Key Concept 2: Population Dynamics

Learning Objectives *Students will be able to ...*	Essential Knowledge *Students need to know that ...*
Population Structure	
ECO 2.1(a) Explain the role abiotic and/or biotic resources play in defining the niche of a species. **ECO 2.1(b)** Collect and/or use data to predict population size, density and/or distribution. **ECO 2.1(c)** Create and/or use models to illustrate how environmental changes can alter the availability of biotic and/or abiotic resources.	**ECO 2.1.1 Species live in a defined range of abiotic and biotic conditions, or niche.** **a.** Sunlight serves as the primary energy input for most ecosystems. **b.** Species have a range of tolerance for abiotic resources and conditions (e.g., sunlight, nutrients, pH, temperature). **c.** Biotic conditions, including competition for mates and food (predator–prey interactions), also limit where organisms can live. **d.** Environmental changes can alter the availability of abiotic and biotic resources and conditions (e.g., climate changes, drought, fire, floods).
Population Growth	
ECO 2.2(a) Use data to explain the growth of a population. **ECO 2.2(b)** Explain the relationship between resource availability and a population's growth pattern. **ECO 2.2(c)** Explain how competition for resources shapes populations.	**ECO 2.2.1 Population growth patterns are influenced by the availability of resources and the interactions that occur within and between populations of species.** **a.** All organisms have the potential for exponential growth, but few organisms demonstrate this growth pattern. **b.** Both density-dependent (e.g., nutrients and food) and density-independent (e.g., weather, natural disasters) factors regulate population growth. **c.** The availability of a single resource may limit the survival of an organism or population (e.g., nitrates in soil are a limiting factor for plant growth). **d.** Due to dynamic resource availability, many populations fluctuate around their carrying capacity, thus demonstrating a logistical growth pattern. **ECO 2.2.2 Populations demonstrate diverse growth strategies.** **a.** r-selected species are typically short-lived. Therefore, they invest energy in producing many offspring during reproduction but provide little to no care for those offspring. **b.** K-selected species typically live longer. Therefore, they have fewer offspring during reproduction but invest energy in the care of those offspring to ensure survival.

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Food Webs and Flow of Energy in Ecosystems	
ECO 2.3(a) Create and/or use models to explain the energy flow through the food web of a community. **ECO 2.3(b)** Analyze data of 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 2.3.1 Energy availability helps shape ecological communities.** **a.** Only 10 percent of the energy available at one trophic level can be transferred to the next. **b.** The metabolic activity required to utilize the energy available in any given trophic level results in a loss of thermal energy to the environment, as heat. **c.** The energy available to organisms decreases from lower-order trophic levels (primary producers) to higher-order trophic levels (tertiary consumers).

Content Boundary: Students should begin to gain a conceptual understanding of how populations grow (e.g., exponential versus logistical growth). However, many students may not mathematically be able to distinguish the subtle differences between these two growth curves, especially in early generations. Therefore, assessment questions about growth patterns will be limited to what influences this type of growth; calculations of growth curves are *beyond the scope* of this course.

Cross Connections: Students should have strong familiarity with food webs from middle school life science. This course should give students opportunities to *make connections* and extend their beginning understanding of characteristics of organisms and food webs to deeper conceptual knowledge about how energy is transferred through diverse ecosystems.