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UNIT NARRATIVE

Unit 2 of AP Environmental Science focuses on biodiversity as a foundational concept for understanding ecosystem stability, resilience, and function. This unit strategically integrates topics from both Unit 2 and selected topics from Unit 5 of the CED (Land and Water Use) to provide students with a holistic understanding of biodiversity and population ecology. Throughout the unit the College Board SEPs (Science and Engineering Practices) are embedded in simulations, labs, and data interpretation exercises, ensuring students not only learn environmental science content but develop disciplinary literacy. The thoughtful sequencing, starting with foundational biodiversity concepts and moving toward applied population analysis—ensures students build a coherent understanding of the ecological systems that underpin life on Earth. By the end of the unit, students should be able to seamlessly explain the interconnectedness of biodiversity with ecosystem resilience and population ecology.

The unit opens with a two-day **Biodiversity Index lab** (Days 1–2), which introduces students to measuring biodiversity using species richness and evenness. This hands-on simulation sets the stage for understanding the different types of biodiversity and their relevance in ecological studies. This lab focuses on core Science Practices Data Analysis and Making Claims supported by evidence and Reasoning. With a core understanding of what biodiversity is students continue with the **Bubble Lab** (Days 3–4), where they explore survivorship curves and make connections with **r-selected and K-selected species**. This simulation encourages students to draw connections between reproductive strategies and species' vulnerability to environmental disturbances and change.

The unit then transitions to the **Adaptations** (Day 5) and **Ecological Tolerance** (Day 6) lessons, where students analyze how species survive and evolve in response to environmental pressures. This sequencing ensures students have a firm grasp of evolutionary mechanisms before tackling **Island Biogeography** (Day 7), which synthesizes adaptation, tolerance, and biodiversity concepts within the context of isolated ecosystems. This placement is intentional, as students can now evaluate island species evolution through the lens of prior understandings.

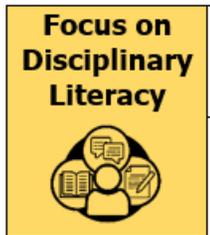
Midway through the unit, students shift focus to **Ecosystem Services** (Day 8), where they identify and classify services ecosystems provide, and consider how human activity impacts these services. This lesson uses a jigsaw strategy and card sort activity, leveraging peer discourse and categorical reasoning to build conceptual understanding rather than memorization. The following lesson, **Natural Disruptions** (Day 9) builds upon the concept of ecosystem vulnerability and resilience, preparing students to understand **Ecological Succession** in more depth. **Primary and Secondary Succession** (Days 10–11) are taught back-to-back to highlight their differences and respective ecological timelines. Students engage in card sorting and data analysis to compare species diversity as ecosystems changes over time. The

inclusion of these lessons after the natural disruption lesson emphasizes the idea that succession is nature’s response to disturbance—scaffolding students' understanding of ecosystem recovery.

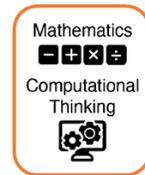
The final sequence of lessons (Days 12–13) focuses on **Population Dynamics**, where students will connect previous topics with the concepts of population growth, carrying capacity, and environmental resistance. Students interpret population graphs (J-curve, S-curve), reinforcing the role of resource availability and species strategies (generalist/specialist, r-/K-selected) in ecosystem stability.

Unit 3 Topics Covered:

- 3.1 Generalist and Specialist Species
- 3.2 K-Selected and r-Selected Species
- 3.3 Survivorship Curves
- 3.4 Carrying Capacity
- 3.5 Population Growth and Resource Availability



In science, disciplinary literacy is synonymous with the science and engineering practices. The SEPs are the context through which all science concepts should be taught. In the lessons, you will find the Science and Engineering practices icons when the SEPs are being explicitly used by students.



UNPACKED CONTENT STANDARDS

Below are the standards **taught** and **assessed** in this unit.

Learning Objective				Essential Knowledge	
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.
				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.
				ERT-2.A.3	Ecosystems that have a larger number of species are more likely to recover from disruptions.
				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.
				ERT-2.A.5	Species richness refers to the number of different species found in an ecosystem.
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.
		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.
2.3	Island Biogeography	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
				ERT-2.D.2	Islands have been colonized in the past by new species arriving from elsewhere.
		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.
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.
				ERT-2.F.2	Ecological tolerance can apply to individuals and to species.
2.5	Natural Disruptions to Ecosystems	ERT-2.G	Explain how natural disruptions, both short and	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
				ERT-2.G.2	Earth system processes operate on a range of scales in terms of time. Processes can be periodic, episodic, or random.

			long-term, impact an ecosystem.	ERT-2.G.3	Earth's climate has changed over geological time for many reasons
				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.
				ERT-2.G.5	Major environmental change or upheaval commonly results in large swathes of habitat changes.
				ERT-2.G.6	Wildlife engages in both short- and long-term migration for a variety of reasons, including natural disruptions.
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.
				ERT-2.H.2	Environmental changes, either sudden or gradual, may threaten a species' survival, requiring individuals to alter behaviors, move, or perish.
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.
				ERT-2.I.2	A keystone species in an ecosystem is a species whose activities have a particularly significant role in determining community structure.
				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
		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.
				ERT-2.J.2	Succession in a disturbed ecosystem will affect the total biomass, species richness, and net productivity over time.
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.
3.2	K-Selected and 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.
				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.
				ERT-3.B.3	Biotic potential refers to the maximum reproductive rate of a population in ideal conditions.
				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.
				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.

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.
				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.
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.
		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.
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.
				ERT-3.F.2	Resource availability and the total resource base are limited and finite over all scales of time.
				ERT-3.F.3	When the resources needed by a population for growth are abundant, population growth usually accelerates.
				ERT-3.F.4	When the resource base of a population shrinks, the increased potential for unequal distribution of resources will ultimately result in increased mortality, decreased fecundity, or both, resulting in population growth declining to, or below, carrying capacity.

UNDERSTANDINGS AND QUESTIONS

Important big ideas and processes for the unit.

