NGSS Connections

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Chain Links
Middle School

Performance Expectations: Students' ability to complete the following performance expectation(s) will be supported by participation in this activity. MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. HS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.		
Dimension	**NGSS Code or citation**	**Corresponding student task in activity**
Disciplinary Core Idea	LS2.A Interdependent Relationships in Ecosystems • Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with non-living factors.	Students are asked to address the driving question: What happens to living things when pollutants are added to the Bay? They also model population interactions when osprey and microbe populations decline in a Bay community.
	LS2.B Cycle of Matter and Energy Transfer in Ecosystems • Food webs are models that demonstrate how matter and energy are transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and non-living parts of the ecosystem.	Students construct a food web model for the Chesapeake Bay then use the food web to predict impacts on other species if a species population shifts.

	LS2.C Ecosystem Dynamics, Functioning, and Resilience • Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. • Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.	Students construct a food web for the Chesapeake Bay, then model the impact on the community as populations shift. Students investigate pollutant effect on a microbe, and construct an explanation of the impacts on the rest of the food web. Students are asked this question: What would happen to other populations if the bacteria were susceptible or sensitive to the pollutants Silvia found? Students are asked this question: Based on the food web models, is a healthier ecosystem one with more or less biodiversity? Why?
	ESS3.C Human Impacts on Earth Systems • Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (positive and negative) for different living things.	Students use a food web model to explain community interactions. Students also determine pollutant impacts on the base of the food web, then construct an explanation of how those pollutants would impact the rest of the community based on the reduced numbers of microbes (food chain base).
Practice	Planning and Carrying Out Investigations • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.	Students order and reorder steps of the protocol to test the bacteria's sensitivity to various environmental contaminants.

	• Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.	Students collect data to determine the reaction of bacteria to exposure to pollutants and use the data and their models to predict impacts across the food web.
	Analyzing and Interpreting Data • Analyze and interpret data to provide evidence for phenomena.	Students analyze and interpret data they collected in their investigation to determine bacterial sensitivity to environmental contaminants; not all contaminants kill the bacteria but still have adverse reactions in the environment.
	Constructing an explanation • Construct an explanation using models or representations. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.	Students construct food web models then use them to explain the impacts of pollution killing microbes in the Chesapeake Bay. Students construct a scientific explanation using the Claim-Evidence-Reasoning framework about bacteria's sensitivity to environmental contaminants can affect the food web.
	Develop and use models • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena.	Students develop a model of a Chesapeake Bay food web then manipulate it to predict what happens when different populations in the food web decline.
Crosscutting Concept	Stability and Change • Small changes in one part of a system might cause large changes in another part.	Populations change in response to changes in other parts of the food web.
	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems.	Students use the C-E-R framework to recognize the cause and effect of adding pollutants causes microbial

		populations to decline, which in turn causes decline in other species in the food web.

Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations.

Scientific Investigations Use a Variety of Methods

- Science investigations are guided by a set of values to ensure accuracy of measurements, observations, and objectivity of findings.

Science Addresses Questions About the Natural and Material World

- Science knowledge can describe consequences of actions but is not responsible for society's decisions.

Connections to Common Core State Standards

English Language Arts/Literacy RST.6-8.1 RST.6-8.3 RST.6-8.7	