LAB-AIDS®
Experiencing Science

Modeling the Effects of an Introduced Species

KIT# 547S

Teacher's Guide

This kit, and all other Lab-Aids® kits with catalog numbers ending in "S," have been adapted from a SEPUP™ curriculum product. The activity in this kit is based on an activity from SEPUP's NGSS designed, 3rd Edition middle school Ecology unit. Please consider using other SEPUP products such as full year courses, individual course units, modules, and other Lab-Aids kits with catalog numbers ending in "S." Lab-Aids kits ending in "SEL" contain enough materials to allow for one additional group but do not contain a Teachers Guide or any materials shared by all groups.

CONTENTS

1	set of Introduced Species cards
8	sets of Food Web cards
9	resealable bags
32	Student Worksheet and Guides
1	Teacher's Guide

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OVERVIEW

Using a set of Food Web cards, each depicting an organism, students work in groups to model a food web for one of four ecosystems. Students are then given an additional card representing an introduced species. They must revise their models to explore and explain how the flow of energy and cycling of matter are disrupted by this introduced species.

NGSS CORRELATIONS

Performance Expectation

MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Disciplinary Core Ideas

MS-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 recycled repeatedly between the living and nonliving parts of the ecosystem.

MS-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.

Science and Engineering Practices

Developing and Using Models: Develop a model to describe phenomena.

Crosscutting Concepts

Energy and Matter: The transfer of energy can be tracked as energy flows through a natural system.

Systems and System Models: Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy and matter flows within systems.

Connections to Nature of Science: Scientific Knowledge Assumes an Order and Consistency in Natural Systems: Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.

Common Core State Standards—ELA/Literacy

WHST.6-8.1: Write arguments to support claims with clear reasons and relevant evidence.

KEY VOCABULARY

consumer
food web
predator
prey
producer

ADVANCE PREPARATION

Gather the following optional materials for each student group: either a large sheet of paper and a set of markers or a ribbon or a string. See Teaching Step 2b and 2c.

There are two sets of each different Food Web Ecosystem: A (forest), B (desert), C (marine), and D (grassland), making a total of eight sets . Each lettered set contains nine blue Food Web cards and one orange-yellow Introduced Species card. For ease of class management, each set of Food Web cards and the set Introduced Species cards can be sorted and placed into the resealable bags.

TEACHING STEPS

Getting Started

1. Students review what they know about food webs.

   a. Review the components and interactions in a food web.

      Before beginning this activity, students should have a clear understanding that the components in the food web are the different organisms and that the interactions are the flow of energy and matter from one organism to another. Make sure students are familiar with these aspects of food webs and, if necessary, review or introduce the terms producer, consumer, predator, and prey then draw a simple web to illustrate and review the components and interactions.

   b. Ask, "How do you think the introduction of a new species affects a food web?" Have them discuss briefly with their partners.

      The point of asking this question and having students answer to their partners is to have them start thinking about effects of an introduced species as they create their models.

DO THE ACTIVITY

2. Students construct a food web using their set of Food Web cards.

   a. Give each group a set of Food Web cards, being sure to withhold the Introduced Species cards.

      The Food Web cards have a teal border, while the Introduced Species cards have an orange border. Separate the Introduced Species cards from the set and distribute these in Step 3 below. There are two identical sets of cards for four different ecosystems. Each card has a brief description of an organism and enough information for the students to be able to determine whether the organism is a producer or a consumer, and if the consumer eats plants, animals, or both.

   b. Explain the criteria for their models.

      Students' models must show the food web's biotic components (organisms) and interactions (feeding relationships). They must indicate how energy is flowing and matter is cycling in the ecosystem. Depending upon your students' understanding, the models can also incorporate abiotic components in the environment to indicate the original source of energy for the ecosystem (the Sun) and the matter that exists outside of the organisms (e.g. oxygen, carbon dioxide, water, soil nutrients). This should be done by drawing arrows or placing pieces of ribbon or string between organisms, tying a knot at the end of the string or ribbon suggesting the point of the arrow. Students should use different colors of arrows to distinguish energy from matter.

   c. Instruct groups to create food webs for their set of organisms.