Key Understandings

- Describe the three types of biodiversity
- Explain how species biodiversity is measured
- Explain how biodiversity is important for ecosystem stability, resilience, and services to humans
- Describe characteristic traits r-selected species
- Describe characteristics traits of K-selected species
- Read and describe the different characteristic shapes of survivorship curves
- Describe the characteristics of a species that result in the different types of survivorship curves
- Adaptations increase an organism's fitness (ability to survive and reproduce).
- Adaptation is a slow process that includes many individuals, with less advantageous traits, not surviving to reproduce.
- Populations adapt over generations. Individuals do not adapt over a lifetime.
- Variation within a species increases the likelihood that it will adapt to changes in its environment.
- Identify and describe environmental abiotic factors
- Ecological tolerance applies to organisms and species
- Describe how an organism or species is able to survive over a range of an abiotic factor
- Describe an organism or species response options when an abiotic factor exceeds its ecological tolerance
- Species move from the mainland to islands
- Relationship between island size and the number/type of species that can/do move there.
- Relationship between island distance and the number/type of species that can/do move there.
- Island Biodiversity is largely affected by distance from the mainland and size of island
- Island abiotic and biotic conditions can create new species through adaptation
- Describe characteristics of each category of ecosystem services
- Identify examples of ecosystem services from each category
- Explain how ecosystem services are critical for humans
- Explain how ecosystem services are critical for the health of ecosystems
- Natural disruptions happen frequently and can be small (the death and falling of a large tree in a forest) or very large (a large volcanic explosion, tsunami, forest fire, flood, erosion)
- Generalists are more likely to endure than specialists
- Ecological succession is a predictable process after an ecological disturbance.
- Primary succession occurs on surfaces which lack soil.
- Primary succession is a very long process (primarily because of the time required to create soil).
- Describe a Pioneer species
- Biodiversity increases as succession proceeds
- Larger organisms are present further into succession

- Secondary succession occurs where disturbances have happened but soil is still present.
- Secondary succession is a much shorter process than primary succession (decades vs centuries)
- More specialist species are present in late succession
- Each species has an intrinsic rate of growth (r) that is based on its characteristics like age of reaching sexual maturity, number of young produced at once, frequency of reproduction, etc.
- Explain how J-shaped growth often leads to an overshoot
- Populations that grow at or close to their intrinsic rate of growth experience a J-shaped growth curve (r -selected species or generalists)
- Other populations follow a logistic growth curve (S-shaped) because environmental resistance significantly reduces their population growth rate
- Density dependent environmental resistance factors are those that put more pressure on a species population as the population in each area (population density) increases, like availability of food resources, shelter and mates.
- Carrying capacity for a population is determined by the density dependent environmental resistance factors

Key Questions

BIG IDEA 1 - Energy Transfer

- How does energy change forms?
- How does energy move through ecosystems?

BIG IDEA 2 - Interactions Between Earth Systems

- How does matter move through ecosystems and the biosphere?
- How old is the water you drink?

ROADMAP

AT A Glance: Unit #:				
Day	Date	Lesson	Lesson Title	Pacing Notes
1		01	Biodiversity Index – Day 1	
2		02	Biodiversity Index – Day 2	
3		03	Bubble Lab (survivorship) – Day 1	
4		04	Bubble Lab (survivorship) – Day 2	
5		05	Adaptations	
6		06	Ecological Tolerance	
7		07	Island Biogeography	
8		08	Ecosystem Services	
9		09	Natural Disruptions	
10		10	Succession – Primary	
11		11	Succession - Secondary	
12		12	Population Dynamics – Day 1	
13		13	Population Dynamics – Day 2	
14		Flex		
15		Unit Exam	TX_SCI_APEnvironmentalScience_F25_UE2	
16		Success Day	<i>Time Permitting</i> - Success Day Lesson Plan to review the UE FRQ and MC gaps.	

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
<p>Day 01</p> <p>Biodiversity Index–Day 01</p>	<p>Topic 2.1 – Introduction to Biodiversity ERT-2. Explain levels of biodiversity and their importance to ecosystems.</p> <p>SWBAT: Describe how biodiversity is measured and can be used to compare biodiversity across locations and times.</p> <p>SWBAT: Describe the different types of biodiversity and the importance of each to the health of ecosystems.</p> <p>DISCIPLINARY LITERACY FOCUS:</p> 	<p>KEY UNDERSTANDINGS CHECKLIST</p> <ul style="list-style-type: none"> <input type="checkbox"/> Describe the three types of biodiversity <input type="checkbox"/> Explain how species biodiversity is measured <input type="checkbox"/> Explain how biodiversity is important for ecosystem stability, resilience, and services to humans. <p>LESSON CONTEXT FOR LESSON MASTERY This lesson introduces the concept of species biodiversity by having students actively engage in calculating and comparing a biodiversity index for several different representations of different biomes. This gives students the opportunity to explore the two factors that affect a biodiversity index, species richness and species evenness, directly and naturally make connections between biodiversity and biomes. Students will have the perspective of how biodiversity is measured for the rest of this unit and this course. <i>Note – students will not be required to calculate a biodiversity index on the AP Exam.</i></p> <p>LOOK-FORS 🔍 (What to observe students doing or producing)</p> <p>Students can explain that variation exists within populations.</p> <ul style="list-style-type: none"> • Collecting and recording species richness data • Calculating Simpson’s Index for each biome • Students comparing the biodiversity index of different biomes and attempting to explain the differences they observe <p>COMMON MISCONCEPTIONS ▶ (Historical/widespread misunderstandings)</p> <ul style="list-style-type: none"> • Thinking only about diversity in observable traits like color, or size and forgetting that many important traits like resistance to pests, or growth rate may not be easily observed. • Thinking that the fact that some biomes <p>MAKING CONNECTIONS</p> <ul style="list-style-type: none"> • This lab focuses on species diversity (richness and evenness) but all three different types of biodiversity (genetic, species and habitat/biome diversity) are important because they are all interdependent 	<p><u>Create biome species bags</u></p> <ul style="list-style-type: none"> • At least 7 different Ziplock or paper bags • At least 15 different types of dry beans, noodles of different shapes and seeds work well to represent different species • Graph paper <p>CONTENT BACKGROUND RESOURCES: Khan – Simpsons Diversity Index Libre Texts - Biodiversity</p>

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
<p style="text-align: center;">Day 02</p> <p>Biodiversity Index–Day 02</p>		<ul style="list-style-type: none"> • Greater species diversity helps a habitat/ecosystem recover after significant natural or anthropogenic disturbances (increased resilience) • Specialist species (K-selected) are more vulnerable to habitat degradation and loss through disturbances. 	

