Unit 4: Matter and Energy in Ecosystems

Theme: Cycles of Matter and Energy Transfer in Ecosystems

Big Idea: The persistence of an ecosystem depends on the availability of energy, resources, and materials in an environment. Energy and matter is cycled through the biogeochemical cycles (i.e., carbon cycle).

Essential Questions for this Unit:

1. How does energy flow through ecosystems?
2. Which biogeochemical cycles are key to life?
3. How do carbon, water, nitrogen, and phosphorus cycle through the biosphere?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
Essential HS.L2U1.21 Obtain, evaluate, and communicate data showing the relationship of photosynthesis and cellular respiration; flow of energy and cycling of matter. **Essential HS.L2U1.19** Develop and use models that show how changes in the transfer of matter and energy within an ecosystem and interactions between species may affect organisms and their environment.	**L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.** ● As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. ● Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. ● Plants or algae form the lowest level of the food web. ● The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil and are combined and recombined in different ways. ● At each link in an ecosystem, matter and energy are conserved; some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. Competition among species is ultimately competition for the matter and energy needed for life.	●I can assess how the extreme fluctuations in conditions or the size of any population can challenge the functioning of ecosystems in terms of resources and habitat availability that can even result in a new ecosystem. ●I can model how energy from photosynthesis and respiration drives the cycling of matter and flow of energy under aerobic or anaerobic conditions within an ecosystem. ● I can model the transfer and conservation of matter and energy within an ecosystem (trophic levels) and interactions between species (competition, symbiotic relationships, predator-prey relationships). ● I can show how all organisms take in matter and rearrange the elements in chemical reactions. ● I can model how photosynthesis captures energy in sunlight to create chemical products that can be used as food in cellular respiration ● I can illustrate how cellular respiration is the process by which the matter in food (sugars, fats) reacts chemically with other compounds, rearranging the matter to release energy used by the cell for essential life processes. ●I can explain how matter and energy transfer through the interactions of biotic and abiotic factors in the system in which they live, including but not limited to photosynthesis and cellular respiration.	**Summative Assessments:** CANVAS Benchmark Tests APEX UNIT Tests Research Report: Explore/WebQuest •Construct and explain the cycling of matter and flow of energy in aerobic and anaerobic conditions, abiotic and biotic conditions, based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) **Formative Assessments:** APEX Lesson Quizzes WS Questions during lectures Labster - WS Questions **Short Performance Assessment:** •Construct an enlarged model illustrating the roles of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere, showing the relationships among variables in systems and their components in the natural and designed world. *https://flexbooks.ck12.org/cbook/ck-12-middle-school-life-science-2.0/section/2.17/primary/lesson/connecting-cellular-respiration-and-photosynthesis-ms-ls*	• **APEX** Lesson Assignments • **CANVAS:** students will complete all prompts with provided figures ws and videos: **-The AMAZING Process of Photosynthesis: video & ws** *https://youtu.be/xEF8shaU_34* **-Carbon in the Carbon Cycle:** *https://youtu.be/E8Y6L5TI_94* **-Leaves and Photosynthesis Introduces how plants use sunlight to produce sugars: video & ws** *https://www.ck12.org/biology/leaves-and-photosynthesis/lesson/Photosynthesis-BIO/* **-A Tree in the Sun: Visualizing Photosynthesis video & ws** *https://vimeo.com/7746357* •**LABSTER: Simulated Lessons** *- Analyze various models: cycling of matter through the biogeochemical cycles* *- Differentiate between primary and secondary succession.* *-Interpret how carbon flows through the geological and biological carbon cycles.* *-Define and diagram the biological and geological carbon cycle.* *- Use quantitative evidence to explain factors that affect population size and carrying capacity within an ecosystem.*	Biotic Abiotic Carbon cycle Nitrogen cycle Phosphorous cycle producers consumers Food chain Herbivore Carnivore omnivore Autotroph Heterotroph Herbivore Carnivore Omnivore Decomposer relationships Food web Food chain Energy Species Organism Population Ecosystem Community Biomes Biosphere

