

Learning Set 1 Question: How Do Populations Interact?

Scientific Principles

- ⬆ *In an ecosystem, all individuals interact with each other and with the physical surroundings; these interactions can be direct or indirect interactions and can result in immediate or delayed effects.*
- ⬆ *All ecosystems have a limited amount of resources needed for survival.*
- ⬆ *Some individuals will be more successful than others at consuming the resources in an ecosystem, simply because the distribution of resources around each individual vary.*
- ⬆ *Changes in population size directly affect the amount of available resources necessary for survival in an ecosystem, which in turn affect future population sizes.*
- ⬆ *When the environmental conditions change and remain changed for extended periods of time, the stability of the ecosystem tends to change and remain changed.*
- ⬆ *Every population affects the size of other populations either indirectly or directly, through immediate or delayed interactions and outcomes.*
- ⬆ *When all the individuals in a population are identical the competitive advantage these individuals have compared to individuals in other populations will change as the environmental conditions keep changing.*
- ⬆ *When one population outcompetes another, it may either lead to the immediate or eventual disappearance of other populations in the ecosystem.*

Lesson Question	Learning Performances in the Activity	Evidence that students evaluate	What students should know	Vocabulary to post	Learning Performances in the Homework
<u>Activity 1</u> What Changed and What Will Change?	Brainstorm possible abiotic and biotic changes that might be observed in an ecosystem in a human lifetime and over millions of years . List the types of evidence scientists could hunt for that might help them reconstruct what environmental changes happened in the past on Earth Pose individual questions about how populations or ecosystems change over time.	photographs of 2 pond ecosystems	Questions students have about how environments and populations change over time	The Driving Question Board should be posted. <i>Abiotic</i> <i>Biotic</i>	Brainstorm possible changes in the climate, geology, and forms of life found in fossils that occurred on Earth over millions of years. Pose individual questions about how populations or ecosystems change over time.

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<u>Activity 2</u> What type of interactions occur in ecosystems?	<p>Develop a definition for an ecosystem and an interaction.</p> <p>Identify different types of interactions between populations in an ecosystem including Produce/consumer and Predator/prey.</p> <p>Identify resources that are necessary for survival (food, space, water, air, and shelter) and some factors that might influence the distribution of resources.</p> <p>Build and use a model of pond food web to predict and visualize outcomes from various types of interactions between populations.</p>	<p>photographs of 2 pond ecosystems</p> <p>a simplified list of organisms in a pond ecosystem</p>	<i>In an ecosystem, all individuals interact with each other and with the physical surroundings; these interactions can be direct or indirect interactions and can result in immediate or delayed effects.</i>	<p>Ecosystem</p> <p>Interaction</p> <p>Direct vs. indirect</p> <p>Immediate vs. delayed</p> <p>Model</p>	Identify what type of objects and interactions they think might be important to include in a computer simulation of an ecosystem.

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<u>Activity 3</u> What causes competition between individuals in an ecosystem?	<p>Make predictions and compare the results for a participatory simulation of a simple consumer/producer ecosystem.</p> <p>Analyze population histogram graphs from a simulation to identify the range of the graph and where most individuals are concentrated.</p> <p>Identify and critique the modeling assumptions used in a computer model of a simple consumer/producer ecosystem.</p>	<p>Output of a participatory simulation from a model of a simplified consumer & producer ecosystem under two conditions: 1) when consumers are controlled by students and 2) when the consumers are randomly driven by the computer.</p>	<p><i>All ecosystems have a limited amount of resources needed for survival.</i></p> <p><i>Some individuals will be more successful than others at consuming the resources in an ecosystem, simply because the distribution of resources around each individual vary.</i></p>	<p>Competition</p> <p>Resources (food, water, shelter, light)</p>	<p>Compare the variations in the local surroundings between two individuals in the same ecosystem.</p> <p>Calculate how the amount of grass and amount of bugs would affect the average amount of grass available per bug, and likewise how changes in this average food availability would effect the death rate and birth rates in the bug population.</p> <p>Describe how local variations of resources necessary for survival contributes to differences in the level of success different individuals have in acquiring those resources.</p>

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Activity 4 How Do Population Sizes Change In Ecosystems?	Analyze population level graphs for fluctuations and stability. Describe the capacity of a population in an ecosystem as the average population level over time. Describe why changing the amount of a limited resource necessary for survival would affect the size of this population. Explain the cyclical pattern of population size changes in terms of delayed effects between the average amount of grass available per bug, and death rates and birth rates in the bug population.	Model runs and population graphs from experiments with a simple producer & consumer ecosystem model under different environmental conditions. Hudson Bay Company records of pelt-trading of Canadian lynx and snowshoe hares from 1825 to 1925. Map of zebra mussle sighting distribution in the U.S.	<i>Changes in population size directly affect the amount of available resources necessary for survival in an ecosystem, which in turn affect future population sizes.</i> <i>When the environmental conditions change and remain changed for extended periods of time, the stability of the ecosystem tends to change and remain changed.</i>	<i>Fluctuation</i> <i>Stable System</i> <i>Carrying capacity</i>	Critique the usefulness of the computer model by comparing the model predictions to predator/prey data from a real-world ecosystem.

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Activity 5 How Do Populations Affect Each Other In Ecosystems?	Analyze population level graphs to determine when peak sizes occur for producer, consumer, and predator populations. Describe why changing the amount of a limited resource necessary for one population could have delayed effect on the size of that population and describe why it could have a indirect effect on the size of other populations in the ecosystem. Experiment with how changing the attribute of a population can give it a different competitive advantage for survival.	Model runs and population graphs from experiments with consumer & predator ecosystem model under when predators and invasive species are added. Graphs of past average temperature of the planet from kya and mya time scales.	<i>Every population affects the size of other populations either indirectly or directly, through immediate or delayed interactions and outcomes.</i>	<i>Invasive species</i> <i>Trait Variation</i>	Evaluate the usefulness of a model by comparing the model predictions to predator/prey data from a real-world ecosystem. Identify environmental changes and trait variations that might contribute to whether an invasive species will survive in a new region.

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Activity 6 Can You Design A Population That Will Outcompete All Others?	Design creatures with different combinations of traits to test in an ecosystem. Record and compare the success of various creature designs in terms of longevity	Output of a participatory simulation from a complex ecosystem with dozens of competing species when trait variation for each species 1) is designed by other participants and 2) when trait variation is randomly assigned by the	<i>When all the individuals in a population are identical the competitive advantage these individuals have compared to individuals in other populations will change as the environmental conditions keep changing.</i> <i>When one population outcompetes another, it may either lead to the immediate or eventual</i>	<i>Extinction</i>	Explain why no single set of trait combinations for a species will guarantee that the offspring will survive in a changing ecosystem. Propose possible reasons why most of the species that have lived on Earth in the past are now

	of their offspring population.	computer.	<i>disappearance of other populations in the ecosystem.</i>		extinct
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