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
<p>Day 03 - 04</p> <p>Bubble Lab: Day 1 - 2</p>	<p>Topic 3.2 – K-Selected & r-selected Species ERT-3. B Identify differences between K- and r-selected species Topic 3.3 – Survivorship Curves ERT-3.C Explain survivorship curves</p> <p>SWBAT: Describe differences between K and r selected species and describe how and why they have different types of survivorship curves.</p> <p>DISCIPLINARY LITERACY FOCUS:</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="304 889 445 1057" style="border: 1px solid green; border-radius: 10px; padding: 5px; text-align: center;">  <p>Planning and Carrying Out Investigations</p> </div> <div data-bbox="529 889 669 1057" style="border: 1px solid purple; border-radius: 10px; padding: 5px; text-align: center;">  <p>Analyzing and Interpreting Data</p> </div> </div>	<p>KEY UNDERSTANDINGS CHECKLIST:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Describe characteristic traits r-selected specie <input type="checkbox"/> Describe characteristics traits of K-selected species <input type="checkbox"/> Read and describe the different characteristic shapes of survivorship curves <input type="checkbox"/> Describe the characteristics of a species that result in the different types of survivorship curves <p>LESSON CONTEXT FOR LESSON MASTERY This lesson is a hands-on simulation activity where students have the opportunity to experience different types of survivorship curves metaphorically and describe the different species characteristics that affect survivorship. By comparing survivorship characteristics to the characteristics to r-selected and K-selected characteristics students naturally make connections between the two topics which increases their understanding of both topics.</p> <p>LOOK-FORS  (What to observe students doing or producing)</p> <ul style="list-style-type: none"> • Collecting survivorship data in an organized manner • Graphing survivorship data • Student trying different strategies to “keep their bubbles alive” <p>COMMON MISCONCEPTIONS  (Historical/widespread misunderstandings)</p> <ul style="list-style-type: none"> • All large animals are K- selected and all small animals are r- selected. Example: The ocean sun fish (heaviest fish) lays many eggs, no parental care, and high mortality rates. Size is often wrongly used as the only factor. <p>MAKING CONNECTIONS</p> <ul style="list-style-type: none"> • Invasive species tend to be r-selected species with type III survivorship curve because these are the types of species that are most likely to thrive in biomes other than their native biome. 	<div style="border: 1px solid magenta; padding: 10px; margin-bottom: 20px;"> <p>Materials per Group</p> <ul style="list-style-type: none"> • Bubbles and wand • Hula hoop or quadrant frame </div> <p>CONTENT BACKGROUND RESOURCES: Khan Academy – K-selected and r-selected species Khan Academy – Survivorship curves and K/r species</p>
	<p>Topic 2.6 – Adaptations</p>	<p>KEY UNDERSTANDINGS CHECKLIST:</p>	

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
<p>Day 05</p> <p>Adaptations</p>	<p>ERT-2.H Describe how organisms adapt to their environment</p> <p>SWBAT: Explain the process of species adaptation to changes in its environment.</p> <p>DISCIPLINARY LITERACY FOCUS:</p> 	<ul style="list-style-type: none"> <input type="checkbox"/> Adaptations increase an organism’s fitness (ability to survive and reproduce). <input type="checkbox"/> Adaptation is a slow process that includes many individuals, with less advantageous traits, not surviving to reproduce. <input type="checkbox"/> Populations adapt over generations. Individuals do not adapt over a lifetime. <input type="checkbox"/> Variation within a species increases the likelihood that it will adapt to changes in its environment. <p>LESSON CONTEXT FOR LESSON MASTERY Students will explore how species adapt to changes in their environment using a PhET simulation. Students have the opportunity to explain the process of adaptation through natural selection by observing, discussing and explaining several scenarios in the PhET simulation.</p> <p>LOOK-FORS 🔍 (What to observe students doing or producing)</p> <ul style="list-style-type: none"> • Following the specific instructions for each scenario about how and when the environment changes • Counting/estimating the number of species with different characteristics and how they change over time <p>COMMON MISCONCEPTIONS ▶ (Historical/widespread misunderstandings)</p> <ul style="list-style-type: none"> • Organisms get what they need. Adaptations don’t happen because organisms <i>want</i> or <i>need</i> them — they occur due to random mutations that are naturally selected if they are beneficial. • Genetic mutations are beneficial for an organism or species. Most random mutations are neutral or harmful to an organism. • Individual organisms adapt over time. Individual organisms don’t <i>change</i> during their lifetime. Populations change over generations. This can be observed in the PhET Simulation. • Survival of the fittest. The common thought that species or individuals that survive are “better” than those that do not in the sense of being faster, stronger, smarter, etc. <p>MAKING CONNECTIONS</p>	<p>CONTENT BACKGROUND RESOURCES: Crash Course – Natural Selection</p>

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
		<ul style="list-style-type: none"> • Higher genetic diversity makes it more likely that a species will be able to adapt to a changing ecosystem. • The process of evolution is based on species adapting through Natural Selection to new and changing environments. Sometimes the environment changed and sometimes the species moved to new environments or new environments were created (for example: volcanic islands created or retreating glaciers) • Environments have been changing throughout the history of life on Earth due to changing climate and the movement of tectonic plates, but these changes usually happened over hundreds of thousands to tens of millions of years, which gives species a much higher chance of adapting to the changes. Modern changes to the environment (especially increasing temperatures and pollution) have happened on the scale of decades to a few centuries • Humans have been forcing species (typically food crops and livestock) to adapt in particular ways through the process of artificial selection 	
<p>Day 06</p> <p>Ecological Tolerance</p>	<p>Topic 2.4 – Ecological Tolerance ERT-2. FDescribe ecological tolerance.</p> <p>SWBAT: Describe the ecological tolerance of a species using graphical data about the species survival vs an abiotic environmental factor and in applied contexts.</p> <p>DISCIPLINARY LITERACY FOCUS:</p> 	<p>KEY UNDERSTANDINGS CHECKLIST:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Identify and describe environmental abiotic factors <input type="checkbox"/> Ecological tolerance applies to organisms and species <input type="checkbox"/> Describe how an organism or species is able to survive over a range of an abiotic factor <input type="checkbox"/> Describe an organism or species response options when an abiotic factor exceeds its ecological tolerance <p>LESSON CONTEXT FOR LESSON MASTERY This lesson comes after adaptations so that students can make connections between the process of adaptation via natural selection and how changes in abiotic environmental factors can be the cause of the change. Students will explore ecological tolerance by analyzing and making claims about graphs showing the species survival rates versus an abiotic characteristic of their environment. There is very wide variety of different types of graphs and data that students must be familiar with in this class so it is important that they have many opportunities to analyze different types of graphs and data to make and support claims.</p>	<p>CONTENT BACKGROUND RESOURCES: Khan Academy – Tolerance Ranges of Species Article</p>