Crosscutting Concepts	Science and Engineering Practices
Energy and Matter: ● The total amount of energy and matter in closed systems is conserved. ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. **Systems and System Models:** ● Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. ● Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models	**Obtaining, Evaluating and Communicating Information:** ● Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or the process of development and the design and performance of a proposed process or system. **Developing and Using Models:** ● Develop, revise, and use models to predict and support explanations of relationships between systems or between components of a system. ● Evaluate merits and limitations of two different models of the same proposed tool, process, or system in order to select or revise a model that best fits the evidence or design criteria. **Constructing Explanations and Designing Solutions:** ● Construct and revise explanations based on evidence obtained from a variety of sources (e.g., scientific principles, models, theories, simulations) and peer review. • Base causal explanations on valid and reliable empirical evidence from multiple sources and the assumption that natural laws operate today as they did in the past and will continue to do so in the future.
Anchoring Phenomenon	**Investigative Phenomenon**
A Burning Candle in a Jar *https://youtu.be/9RnYenXimSA* *https://youtu.be/vzHVQXTwgkg*	**Photosynthesis and Respiration in Plants** *https://youtu.be/H8PLS1h6HJQ*

Unit 4: Matter and Energy in Ecosystems

Theme: Flow of Energy & Tropic Levels

Big Idea: Energy is not created or destroyed, but only 10% of energy can be transferred directly from one organism to another. Matter used for carrying out life processes is also not created or destroyed. It must be consumed or re-assembled from existing materials.

Essential Questions for this Unit:

1. How do organisms interact with the living and nonliving environments to obtain matter and energy?
2. What do the three types of ecological pyramids illustrate?
3. How are both energy and matter cycled between organisms and their environment based on mathematical models?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
Plus HS+B.L2U1.3 Use mathematics and computational thinking to support claims for the cycling of matter and flow of energy through trophic levels in an ecosystem.	**L2: Organisms require a supply of energy & materials for which they often depend on, or compete with, other organisms.** ● As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. ● Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. ● Plants or algae form the lowest level of the food web. ● The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil and are combined and recombined in different ways. ● At each link in an ecosystem, matter and energy are conserved; some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. Competition among species is ultimately competition for the matter and energy needed for life.	● I can describe the transfer of matter (as elements and molecules) and flow of energy upward between organisms and their environment. ●I can identify the relative proportion of organisms, based on biomass and energy, at each trophic level by correctly identifying producers and consumers. *(Proportional reasoning here means students should be able to think about different trophic levels in terms of the percentage or proportion of biomass they obtained from the trophic level below).* ●I can provide supports claims for the pattern of conservation with the transfer of energy and matter through a system.	**Summative Assessments:** CANVAS Benchmark Tests APEX UNIT Tests Research Report: Use a mathematical model to describe the conservation/destruction of atoms and molecules as they move through trophic levels. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen, and nitrogen being conserved as they move through trophic levels. **Formative Assessments:** APEX Lesson Quizzes WS Questions during lectures Labster - WS Questions **Short Performance Assessment:** • Given relative numbers of organisms for a simple food chain in a prairie, forest, or lake ecosystem, students will construct a model showing those numbers as widths of stacking columns (pyramid). Calculate the percentage decrease and construct possible explanations as to why stable ecosystems have this pyramid like shape. **Biomass and Trophic Levels:** *https://docs.google.com/document/d/1GuT1xWSTqgqTs2VFJap0zxhB4hW12PyYeikA91rMjM8/edit*	• **APEX** Lesson Assignments • **CANVAS:** students will complete all prompts with provided figures ws and videos: -Explain the roles of organisms in an ecosystem and the effect of biomagnifications: **Eutrophication Explained** *https://www.youtube.com/watch?v=mLbDbmmV6Qc* ***The Effect of Mercury on Biomagnifications*** *https://docs.google.com/document/d/1HRFJaiEXft72NBtwRLKJRT8Zeph0KD7Oc5WBWd9W8KA/template/preview* ***Bioaccumulation of Mercury*** *https://docs.google.com/document/d/192V2BayL9iXLgAbdhsU9Qs-vfYArjQlmKWybKfsPR9g/template/preview* •**LABSTER: Simulated Lessons** *Analyze various models:* -Present students with a range of evidence on climate change (models, data, video). Ask students to construct causal explanations to include the multiple contributing factors: **Identify the levels of Ecological Pyramids** https://www.youtube.com/watch?v=nC1ZcUo7XoA -Identify the concentration of	Organisms Ecosystems Producers Consumers Trophic levels Ecological pyramids Matter cycling Energy flow Primary Succession Secondary Succession Biomass Conservation Energy Eutrophication Biomagnification Laws of Thermodynamics Biomass Energy Pyramid

				toxins in an organism as a result of ingesting other plants or animals in which toxins are more widely dispersed. **Trophic Levels** Illustrate an energy pyramid using trophic levels and explain the flow of energy and its components.	

