

Ecosystems: Interactions, Energy, and Dynamics and Earth’s Systems	Connections to Classroom Activity
Performance Expectations	
5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	Students used 2-liter bottles to create a closed ecosystem that included two connected components: aquatic and terrestrial environments.
5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	
4-LS1-1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	
Science and Engineering Practices	
Asking questions and defining problems	Students’ predictions about living and nonliving things led to investigative questions about how things interact in an environment.
Planning and carrying out investigations	Students helped build 2-liter bottle ecosystems to explore how the living and nonliving interact in an ecosystem.
Developing and using models	Students labeled different parts of the 2-liter bottle ecosystem.
Constructing explanations	Students created diagrams to explain how different parts of an ecosystem are related.
Disciplinary Core Ideas	
LS2.A: Interdependent Relationships in Ecosystems: The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.	Students' firsthand experiences with the bottled ecosystem connect to what they learned through reading and a teacher explanation. The teacher explanation introduced food webs and decomposers.
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems: Matter cycles between the air	Students considered the relationship between plants and animals in the bottled

and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment and release waste matter (gas, liquid, or solid) back into the environment.	ecosystems. They learned from the reading that plants produce oxygen. During the teacher explanation, they created diagrams showing the reciprocal exchange of gases between plants and animals (i.e., plants produce oxygen and animals produce carbon dioxide).
LS1.A: Structure and Function: Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.	Students closely observed one living thing to describe specific features and their purposes.
ESS2.A: Earth Materials and Systems: Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.	Students learned from their bottle ecosystem that the aquatic habitat provides water for the terrestrial habitat. Earth systems are similar to the 2-liter bottled ecosystem and interact and affect each other in multiple ways.
Crosscutting Concepts	
System and system models	Students used scientific models to explain the interactions that occurred within the bottled ecosystem and make predictions about other examples of ecosystems.
Cause and effect	Students predicted the influence of changing one factor on another in the bottled ecosystem.

Note: The materials, lessons, and activities outlined in this article are just one step toward reaching the performance expectations listed in this table. Additional supporting materials, lessons, and activities will be required. See www.nextgenscience.org/pe/5-ls2-1-ecosystems-interactions-energy-and-dynamics, www.nextgenscience.org/pe/5-ess2-1-earths-systems, and www.nextgenscience.org/pe/4-ls1-1-molecules-organisms-structures-and-processes.