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
		<p>Students will be able to read a tolerance curve or graph showing survival vs. an abiotic factor, can label the optimal range, zone of physiological stress, and intolerance zones on a graph. Can use a graph to compare different species' tolerances to the same factor.</p> <p>Students will also engage in class discussion about the ecological tolerance of humans.</p> <p>LOOK-FORS  (What to observe students doing or producing)</p> <ul style="list-style-type: none"> Labeling optimal range, zones of stress, and zones of intolerance on graphs Discussion about what happens when a species range of tolerance is exceeded <p>COMMON MISCONCEPTIONS (Historical/widespread misunderstandings).</p> <ul style="list-style-type: none"> That a species can survive equally well throughout its tolerance range. All individuals in a species have the exact same tolerance range. That when a species ecological tolerance is exceeded all or most of the organisms will be killed/ <p>MAKING CONNECTIONS</p> <ul style="list-style-type: none"> When an abiotic factor is outside of a species range of tolerance it will either kill individuals in the species but more often it impacts the rate of reproduction and/or young organism survival. Increasing global temperatures due to Climate Change are disrupting species' survival and reproduction in countless ways, in both terrestrial and aquatic habitats including bleaching coral and disrupting the cycles and timing of pollinators and the pollination of flowers. 	
<p>Day 07</p> <p>Island Biogeography</p>	<p>Topic 2.3 – Island Biogeography</p> <p>ERT-2. D Describe Island biogeography.</p> <p>ERT-2. E Describe the role of island biogeography in evolution.</p>	<p>KEY UNDERSTANDINGS CHECKLIST:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Species move from the mainland to islands <input type="checkbox"/> Relationship between island size and the number/type of species that can/do move there. <input type="checkbox"/> Relationship between island distance and the number/type of species that can/do move there. <input type="checkbox"/> Island Biodiversity is largely affected by distance from the mainland and size of island 	<p>CONTENT BACKGROUND RESOURCES:</p> <p>Theory of Island Biogeography</p>

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
	<p>SWBAT: Describe Island biogeography and the role of island biogeography in evolution.</p> <p>DISCIPLINARY LITERACY FOCUS:</p> <div data-bbox="388 552 525 722" style="border: 1px solid purple; border-radius: 10px; padding: 5px; text-align: center;">  <p>Engaging in Argument from Evidence</p> </div>	<p><input type="checkbox"/> Island abiotic and biotic conditions can create new species through adaptation</p> <p>LESSON CONTEXT FOR LESSON MASTERY Students will also complete some aspects of experimental design during this lab activity. Students will engage in an activity to simulate how new islands get populated with species so they can observe the resulting species diversity of islands with different characteristics and draw conclusions from the observations. This lesson comes after adaptations and ecological tolerance because of the connections that can be made between both of these and island biodiversity.</p> <p>LOOK-FORS  (What to observe students doing or producing)</p> <ul style="list-style-type: none"> Comparing islands' number of species versus island size and distance from the mainland. <p>COMMON MISCONCEPTIONS (Historical/widespread misunderstandings).</p> <ul style="list-style-type: none"> Bigger islands always have a large number of species (high species diversity) regardless of distance. Species that migrated to an island a long time ago are the same as their mainland relatives Species on small islands are less likely to be endangered because there is less competition or predators. <p>MAKING CONNECTIONS</p> <ul style="list-style-type: none"> There are “islands” everywhere in the modern world. Everywhere there is a field or plot of land left abandoned for several years. Everywhere humans have developed an area but left a section of land relatively untouched. State and Nation parks and wildlife preserves. Land does not need to be surrounded by water to be a biodiversity “island”. Sometimes islands are created by natural disasters, like when a forest fire or flood affects a large area but there are certain “islands” that we less affected. 	

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
<p>Day 08</p> <p>Ecosystem Services</p>	<p>Topic 2.2 – Ecosystem Services ERT-2. B Describe ecosystem services. ERT-2.C Describe the results of human disruptions to ecosystem services SWBAT Describe ecosystem services using different categories and describe how human activities disrupt ecosystem services.</p> <p>DISCIPLINARY LITERACY FOCUS:</p> 	<p>KEY UNDERSTANDINGS CHECKLIST:</p> <ul style="list-style-type: none"> Describe characteristics of each category of ecosystem services Identify examples of ecosystem services from each category Explain how ecosystem services are critical for humans Explain how ecosystem services are critical for the health of ecosystems <p>LESSON CONTEXT FOR LESSON MASTERY Students will research the different categories of ecosystem services and discuss them in small groups using a jigsaw format and then complete a card sort of ecosystem services.</p> <p>LOOK-FORS  (What to observe students doing or producing)</p> <ul style="list-style-type: none"> Actively listening and asking question during jigsaw activity Sorting cards by type of ecosystem service <p>COMMON MISCONCEPTIONS (Historical/widespread misunderstandings).</p> <ul style="list-style-type: none"> Many students think ecosystem services = only provisioning (food, water, timber). Students mix up supporting services, like nutrient cycling or photosynthesis, with provisioning services, the direct products humans use <p>MAKING CONNECTIONS</p> <ul style="list-style-type: none"> Ecosystem services depend on healthy ecosystems which depend on biodiversity because all the different species populations must fill their niche (do their job to keep the ecosystem functioning properly). Tragedy of the Commons can lead to overexploitation of ecosystem services to the point where the services are no longer sufficient to maintain the health of the ecosystem and/or supply humans with the required resources Some environmentalists use the monetary value of Provisioning Services (that provide goods and resources humans use) to justify the conservation of habitats or species or other environmentally friendly policies or decisions 	<p>CONTENT BACKGROUND RESOURCES: Khan Academy – Ecosystem Services Earth.org – What are Ecosystem Services?</p>  <p><small>source: Final Recommendations of the Interagency Ocean Policy Taskforce.</small></p>

