Biology - Unit 1 - Ecology and Ecosystems

Unit Focus

This unit introduces students to the broad fundamental principles governing living things. Students will explore the integral parts of an ecosystem, specifically the linear flow of energy as it moves within and between organisms. Students will learn about selective pressures driven by relationships among and between different organisms, and nonliving factors within the biosphere that affect populations. Students will explore population dynamics influenced by limiting factors such as predator-prey relationships, climate, and availability of natural resources. Students will investigate what factors lead to a balanced, healthy ecosystem and, through a case study, learn about how ecosystems become unbalanced and the factors that cause this disruption. Through collaborative work, they will develop and revise a model to explain an anchoring phenomenon, and use this model to make predictions about related phenomena. By the end of the unit, students will have a deeper understanding of the essential processes that sustain life on our planet and the delicate balance between matter and energy within ecosystems.

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science Standards
Performance Expectations: High School Earth and Space Sciences

- Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. (HSESS2-7)

Performance Expectations: High School Life Sciences

- Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. (HS-LS2-6)
- Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. (HSLS2-8)

Next Generation Science Standards (DCI)
Science: 9

- 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 nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce

Transfer

Students will be able to independently use their learning to...
T1 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.
T2 Create models to explore complex systems, show mastery of key science concepts, and/or develop solutions through creation of a product open to testing and redesign.

Meaning

Understanding(s)

Students will understand that...
U1 The biosphere is the global, ecological system integrating all living things (biotic) and their relationships with the nonliving (abiotic) components of the environment.
U2 All living things have basic needs in order to survive and grow.
U3 The flow of energy into and throughout the Earth system is non cyclical
U4 Plants convert light energy from the sun to stored chemical energy that animals can use
U5 Feeding relationships within an ecosystem are adaptations that transfer energy from one organism to another
U6 The second law of thermodynamics states that whenever energy is transformed, there is a loss energy through the release of heat
U7 Environments can change over time in response to natural and human pressures

Essential Question(s)

Students will keep considering...
Q1 How are the living and nonliving components of the Earth system connected?
Q2 How does energy flow into and within components of the Earth system?
Q3 Why do populations change over time, and how can changes in populations be predicted?
Q4 What factors shape an ecosystem?

Stage 1: Desired Results - Key Understandings

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. (LS2.9.A1)

- 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. (LS2.9.C1)
- Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (LS2.9.D1)
- Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline-and sometimes the extinction-of some species. (LS4.9.C4)
- Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (LS4.9.C5)
- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (LS4.9.D1)
- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (PS3.9.B1)
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (PS3.9.B2)

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U8 The amount of available resources and limiting factors affects the growth of a population
U9 The combined effect of biotic and abiotic factors determine the overall productivity of an ecosystem
U10 Adaptations and behaviors in response to environmental pressures that positively affect survival are more likely to be reproduced, and thus are more common in a population

Acquisition of Knowledge and Skill

Knowledge

Students will know...
K1 Biological influences on organisms within an ecosystem are called biotic factors. These can include living (biotic), and nonliving (abiotic)
K2 The nonliving abiotic components of the biosphere include the lithosphere, geosphere, hydrosphere, and atmosphere.
K3 Biotic components are the living things that shape an ecosystem, and include producers, such as autotrophs, and consumers called heterotrophs
K4 Within the biosphere organisms function and interact among other living organisms at the species, population, and community level, as well as interact with the non living to form ecosystems.
K5 A hierarchy within a food chain consists of trophic feeding levels that begins with primary producers and ends with tertiary consumers.
K6 Due to heat loss and metabolic processes, only a fraction of the energy consumed at the lower trophic levels of a food web is transferred up, resulting in fewer organisms at higher levels.
K7 Factors that affect population size include the number of births, the number of deaths, and the number of individuals that immigrate or emigrate the population.
K8 Under ideal conditions with unlimited resources, a population will grow exponentially
K9 The ability of an individual organism in a population to survive and reproduce in its specific environment is called fitness, which depends on an organism's ability to adapt to changes in its environment

Skill(s)

Students will be skilled at...
S1 Construct a model that illustrates and explains that natural complexity of an organism's function and interaction with the biotic and abiotic components of the biosphere
S2 Analyze and interpret a mathematical model or representation of stored energy in biomass to describe and explain the transfer of energy from one trophic level to another.
S3 Evaluate evidence and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem
S4 Revise a model that predicts changes in populations when stable or unstable conditions are present.

Stage 1: Desired Results - Key Understandings		
• Analyzing: Examining information/data/ evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2) • Product Creation: Effectively use a medium to communicate important information. (POG.3.2)	**K10** Populations do not exist in isolation. They interact with other populations competing for food and resources **K11** Population density are numbers of organisms of the same type per unit area of living space **K12** Organisms introduced into non native environment are called invasive species, and can place unexpected pressures to how populations compete for resources **K13** Density dependent limiting factors are specific to a population's size, while density independent limiting factors can affect all populations in similar ways regardless of their population size **K14** Vocabulary: Abiotic Factor, Autotroph, Biotic Factors, Biomass (pyramid of), Biome, Biosphere, Carbon Dioxide, Carnivore, Carrying Capacity, Chemosynthesis, Community, Competition Competitive Exclusion Principle, Consumer, Decomposer, Density - Dependent Limiting Factors, Density - Independent Limiting Factors, Detritus, Detritivore, Ecological pyramid, Ecosystem, Emigration, Exponential growth, Food chain, Food web, Herbivore, Heterotroph, Immigration, Limiting Factor, Limiting nutrient, Logistic growth, Matter, Niche Nutrient, Omnivore, Oxygen, Photosynthesis, Population, Population Density, Predator, Prey, Producer, Pyramid of energy, Pyramid of numbers, Species, Trophic level, Trophic Cascade	