | | STB-4.F.6 Climate change can affect soil through changes in temperature and rainfall, which can impact soil's viability and potentially increase erosion. | Ch. 18 Global Climate Change (pg. 502) |

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| | | STB-4.F.7 Earth's polar regions are showing faster response times to global climate change because ice and snow in these regions reflect the most energy back out to space, leading to a positive feedback loop. | Ch. 18 Global Climate Change (pg. 500) |
| | | STB-4.F.8 As the Earth warms, this ice and snow melts, meaning less solar energy is radiated back into space and instead is absorbed by the Earth's surface. This in turn causes more warming of the polar regions. | Ch. 18 Global Climate Change (pg. 502) |
| | | STB-4.F.9 Global climate change response time in the Arctic is due to positive feedback loops involving melting sea ice and thawing tundra, and the subsequent release of greenhouse gases like methane. | Ch. 18 Global Climate Change (pg. 502) |
| | | STB-4.F.10 One consequence of the loss of ice and snow in polar regions is the effect on species that depend on the ice for habitat and food. | Not Found |
| 9.6 Ocean Warming | STB-4.G Explain the causes and effects of ocean warming | STB-4.G.1 Ocean warming is caused by the increase in greenhouse gases in the atmosphere. | Ch. 18 Global Climate Change (pg. 490) |

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| | | STB-4.G.2 Ocean warming can affect marine species in a variety of ways, including loss of habitat, and metabolic and reproductive changes. | Ch. 16 Marine and Coastal Systems and Resources (pg. 446) |
| | | STB-4.G.3 Ocean warming is causing coral bleaching, which occurs when the loss of algae within corals cause the corals to bleach white. Some corals recover and some die. | Ch. 16 Marine and Coastal Systems and Resources (pg. 437) |
| 9.7 Ocean Acidification | STB-4.H Explain the causes and effects of ocean acidification. | STB-4.H.1 Ocean acidification is the decrease in pH of the oceans, primarily due to increased CO2 concentrations in the atmosphere, and can be expressed as chemical equations. | Ch. 16 Marine and Coastal Systems and Resources (pg. 437) |
| | | STB-4.H.2 As more CO2 is released into the atmosphere, the oceans, which absorb a large part of that CO2, become more acidic. | Ch. 16 Marine and Coastal Systems and Resources (pg. 437) |
| | | STB-4.H.3 Anthropogenic activities that contribute to ocean acidification are those that lead to increased CO2 concentrations in the atmosphere: burning of fossil fuels, vehicle emissions, and deforestation. | Ch. 16 Marine and Coastal Systems and Resources (pg. 437) |
| | | STB-4.H.4 Ocean acidification damages coral because acidification makes it difficult for them to form shells, due to the loss of calcium carbonate. | Ch. 16 Marine and Coastal Systems and Resources (pg. 437) |

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| 9.8 Invasive Species | EIN-4.A Explain the environmental problems associated with invasive species and strategies to control them. | EIN-4.A.1 Invasive species are species that can live, and sometimes thrive, outside of their normal habitat. Invasive species can sometimes be beneficial, but they are considered invasive when they threaten native species. | Ch. 4 Species Interactions and Community Ecology (pg.88) |
| | | EIN-4.A.2 Invasive species are often generalist, r-selected species and therefore may outcompete native species for resources. | Ch. 4 Species Interactions and Community Ecology (pg.89) |
| | | EIN-4.A.3 Invasive species can be controlled through a variety of human interventions. | Ch. 4 Species Interactions and Community Ecology (pg.89) |
| 9.9 Endangered Species | EIN-4.B Explain how species become endangered and strategies to combat the problem. | EIN-4.B.1 A variety of factors can lead to a species becoming threatened with extinction, such as being extensively hunted, having limited diet, being outcompeted by invasive species, or having specific and limited habitat requirements. | Ch. 11 Biodiversity and Its Conservation (pg. 296) |
| | | EIN-4.B.2 Not all species will be in danger of extinction when exposed to the same changes in their ecosystem. Species that are able to adapt to changes in their environment or that are able to move to a new environment are less likely to face extinction. | Ch. 11 Biodiversity and Its Conservation (pg. 294) |

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| | | EIN-4.B.3 Selective pressures are any factors that change the behaviors and fitness of organisms within an environment. | Ch. 11 Biodiversity and Its Conservation (pg. 296) |
| | | EIN-4.B.4 Species in a given ecosystem compete for resources like territory, food, mates, and habitat, and this competition may lead to endangerment or extinction. | Ch. 4 Species Interactions and Community Ecology (pg.77) |
| | | EIN-4.B.5 Strategies to protect animal populations include criminalizing poaching, protecting animal habitats, and legislation. | Ch. 11 Biodiversity and Its Conservation (pg. 290) |
| 9.10 Human Impacts on Biodiversity | EIN-4.C Explain how human activities affect biodiversity and strategies to combat the problem. | EIN-4.C.1 HIPPCO (habitat destruction, invasive species, population growth, pollution, climate change, and over exploitation) describes the main factors leading to a decrease in biodiversity. | Ch. 11 Biodiversity and Its Conservation (pg. 295) |
| | | EIN-4.C.2 Habitat fragmentation occurs when large habitats are broken into smaller, isolated areas. Causes of habitat fragmentation include the construction of roads and pipelines, clearing for agriculture or development, and logging. | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 329) |

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| | | EIN-4.C.3 The scale of habitat fragmentation that has an adverse effect on the inhabitants of a given ecosystem will vary from species to species within that ecosystem. | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 329) |
| | | EIN-4.C.4 Global climate change can cause habitat loss via changes in temperature, precipitation, and sea level rise. | Ch. 12 Forests, Forest Management, and Protected Areas (pg. 329) |
| | | EIN-4.C.5 Some organisms have been somewhat or completely domesticated and are now managed for economic returns, such as honeybee colonies and domestic livestock. This domestication can have a negative impact on the biodiversity of that organism | Ch. 3 Evolution and Population Ecology (pg. 52) |
| | | EIN-4.C.6 Some ways humans can mitigate the impact of loss of biodiversity include creating protected areas, use of habitat corridors, promoting sustainable land use practices, and restoring lost habitats. | Ch. 11 Biodiversity and Its Conservation (pg. 299) |

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