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
		<ul style="list-style-type: none"> Life begets more life – ecosystem services help maintain healthy ecosystems and all the species interactions are important to maintain the stability of all ecosystems: 	
<p>Day 09</p> <p>Natural Disruptions</p>	<p>Topic 2.5 – Natural Disruptions to Ecosystems ERT-2. G Explain how natural disruptions, both short and long-term, impact an ecosystem.</p> <p>SWBAT: Explain how natural disruptions, both short and long-term, impact an ecosystem.</p> <p>DISCIPLINARY LITERACY FOCUS:</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div data-bbox="289 948 426 1122" style="border: 1px solid purple; border-radius: 10px; padding: 5px; text-align: center;">  <p>Analyzing and Interpreting Data</p> </div> <div data-bbox="531 948 667 1122" style="border: 1px solid purple; border-radius: 10px; padding: 5px; text-align: center;">  <p>Engaging in Argument from Evidence</p> </div> </div>	<p>KEY UNDERSTANDINGS CHECKLIST:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Natural disruptions happen frequently and can be small (the death and falling of a large tree in a forest) or very large (a large volcanic explosion, tsunami, forest fire, flood, erosion) <input type="checkbox"/> Generalists are more likely to endure than specialists <p>LESSON CONTEXT FOR LESSON MASTERY Students will explore natural disruptions with both video and reading and discussion with table partners. This is a good way for students to explore a variety of natural disturbances. Students will also analyze graphical data to answer analysis question about natural disturbances.</p> <p>LOOK-FORS  (What to observe students doing or producing)</p> <ul style="list-style-type: none"> Annotating reading Takes notes about videos Discussion with peers about videos and reading Comparing answers with justification for graphical analysis questions <p>COMMON MISCONCEPTIONS (Historical/widespread misunderstandings).</p> <ul style="list-style-type: none"> Students think only human actions disrupt ecosystems — they overlook natural events like hurricanes, wildfires, volcanic eruptions, droughts, floods, and diseases. Students overlook small disturbances and only focus are large, devastating disturbances <p>MAKING CONNECTIONS</p> <ul style="list-style-type: none"> Higher species diversity makes an ecosystem more resilient when there are large, sudden disruptions to an ecosystem 	<p>CONTENT BACKGROUND RESOURCES:</p> <p>https://apclassroom.collegeboard.org/14/home?apd=5yb4e05ro3&unit=2</p> <p>https://apclassroom.collegeboard.org/14/home?apd=bbf7iz8eoi&unit=2</p>

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
<p>Day 10</p> <p>Succession - Primary</p>	<p>Topic 2.7 – Ecological Succession</p> <p>ERT-2. I Describe ecological succession.</p> <p>ERT-2. J Describe the effect of ecological succession on ecosystems.</p> <p>SWBAT: Describe the process of Primary Succession and the effects it has on an ecosystem.</p> <p>DISCIPLINARY LITERACY FOCUS:</p> 	<p>KEY UNDERSTANDINGS CHECKLIST:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Ecological succession is a predictable process after an ecological disturbance. <input type="checkbox"/> Primary succession occurs on surfaces which lack soil. <input type="checkbox"/> Primary succession is a very long process (primarily because of the time required to create soil). <input type="checkbox"/> Describe a Pioneer species <input type="checkbox"/> Biodiversity increases as succession proceeds <input type="checkbox"/> Larger organisms are present further into succession <input type="checkbox"/> More specialist are present in late succession <p>LESSON CONTEXT FOR LESSON MASTERY</p> <p>This lesson comes directly after natural disturbances because succession ALWAYS starts immediately after any disturbance, natural or anthropogenic, big or small. We start with primary succession and then move directly to secondary succession because this feels like a natural progression. Students will work in small groups to complete a card sort categorizing the characteristics of the species present in an area undergoing primary succession into distinct time periods. This gives students an opportunity to easily discuss their observations, claims and justification about how to classify each characteristic and the overall patterns they see in the stages of primary succession.</p> <p>LOOK-FORS 🔍 (What to observe students doing or producing)</p> <ul style="list-style-type: none"> • Moving characteristics around with respectful argumentation about which time period they belong in • Asking clarifying questions with their partners • Justifying claims with environmental concepts and principles <p>COMMON MISCONCEPTIONS (Historical/widespread misunderstandings).</p> <ul style="list-style-type: none"> • Not distinguishing between primary and secondary succession, or thinking they are the same • Thinking the time scale for primary and secondary succession is the same <p>Making Connections</p>	<p>CONTENT BACKGROUND RESOURCES:</p> <p>Khan Academy Ecological Succession - Video</p> <p>Khan Academy Ecological Succession - Article</p>

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
		<ul style="list-style-type: none"> • Succession is happening all around us all the time. Every weed growing through a crack in the pavement is an attempt at succession. • The climax community of any area is determined primarily by the abiotic factors of temperature and precipitation (climate) • An ecosystem becomes more biodiverse as Primary or secondary succession progresses • Typically, specialists only live in late succession ecosystems, which makes them more vulnerable to becoming endangered as more ecosystems are disturbed or destroyed by humans • A metaphor for pioneer species is “nature’s band aid” because whenever there is a disturbance to an ecosystem pioneer species jump in to cover it up, minimize soil erosion and make it easier for other species to grow. 	
<p>Day 11</p> <p>Succession - Secondary</p>	<p>Topic 2.7 – Ecological Succession ERT-2.I Describe ecological succession. ERT-2.J Describe the effect of ecological succession on ecosystems.</p> <p>SWBAT: Describe how the characteristics of a biome change as it moves through secondary succession using graphs, data and diagrams to make accurate claims supported by evidence.</p> <p>DISCIPLINARY LITERACY FOCUS:</p>	<p>KEY UNDERSTANDINGS CHECKLIST:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Ecological succession is a predictable process after an ecological disturbance. <input type="checkbox"/> Secondary succession occurs where disturbances have happened but soil is still present. <input type="checkbox"/> Secondary succession is a much shorter process than primary succession (decades vs centuries) <input type="checkbox"/> Describe a Pioneer species <input type="checkbox"/> Biodiversity increases as succession proceeds <input type="checkbox"/> Larger organisms are present further into succession <input type="checkbox"/> More specialist present in late succession <p>LESSON CONTEXT FOR LESSON MASTERY Students will explore secondary succession by exploring and analyzing data about an abandoned agriculture field that goes through the process of secondary succession. Students will work in groups to describe how the types of species present over time changes based on the data. This lesson is naturally sequenced with the primary succession lesson immediately before it because primary succession would happen in an area before secondary succession ever could</p> <p>LOOK-FORS  (What to observe students doing or producing)</p> <ul style="list-style-type: none"> • Counting the number of plant species at each time period 	<p>CONTENT BACKGROUND RESOURCES: See links from Day 10</p>