Crosscutting Concepts	Science and Engineering Practices
Energy and Matter: ● The total amount of energy and matter in closed systems is conserved. ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. Cycles of Matter and Energy Transfer in Ecosystems– Teacher Video *https://thewonderofscience.com/videos/2017/12/10/ls2b-cycle-of-matter-and-energy-transfer-in-ecosystems* *https://thewonderofscience.com/videos/2017/12/10/ccc5-matter-and-energy* **Patterns:** • Mathematical representations are needed to identify some patterns. **Systems and System Models:** ● Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. ● Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models	**Using Mathematics and Computational Thinking:** ● Create a simple computational model or simulation of a designed device, process, or system. ● Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world. **Developing and Using Models:** ● Use models (including mathematical and computational) to generate data to support explanations and predict phenomena, analyze systems, and solve problems. ● Develop, revise, and use models to predict and support explanations of relationships between systems or between components of a system.
Anchoring Phenomenon	**Investigative Phenomenon**
Toxic Algae Blooms *https://youtu.be/FGAJizX5qv0*	**Biomagnification and Bioaccumulation** *https://www.youtube.com/watch?v=85I7oPWUuak*

Unit 4: Matter and Energy in Ecosystems

Theme: Natural Hazards and Natural Resources

Big Idea: Natural hazards, human activities, and changes in climate control the growth of certain plants and animals and change the resources available in an ecosystem. Natural resources can include but not limited to access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can include but are not limited to interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts) Examples of the results of changes in climate can include but not limited to factors that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.

Essential Questions for this Unit:

1. How have human activities shaped local and global ecology?
2. How can the impact of human activities on natural systems be reduced?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
Essential HS.E1U3.14 Engage in argument from evidence about the availability of natural resources, occurrence of natural hazards, changes in climate, and human activity and how they influence each other. *Note: In this standard, human activities are discussed at the surface level. Examples of natural hazards include interior processes; volcanic eruptions and earthquakes; surface processes such as tsunamis, mass wasting and soil erosion, and severe weather such as hurricanes, floods, and Droughts. Examples of the results of changes in climate include factors that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation.*	**E1: The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface and its climate.** ● Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. ● As the global human population increases and people's demands for better living conditions increase, resources considered readily available in the past, such as land for agriculture or drinkable water, are becoming scarcer and more valued. ● All forms of resource extraction and land use have associated economic, social, environmental, and geopolitical costs and risks, as well as benefits. ● Natural hazards and other geologic events have shaped the course of human history. ● Natural hazards can be local, regional, or global in origin, and their risks increase as	●I can discuss the specific cause and effect relationships between environmental factors (natural hazards, changes in climate, and the availability of natural resources) of human activities. ●I can obtain and interpret how natural hazard occurrences can affect human activity that has significantly altered the sizes and distributions of human populations in particular regions. ●I can collect data and display the costs, risks and/or benefits of how the human extraction of natural resources (and their associated economic, social, environmental, and geopolitical). ●I can describe the changes in climate that affect human activity (e.g., agriculture) and human populations that can drive mass migrations (past and/or current). ●I can engage in argument from evidence about how human activities affect the stability of available resources and the pattern of climate change	**Summative Assessments:** CANVAS Benchmark Tests APEX UNIT Tests Research Report: *- I can write an argument on how global warming and the greenhouse effect are impacted by humans using evidence from scientific research.* **Sinking Islands** Video & discuss how the negative impacts of climate change on island communities: http://www.emtv.com.pg/article.aspx?slug=Kivalina-Carteret-Similarities-of-the-Sinking-Islands **Formative Assessments:** APEX Lesson Quizzes WS Questions during lectures WS Questions during Labster **Short Performance Assessment:** *-Group will predict the population changes given various ecological disturbances, a focus on data related to costs,. Risks, and benefits related to extraction of natural resources. PowerPoint presentation.*	• **APEX** Lesson Assignments • **CANVAS:** students will complete all prompts :ws and videos: **PBS: Water World** The following video will provide students with a look into the impacts that climate change is having in Bangladesh – discuss how it affects human activity and human populations. http://www.pbs.org/now/shows/543/index.htm *-I can analyze data related to an environmental disruption to explain the order of events responsible for the formation of a new ecosystem.* **NASA: How Does Climate Change Affect Humans?** *https://www.opened.com/video/nasa-how-does-climate-change-affect-humans/5786128* **Coral Bleaching &Climate Change** *https://youtu.be/I_dC2swK9AY* *(2:45) Global Coral Bleaching Event puts Reefs at Risk – National Geographic Society Newsroom* **Can We Expand Our Carrying Capacity?** *https://www.youtube.com/watch?v=lS_msYArtvY*	Natural Hazard Natural Disaster Climate Natural Resources Economic social Political Environment geopolitical Renewable resource Nonrenewable resource