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
	 <p>Analyzing and Interpreting Data</p>	<ul style="list-style-type: none"> • Describing which species are present only at the beginning of the succession, which are present only in late succession and which persist through large time periods • Describing patterns in the types of species that are present in early, middle and late succession <p>COMMON MISCONCEPTIONS (Historical/widespread misunderstandings).</p> <ul style="list-style-type: none"> • Students think that succession only occurs after anthropogenic disturbances • Students think all succession starts the same way — forgetting that that <i>primary succession</i> starts from bare rock with no soil, while <i>secondary succession</i> starts where soil and some organisms remain. • Students underestimate the timescale — they may think both types occur equally quickly, not recognizing that primary succession generally takes MUCH, MUCH longer due to soil formation. <p>MAKING CONNECTIONS</p> <ul style="list-style-type: none"> • Secondary succession is MUCH more common (and observable in the modern world) than primary succession because it happens much more often and over a time frame that humans can readily observe • How do different species fit into the process of succession? Species have different survival strategies; some thrive during early or middle succession and have their niches reduced in late/climax succession • How are weeds beneficial to the process of secondary succession? OR how are weeds like pioneer species? both are r-selected species with fast growth rates and high biotic potential. They act as nature’s band-aid, quickly covering up bare soil which helps reduce erosion and nutrient loss so that other species can begin to grow there as well 	

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
<p>Day 12</p> <p>Population Dynamics – Day 1</p>	<p>Topic 3.5 – Population Growth & Resource Availability</p> <p>ERT-3. F Explain how resource availability affects population growth.</p> <p>SWBAT: Describe why some populations of species might experience exponential growth and others experience logistic growth.</p> <p>DISCIPLINARY LITERACY FOCUS:</p>	<p>KEY UNDERSTANDINGS CHECKLIST:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Each species has an intrinsic rate of growth (r) that is based on its characteristics like age of reaching sexual maturity, number of young produced at once, frequency of reproduction, etc. <input type="checkbox"/> Populations that grow at or close to their intrinsic rate of growth experience a J-shaped growth curve (r-selected species or generalists) <input type="checkbox"/> Explain how J-shaped growth often leads to an overshoot <input type="checkbox"/> Other populations follow a logistic growth curve (S-shaped) because environmental resistance significantly reduces their population growth rate <input type="checkbox"/> Density dependent environmental resistance factors are those that put more pressure on a species population as the population in each area (population density) increases, like availability of food resources, shelter and mates. <input type="checkbox"/> Carrying capacity for a population is determined by the density dependent environmental resistance factors <input type="checkbox"/> Explain how negative feedback loops are involved in population dynamics 	<p>CONTENT BACKGROUND RESOURCES:</p> <p>Khan Academy – Population Ecology Review</p>
<p>Day 13</p> <p>Population Dynamics – Day 2</p>	<p>DISCIPLINARY LITERACY FOCUS:</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div data-bbox="338 768 478 938" style="border: 1px solid purple; border-radius: 10px; padding: 5px; text-align: center;">  <p>Analyzing and Interpreting Data</p> </div> <div data-bbox="512 768 653 938" style="border: 1px solid orange; border-radius: 10px; padding: 5px; text-align: center;"> <p>Mathematics</p> <p>− + × ÷</p> <p>Computational Thinking</p>  </div> </div>	<p>LESSON CONTEXT FOR LESSON MASTERY</p> <p>Students will explore different characteristic types of population growth quantitatively. This gives students another opportunity to work in small groups to analyze graphical data and make and support claims using the data and environmental principles and concepts. This is an appropriate last day of new instruction for this unit because nearly every topic in the unit factors into population dynamics.</p> <p>LOOK-FORS 🔍 (What to observe students doing or producing)</p> <ul style="list-style-type: none"> • Creating graphs for each set of population data • Discussion about how to categorize each graph by population growth type <p>COMMON MISCONCEPTIONS (Historical/widespread misunderstandings).</p> <ul style="list-style-type: none"> • Students think all populations can grow exponentially forever, ignoring, ignoring the natural limits of environmental resistance factors. 	

Lesson	Objective(s) and Standard(s)	Instructional Notes	Resources
		<ul style="list-style-type: none"> Confusing the shapes of the graphs, such as labeling an S-curve as exponential. <p>MAKING CONNECTIONS</p> <ul style="list-style-type: none"> Connect r-selected and k-selected species, generalists and specialists with different types of population growth curves/rates and relationships to carrying capacity Population dynamics are often overlooked by people until they are completely out of whack. Like when areas have trouble with the population of deer, squirrels, etc. because they are eating plants, damaging landscapes or generally being a nuisance, it is often because the population dynamics of the area have broken down and they no longer have enough predators to control their population 	
<p>Day 14</p> <p>Flex/Review</p>	<p>Review Options:</p> <ul style="list-style-type: none"> Access AP Classroom Progress Check for Unit 2 (Note – will not cover Topics 3.1 – 3.5) <ul style="list-style-type: none"> Students should take the MC portion of the Progress Check and then justify their answers with table partners before receiving the correct answers and scoring their Progress Checks Quiz, Quiz, Trade FRQ Box Puzzle – from AP Bio – aligns with APES Units 1 & 2 NMSI AP Bio – Ecological Dynamics Review - aligns with APES Units 1 & 2 <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  02_Bio_SSS_Ecoloci alDynamics_Teacher </div> <div style="text-align: center;">  01_Bio_SSS_Ecologi calDynamics_STUDE </div> <div style="text-align: center;">  Box Puzzle_EcologicalDy </div> </div>	<p>Quiz, Quiz Trade</p>	
<p>Day 15</p> <p>Unit 2 Exam</p>	<p>TX_SCI_APEEnvironmentalScience_F24_UE2</p>		

VERTICAL STANDARDS

This section details the **progression** of key student expectations/standards** in the courses **before** and **after** this course. This will help you understand what **prior knowledge skills to build upon** and guide you in knowing what **skills you are preparing your students** for in the subsequent course.

BEFORE AP Environmental Science

Grade 6

6(11) Earth and space. The student understands how resources are managed. The student is expected to:

- 6(11)(A) research and describe why resource management is important in reducing global energy, poverty, malnutrition, and air and water pollution, and
- 6(11)(B) explain how conservation, increased efficiency, and technology can help manage air, water, soil, and energy resources.

6(12) Organisms and environments. The student knows that interdependence occurs between living systems and the environment. The student is expected to:

- 6(12)(A) investigate how organisms and populations in an ecosystem depend on and may compete for biotic factors such as food and abiotic factors such as availability of light and water, range of temperatures, or soil composition;
- 6(12)(B) describe and give examples of predatory, competitive, and symbiotic relationships between organisms, including mutualism, parasitism, and commensalism; and
-

Grade 7

7(9) Earth and space. The student understands the patterns of movement, organization, and characteristics of components of our solar system. The student is expected to:

- 7(9)(C) analyze the characteristics of Earth that allow life to exist such as the proximity of the Sun, presence of water, and composition of the atmosphere.

7(12) Organisms and environments. The student understands that ecosystems are dependent upon the cycling of matter and the flow of energy. The student is expected to:

- 7(12)(A) diagram the flow of energy within trophic levels and describe how the available energy decreases in successive trophic levels in energy pyramids; and
- 7(12)(B) describe how ecosystems are sustained by the continuous flow of energy and the recycling of matter and nutrients within the biosphere.

Grade 8

8(6) Matter and energy. The student understands that matter can be classified according to its properties and matter is conserved in chemical changes that occur within closed systems. The student is expected to:

- 8(6)(E) investigate how mass is conserved in chemical reactions and relate conservation of mass to the rearrangement of atoms using chemical equations, including photosynthesis

8(11) Earth and space. The student knows that natural events and human activity can impact global climate. The student is expected to:

- 8(11)(C) describe the carbon cycle.

8(12) Organisms and environments. The student understands stability and change in populations and ecosystems. The student is expected to:

- 8(12)(A) explain how disruptions such as population changes, natural disasters, and human intervention impact the transfer of energy in food webs in ecosystems.

8(6) Matter and energy. The student understands that matter can be classified according to its properties and matter is conserved in chemical changes that occur within closed systems. The student is expected to:

- 8(6)(E) investigate how mass is conserved in chemical reactions and relate conservation of mass to the rearrangement of atoms using chemical equations, including photosynthesis.

Pre-AP Biology (Grade 8 or 9)

• **ECO 1: Cycling of Matter in the Biosphere**

- (1.1) Hydrologic Cycle – Water cycles between abiotic and biotic systems in a process known as the hydrologic cycle.
 - ECO 1.1(a) Explain how the unique properties and phase changes of water enable and regulate biological reactions and/or processes.
 - ECO 1.1(b) Create and/or use a model to explain how biological systems function in the hydrologic cycle as water is transferred, transported, and/or stored.
- (1.2) Carbon & Nutrient Cycles – Elements that are building blocks of macromolecules are transported from abiotic to biotic systems through gaseous and sedimentary cycles.
 - ECO 1.2(a) Explain the importance of the cycling of carbon for biological systems.
 - ECO 1.2 (b) Create and/or use models to illustrate how organisms' capture and use of energy plays a role in the cycling of carbon in ecosystems.
 - ECO 1.2(c) Explain the importance of cycling of nutrients for biological systems.
 - ECO 1.2 (d) Create and/or use models to describe the cycling of nitrogen between biotic and abiotic systems.

• **ECO 2: Population Dynamics**

- (2.3) Food webs and Transfer of Energy in Ecosystems – Energy availability helps shape ecological communities.
 - ECO 2.3(a) Create and/or use models to explain the transfer of energy through the food web of a community.
 - ECO 2.3(b) Analyze data about species distributions to make predictions about the availability of resources.
 - ECO 2.3(c) Make predictions about the energy distribution in an ecosystem based on the energy available to organisms.

• **ECO 3: Defining Ecological Communities**

- (3.2) Types of Ecological Communities
 - (3.2.1) Terrestrial biomes are classified by geographic locations and the abiotic factors that shape the unique ecological communities.
 - (3.2.2) Aquatic biomes can generally be classified according to their salt concentrations: ocean, brackish and fresh water.

• **ECO 4: Ecological Community Dynamics**

- (4.1) Interspecific Competition – Competition between species drives complex interactions in ecosystems.
 - ECO 4.1(a) Explain how competition shapes community characteristics
 - ECO 4.1(b) Use data to analyze how competition influences niche-partitioning in an ecological community.
 - ECO 4.1(c) Create and/or use models to explain predictions about the possible effects of changes in the availability of resources on the interactions between species.
- (4.2) Symbiosis – Competition in ecosystems has led to symbiotic relationships where two or more species live closely together.

- ECO 4.2(a) Describe what type of symbiotic relationship exists between two organisms.
- ECO 4.2(b) Explain how a symbiotic relationship provides an advantage for an organism by reducing one or more environmental pressures.
- **CELLS 6: Photosynthesis (6.1.1)** Photosynthetic organisms have the cellular structure to absorb solar radiation and convert it into chemical energy.
 - CELLS 6.1(a) Explain why the products of photosynthesis are ecologically important.
 - CELLS 6.1(b) Create and/or use models to explain the process of converting solar energy into chemical energy through photosynthesis.
 - CELLS 6.1(c) Use data to describe what factors affect rates of photosynthesis.

Pre-AP Chemistry (Grade 9 or 10)

- 1.1.A.1 Create and/or evaluate models that illustrate how the motion and arrangement of particles differ among solids, liquids, and gases.
- 1.2.B.1 Use data to explain the direction of energy flow into or out of a system.
- 3.2.A.1 Create and/or evaluate models of chemical transformations.
- 3.2.B.1 Explain the relationship between the quantity of reactants consumed and the quantity of products formed in a chemical transformation.
- 3.2.C.1 Create and/or evaluate models of a reaction mixture before and/or after a reaction has occurred, including situations with a limiting reactant.
- 3.2.D.1 Calculate the theoretical yield and/or percent yield of a chemical reaction.
- 4.4.A.1 Create and/or evaluate a claim about whether a reaction is endothermic or exothermic from experimental observations.
- 4.4.A.2 Explain the relationship between the measured change in temperature of a solution and the energy transferred by a chemical reaction.
- 4.4.B.1 Create and/or evaluate a claim about the energy transferred as a result of a chemical reaction based on bond energies.
- 4.5.A.2 Explain how experimental changes in the rate of a reaction are related to changes in the concentration, temperature, or surface area of the reactants.

After AP Environmental Science

AP Biology (Grade 10, 11 or 12)

Unit 3: Cellular Energetics

- **ENE-1 The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.**
 - **Topic 3.5 Photosynthesis**
 - ENE-1.I Describe the photosynthetic processes that allow organisms to capture and store energy.
 - ENE-1.J Explain how cells capture energy from light and transfer it to biological molecules for storage and use.
 - **Topic 3.6 Cellular Respiration**
 - ENE-1.K Describe the processes that allow organisms to use energy stored in biological macromolecules.
 - ENE-1.L Explain how cells obtain energy from biological macromolecules in order to power cellular functions.