	populations grow. ● Human activities can contribute to the frequency and intensity of some natural hazards.			**•LABSTER: Simulated Lessons** *Analyze various models:* Ecological Pyramids Virtual Lab In this activity, students will investigate how energy cycles through the environment through different trophic levels within an ecosystem. Students will mathematically model activity within ecosystems and extend this knowledge to other ecosystems. ***http://www.iteachdemo.com/jquery/document/65_661EcologicalPyramidVirtualLab.pdf***	

Crosscutting Concepts	Science and Engineering Practices
Stability and Change: ● Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. **Patterns:** ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. **Cause and Effect:** ● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. ● Systems can be designed to cause a desired effect. ● Changes in systems may have various causes that may not have equal effects Teacher Videos: Natural Hazards – https://thewonderofscience.com/videos/2017/12/10/ess3b-natural-hazards Natural Resources – https://thewonderofscience.com/videos/2017/12/10/ess3a-natural-resources	**Obtaining, Evaluating, and Communicating Information:** ● Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible. ● Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. **Engaging in Argument from Evidence:** ● Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Anchoring Phenomenon	Investigative Phenomenon
Deadliest Natural Disasters of All Time *https://youtu.be/qazRCK0Oeno*	**Seven Billion Dreams. One Planet. Consume with Care.** *https://youtu.be/JyL58vlbvgw*

Unit 5: Ecosystems and Populations

Theme: Population Growth

Big Idea: Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. Different factors affect carrying capacities at different scales.

Essential Questions for this Unit:

1. What factors contribute to changes in populations?
2. What factors determine the carrying capacity of an ecosystem?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
Plus HS+B.L2U1.1 Develop a model showing the relationship between limiting factors and carrying capacity and use the model to make predictions on how environmental changes impact biodiversity.	**L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.** ● Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. ● These limits result from such factors as the availability of living and non-living resources and from such challenges as predation, competition, and disease. ● Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. ● This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.	● I can ask questions about environmental factors that cause populations to increase or decrease within the ecosystem (i.e., availability of food, water, and shelter; predation; natural hazards; disease). ● I can develop a model that shows the relationship between limiting factors and carrying capacity at different scales (i.e., some factors have larger effects than do other factors, factors are interrelated, the significance of a factor is dependent on the scale (i.e., a pond vs. an ocean)). ● I can make predictions from graphs, charts, simulations, or historical data sets on how environmental changes impact biodiversity (i.e., linear growth vs. exponential growth, logistic growth).	**Summative Assessments:** CANVAS Benchmark Tests APEX UNIT Tests Research Report: Explore/WebQuest • Students will be able to describe the effect competition, density-dependent factors and density independent factors have on an ecosystem: Researching and gathering information on habitat similarities and differences between Denali National Park and Lake Clark National Park -Identify food sources -Competition for resources -Limiting factors for carrying capacity -Habitat range -Density of bear populations **Formative Assessments:** APEX Lesson Quizzes WS Questions during lectures WS Questions during Labster **Short Performance Assessment:** **Data Analysis: Plant and Animal: Carrying Capacities Deer on the Kaibab Plateau:** *http://www.biologycorner.com/worksheets/kaibab.htm*	• **APEX** Lesson Assignments • **CANVAS:** students will complete all prompts with provided figures ws and videos: **Limiting Factors in an Ecosystem** *https://youtu.be/pPw51fDTl68* **Species Interactions Activity** ***E*xploring Species Activity** Find two species of your liking – create poster. *http://www.animalplanet.com/wild-animals/endangered-species/* **PACKET: Carrying Capacity and Bears in Alaska** **Reindeer of St. Mathews** - ws Creating a Venn Diagram, or other method of comparison, showing the similarities and differences between Denali bears and Lake Clark bears. Highlight similarities in food availability, prey, availability of resources, territory ranges, and all things you found in your research. **Venn Diagram: Bears & Ecosystem** Create a diagram or drawing of how bears fit into the ecosystem. Create a food web or any other image that shows how far the reach of bears is in this environment **GRAPH: Population Ecology** ***Symbiosis*** *https://youtu.be/zSmL2F1t81Q* •**LABSTER: Simulated Lessons**	Age structure Immigration Emigration Exponential growth Birth rate Death rate Immigration Population Clumped Random uniform Carrying capacity Population density density-dependent competition predation parasitism mutualism commensalism crowding and stress density independent limiting factors S-curve J-curve Interdependent factors