Unit 8: Ecology

- **ENE-3 Timing and coordination of biological mechanisms involved in growth, reproduction, and homeostasis depend on organisms responding to environmental cues.**
- **IST-5 Transmission of information results in changes within and between biological systems.**
- **ENE-1 The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.**
 - **Topic 8.1 Responses to the Environment**

- ENE-3.D Explain how the behavioral and/or physiological response of an organism is related to changes in internal or external environment.
- IST-5.A Explain how the behavioral responses of organisms affect their overall fitness and may contribute to the success of the population.
- **ENE-1 The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.**
 - **Topic 8.2: Energy Flow Through Ecosystems**
 - ENE-1.M Describe the strategies organisms use to acquire and use energy.
 - ENE-1.N Explain how changes in energy availability affect populations and ecosystems.
 - ENE-1.G Explain how the activities of autotrophs and heterotrophs enable the flow of energy within an ecosystem.
- **ENE-4 Communities and ecosystems change on the basis of interactions among populations and disruptions to the environment.**
 - **Topic 8.5: Community Ecology**
 - ENE-4.A Describe the structure of a community according to its species composition and diversity.
 - ENE-4.B Explain how interactions within and among populations influence community structure.
 - ENE-4.C Explain how community structure is related to energy availability in the environment.

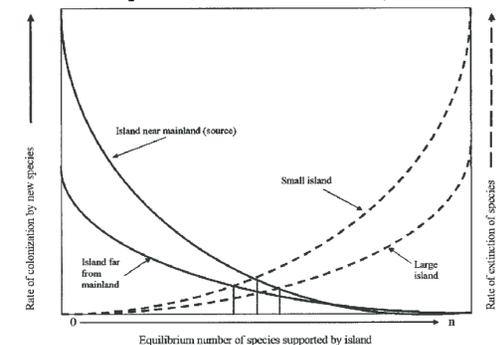
AP Chemistry

VOCABULARY GLOSSARY

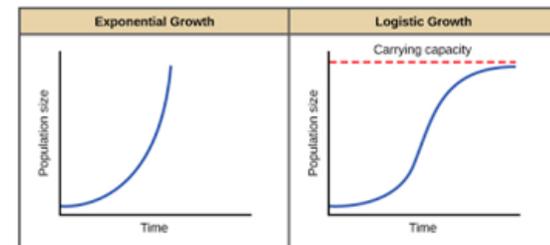
Domain-specific words and definitions for this unit.

Key Content Vocabulary

- **Biodiversity** – variety of different organisms
- **Habitat diversity** – variety of different ecosystems
- **Species Richness** – number of different species in an ecosystem
- **Species Evenness** – number of individuals of each species in an ecosystem
- **Generalist** – organism that may thrive on a variety of food sources in a variety of locations
- **Specialist** - organism that may rely solely on a specific food source or be found in a specific area
- **Ecosystem services** - The benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth.
- **Provisioning services** - Water, food, wood and other goods are some of the material benefits people obtain from ecosystems called 'provisioning services'. Many provisioning services are traded in markets. However, in many regions, rural households also directly depend on provisioning services for their livelihoods.
- **Cultural services** - The non-material benefits people obtain from ecosystems are called 'cultural services. They include aesthetic inspiration, cultural identity, sense of home, and spiritual experience related to the natural environment. Typically, opportunities for tourism and for recreation are also considered within the group.
- **Regulating services** - Maintaining the quality of air and soil, providing flood and disease control, or pollinating crops in the ecosystem. They are often invisible and therefore mostly taken for granted. When they are damaged the resulting losses can be substantial and difficult to restore.
- **Supporting services** - Living spaces such as habitats are provided for the animals and plants in the ecosystem. Furthermore, maintaining the diversity of plants and animals.
- **Theory of island biogeography** - The Theory of Island Biogeography originally explained how species come to be distributed across oceanic islands. This theory predicts the "habitat island's" biodiversity based on how big the island is and how far from the "mainland" it is.
- **Natural Selection** – process by which adaptations become pronounced in a population based on if they give the organism a reproductive advantage
- **Keystone species** – a species whose activities have a particularly significant role in determining community structure
- **Succession** – gradual changes in species composition of an ecosystem over time.
- **Primary succession** – succession which begins following glacial retreat or volcanic eruption in which there is NO soil present.
- **Secondary succession** – a process started by an event (e.g. forest fire, harvesting, hurricane, etc.) that reduces an already established ecosystem (e.g. a forest or a wheat field) to a smaller population of species, and as such secondary succession occurs on preexisting soil.



- **Indicator species** – plant or animal that, by its presence, abundance, scarcity, or chemical composition, demonstrates that some distinctive aspects of the character or quality of an ecosystem is present.
- **Pioneer species** – member of early successional species that move into unoccupied habitat
- **Generalist** - organism that may thrive on a variety of food sources and in a variety of locations
- **Specialist** - organism that may rely solely on a specific food source or be found in limited or specific areas
- **Type I survivorship** – a life history strategy characterized by many individuals surviving through juvenile stage and dying at an advanced age.
- **Type II survivorship** – a life history strategy characterized by individuals having an equal chance of dying at any age.
- **Type III** - a life history strategy characterized by many individuals dying at a young age and a few surviving to reach advanced age.
- **r-selected species** – Species characterized by small body size, many offspring per reproductive event, and lack parental care.
- **K-selected species** - Species characterized by large body size, few offspring per reproductive event, reproduction throughout their lifespan, and large amounts of parental care.
- **Life history strategy** - strategy that a species may use that has evolved over time due to tradeoffs between growth, survival, and reproduction.
- **Invasive species** – a non-native species that is accidentally introduced or released in a particular area. Invasive species cause economic or environmental harm to an area.
- **Carrying capacity (k)** : the maximum number of individuals that an ecosystem can support.
- **Density dependent factors** - those factors such as disease, predation, or competition for resources that begin to impact the population when the density of the population increases.
- **Population growth rate** - the number of offspring an individual can produce in a given time period
- **Intrinsic Growth rate (r)** - the maximum growth rate of a population. The rate at which a population increases in size if there are no density-dependent forces regulating the population is known as the intrinsic rate of increase.
- **J curve** – the shape of a population-time graph following the intrinsic growth rate
- **S curve** – the shape of a population-time graph following logistic growth (where the population is subject to environmental pressure that limit the growth rate
- **Population Overshoot** – when a population increases significantly above its carrying capacity, usually followed by a corresponding collapse
- **Ecological Tolerance (Optimal Range)** – the range of an abiotic factor where a species is able to reproduce to its biotic potential
- **Zone of physiological stress** – occurs when an abiotic factor exists at levels that are too high or low to support normal biotic potential.
- **Zone of intolerance** - occurs when an abiotic factor exists at levels that are so high that survival and reproduction of the organism/species is unlikely or impossible.



Related Vocabulary

Invasive Species Monoculture Resilience (ecosystem)	Population Collapse	Climax Community Old Growth Forest Understory	
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