				- Analyze various models for population change.(i.e. Hare & Lynx, Oh Deer!, etc.).	

Crosscutting Concepts	Science and Engineering Practices
Scale, Proportion, and Quantity: ● Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. *https://youtu.be/vFqv_y1QKRA* ● Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. ● Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). **Cause and Effect:** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. ● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. ● Changes in systems may have various causes that may not have equal effects. **Stability and Change:** ● Much of science deals with construction explanations of how things change and how they remain stable. ● Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.	**Asking Questions and Defining Problems:** ● Ask questions that arise from careful observation of phenomena, models, theory, or unexpected results. ● Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. **Developing and Using Models:** ● Use multiple types of models to represent and support explanations of phenomena and move flexibly between model types based on merits and limitations. ● Use models (including mathematical and computational) to generate data to support explanations and predict phenomena, analyze systems, and solve problems. Population growth Model – Teacher Video: *https://youtu.be/XMHa9doUd1c* **Using Mathematics and Computational Thinking:** ● Use mathematical or algorithmic representations of phenomena or design solutions to describe and support claims and explanations, and create computational models or simulations. ● Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world. ● Create a simple computational model or simulation of a designed device, process, or system.
Anchoring Phenomenon	**Investigative Phenomenon**
How Wolves Change Rivers *https://youtu.be/ysa5OBhXz-Q*	**Competition, Predation, and Symbiosis** *https://youtu.be/D1aRSeT-mQE*

Unit 5: Ecosystems and Populations

Theme: Impacts on Ecosystems

Big Idea: The carrying capacities can be disrupted temporarily or permanently by a biological or physical disturbance to an ecosystem.

Essential Questions for this Unit:

1. In what ways are human activities putting stress on ecosystems?
2. Does species biodiversity impact the stability and sustainability of a community?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
Essential HS.L2U3.18 Obtain, evaluate, and communicate about the positive and negative ethical, social, economic, and political implications of human activity on the biodiversity of an ecosystem. **Plus HS+B.L4U1.2** Engage in argument from evidence that changes in environmental conditions or human interventions may change species diversity in an ecosystem.	**L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.** ● A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. ● If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. ● Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. ● Moreover, anthropogenic changes (induced by human activity) in the environment — including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change — can disrupt an ecosystem and threaten the survival of some species. **L4: The diversity of organisms,**	●I can identify the most important factors that determine biodiversity of an ecosystem and changes over time in numbers and types of organisms in ecosystems of different capacities. ● I can identify interdependence of factors (living and non-living) in biodiversity and population size and resulting effect on carrying capacity. ● I can explain the effects of human intervention activity (i.e., conservation) on a threatened or endangered species or to the genetic variation within a species, with the ultimate goal on biodiversity being avoiding extinction. ● I can give an example of current real-world examples of species whose carrying capacities have been disrupted (stability and change) by biological/physical disturbances and how they respond. ● I can critique proposed human interventions and make arguments and/or counterarguments to the effectiveness.	**Summative Assessments:** CANVAS Benchmark Tests APEX UNIT Tests Research Report: •Provide an example of an ecosystem and summarize the most important factors that determine its biodiversity and the changes that have occurred over time in numbers and types of organisms in ecosystems of different capacities. Biodiversity and Ecosystems https://youtu.be/BSkk2R5psp4 **Formative Assessments:** APEX Lesson Quizzes WS Questions during lectures Labster -WS Questions **Short Performance Assessment:** • In groups of 3, students will prepare a PowerPoint presentation identifying the interdependence of factors in biodiversity and population size that show change in carrying capacity.	• **APEX** Lesson Assignments • **CANVAS:** students will complete all prompts with provided figures ws and videos: **Invasive Species** *-Analyze the impacts of Buffelgrass on the biodiversity of Sonoran Desert.* *-Explore and explain why the Buffelgrass is an invasive species and why it is detrimental to the local ecosystem.* *-Explore and select one example of a local invasive plant species and why it is detrimental to the local ecosystem.* **Disturbance** https://youtu.be/BZTFmuzOpOM **The Importance of Biodiversity** https://youtu.be/C15NXPb67QE **How Ecosystems Change in Response to natural and Human Disturbances** https://youtu.be/_Wx1Co59w58 •**LABSTER: Simulated Lessons** *- Analyze various models: cycling of matter through the biogeochemical cycles* **Primary and Secondary Succession** **Biological Extinction**	Abiotic Biotic Size Distribution Community Species biodiversity Native Species Non-Native Species Pioneer Species Invasive Species Keystone Species Foundation Indicator Primary succession Secondary succession Biological Extinction

	living and extinct, is the result of evolution. ● Biological extinction, being irreversible, is a critical factor in reducing the planet's natural capital.				

Crosscutting Concepts	Science and Engineering Practices
Stability and Change: ● Much of science deals with constructing explanations of how things change and how they remain stable. **Cause and Effect:** ● Changes in systems may have various causes that may not have equal effects.	**Obtaining, Evaluating, and Communicating Information:** ● Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible. ● Compare, integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) in order to address a scientific question or solve a problem. **Engaging in Argument from Evidence:** ● Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ● Construct a counterargument that is based on data and evidence that challenges another proposed argument.
Anchoring Phenomenon	**Investigative Phenomenon**
Why is Biodiversity so Important? *https://youtu.be/GK_vRtHJZu4*	**Megafauna Extinction: Did Humans or Climate Kill Off the mammoths?** *https://youtu.be/x_Nx6C5cSHU*

Unit 5: Ecosystems and Populations

Theme: Environmental Impacts of Humans

Big Idea: Human activity has positive and negative ethical, social, economic, and political implications on the biodiversity of an ecosystem.

Essential Questions for this Unit:

1. What are the threats to biodiversity?
2. What are the two techniques used to restore biodiversity?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
Essential HS.L2U3.18 Obtain, evaluate, and communicate about the positive and negative ethical, social, economic, and political implications of human activity on the biodiversity of an ecosystem. **Plus HS+B.L4U1.2** Engage in argument from evidence that changes in environmental conditions or human interventions may change species diversity in an ecosystem. **Essential HS.P1U3.4** Obtain, evaluate, and communicate information about how the use of chemistry related technologies have had positive and negative ethical, social, economic, and/or political implications **Essential HS.P4U3.9** Engage in argument from evidence regarding the ethical, social, economic, and/or political benefits and liabilities of energy usage and transfer. **Essential HS.E1U3.14** Engage in argument from evidence about the availability of natural resources, occurrence of natural hazards, changes	**L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.** ● Anthropogenic changes (induced by human activity) in the environment —including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change —an disrupt an ecosystem and threaten the survival of some species. **L4: The diversity of organisms, living and extinct, is the result of evolution.** ● Humans depend on the living world for the resources and other benefits provided by biodiversity. ● But human activity is having positive and negative impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. ● These problems have the potential to cause a major wave of biological extinctions—as many species or populations of a given species, unable to survive in changed environments, die out- and the effects may be harmful to humans and other living things. **P1: All matter in the Universe is made of very small particles.** ● Scientific understanding can help	● I can explain the benefits, as well as the ethical, social, economic, and political implications, of maintaining a healthy and balanced ecosystem. ● I can explain the relationships, based on evidence, about human factors, both positive and negative, that affect biodiversity and populations. ● I can analyze data from investigations about how human activities both positively and negatively (overpopulation, overexploitation, climate change, energy use, invasive species, pollution) affect biodiversity, including speciation and extinction. ●I can investigate and draw conclusions from multiple resources that humans use increasing amounts of both renewable and nonrenewable sources (fossil fuels, solar, nuclear), that usage can influence the biodiversity of an ecosystem, and how modern technology can make sustainable energy sources more viable. ● I can make connections, relate ideas that include the positive and negative ethical, social, economic, and political implications of new technologies, different kinds of energy use, and human activities on biodiversity	**Summative Assessments:** CANVAS Benchmark Tests APEX UNIT Tests **Research Report:** • Write a report on how human activities both positively and negatively (overpopulation, overexploitation, climate change, energy use, invasive species, pollution) affect biodiversity, including speciation and extinction. **Formative Assessments:** APEX Lesson Quizzes WS Questions during lectures WS Questions during Labster **Short Performance Assessment:** • Group presentation: using multiple resources : -investigate how humans use increasing amounts of both renewable and nonrenewable sources (fossil fuels, solar, nuclear), -explain how that usage can influence the biodiversity of an ecosystem -justify how modern technology can make sustainable energy sources more viable.	• **APEX** Lesson Assignments • **CANVAS:** students will complete all prompts with provided figures ws and videos: **Article: Coca Cola and India** *https://www.thoughtco.com/coca-cola-groundwater-depletion-in-india-1204204* Exploring Negative and Positive Impacts: **Human Impact on Ecosystems** *https://www.youtube.com/watch?v=17_G6Dq8j3A* **Human Impacts on Earth Systems** https://www.youtube.com/watch?v=lrxZ_UqQKyI **How are Humans Affecting the Environment** https://www.youtube.com/watch?v=HHSAOd__ZD8 •**LABSTER:** *- Analyze various Polluted Locations: superfund Sites* *-Explore Anthropogenic Factors* - Renewable & Nonrenewable Resources *-Population Growth Change* *-Climate Change*	Biodiversity Anthropogenic Climate Change Overpopulation Overexploitation habitat destruction pollution Biodegradable Natural Resources Economic social Political Environment geopolitical Renewable resource Nonrenewable resource Sustainable Use Endemic Bioremediation Biological augmentation CERCLA Superfund Sites

in climate, and human activity and how they influence each other	to identify implications of certain applications but decisions about whether certain actions should be taken will require ethical and moral judgments which are not provided by knowledge of science. ● There is an important difference between the understanding that science provides about, for example, the need to preserve biodiversity, the factors leading to climate change and the adverse effects of harmful substances and lifestyles, and the actions that may or may not be taken in relation to these issues. **P4: The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event.** ● Across the world, the demand for energy increases as human populations grow and because modern lifestyles require more energy, particularly in the convenient form of electrical energy. **E1: The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate.** ● New technologies &regulations can change the balance of these factors. ● Much energy production today comes from nonrenewable sources, such as coal and oil. ● However, advances in related science and technology are reducing the cost of energy from renewable resources, such as sunlight. ● As a result, future energy supplies are likely to come from a much wider range of sources				

Crosscutting Concepts	Science and Engineering Practices
Cause and Effect: ● Systems can be designed to cause a desired effect. ● Changes in systems may have various causes that may not have equal effects. **Stability and Change:** ● Much of science deals with constructing explanations of how things change and how they remain stable. **Energy and Matter:** ● Energy drives the cycling of matter within and between systems. **Scale, Proportion, and Quantity:** ● The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.	**Obtaining, Evaluating, and Communicating Information:** ● Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. ● Compare, integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) in order to address a scientific question or solve a problem. **Engaging in Argument from Evidence:** ● Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ● Construct a counter-argument that is based on data and evidence that challenges another proposed argument. ● Make and defend a claim about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence. ● Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments
Anchoring Phenomenon	**Investigative Phenomenon**
Biodiversity is Collapsing worldwide. Here's Why. *https://youtu.be/1cvMX82iwRM*	**Epic Message to Save the World** *https://youtu.be/B-nEYsyRlYo*