      If groups are constructing their models on a large sheet of paper, they can show relationships with arrows drawn with pencils or markers. If they are constructing their model on a desk or table, they can use pieces of string or ribbon to show relationships.

3. Students introduce a species to their food web models.

   a. Give each group the Introduced Species card that corresponds with their ecosystem.

   b. Explain to groups that they need to revise their models to show how the introduced species impacts the flow of energy and cycling of matter.

      Students will need to develop a way to depict if feeding relationships are disrupted. If groups are struggling, suggest that they make their arrows thicker (or add string) if more energy and/or matter will flow. They can add dashes to their arrows (or make marks on the string) if less energy and/or matter will flow. They can put an "x" on arrows (or remove string) if relationships will be eliminated.

BUILD UNDERSTANDING

4. Students extend their understanding by considering what would happen to their ecosystems if species were removed.

   a. Direct students to Analysis item 2a, which asks them to consider what would happen in their ecosystems if a top predator were removed.

      This scenario represents the problem in conservation biology when a native species, like a tiger or bald eagle, is removed due to hunting or habitat destruction; the entire ecosystem can collapse because all feeding interactions are disrupted.

   b. Direct students to Analysis item 2b, which asks them to consider what would happen if a producer were removed.

      This scenario replicates harvesting of plants for agricultural use. The rest of the food web is disrupted if the plant being removed is the primary producer in the ecosystem.

SAMPLE RESPONSES TO ANALYSIS

1. Explain how the introduction of your new species affected your ecosystem. Be sure to address which interactions were affected.

   Any introduction has consequences for the entire ecosystem because all organisms are connected either directly or indirectly through feeding relationships. Any time a feeding relationship is added to an ecosystem, the flow of energy and cycling of matter are affected. Below are just a few examples of relationships that could be directly or indirectly affected.

   In Set A, the introduced species are wildflowers, which are producers. All interactions could be affected if the wildflower outcompetes the other producers and the animals aren't able to eat the flowers.

   In Set B, the introduced species is the rattlesnake, a predator of small mammals and birds. All interactions could be affected if the snake consumes many of the mammals and birds. Populations of any organisms eaten by those mammals and birds might then increase.

   In Set C, the introduced species is a shrimp, which eats tiny plants and animals. If the shrimp outcompetes other animals that feed on the same organisms, these other animals may disappear. If so, all of the interactions could be affected.

   In Set D, the introduced species is a wild pig, which eats plants. If the pig eats most of the plants, there may not be enough food left for other plant-eating animals. Any population of predator that feeds on these other animals could decline.

2. What would happen if

   a. the top predators disappeared from your ecosystem? This might happen if the predators were overhunted. How does this affect the flow of energy through your ecosystem?

      The entire ecosystem can collapse because all feeding interactions are disrupted. Removing a top predator allows the population of other predators to increase. If this happens, their prey items may decrease. Eventually, the only component left in the ecosystem may be the plants, because there is nothing left to eat them.

   b. the producers disappeared from your ecosystem? This might happen if a disease caused the producers to die off. How does this affect the flow of energy through your ecosystem?

      The source of energy for all of the other organisms would cause the collapse of the ecosystem. The animals that eat plants would have no source of energy, so the predators that eat those plant-eating animals would also lose their source of energy.

REVISIT THE GUIDING QUESTION

How does a new species affect the flow of energy and cycling of matter through an ecosystem?

A new species affects the entire ecosystem because all components are directly or indirectly connected through energy and matter interactions. A new plant species may outcompete other plants for sunlight or matter. A new predator may have a domino effect on the entire ecosystem if it is at the top of the food web. All new species have the potential to rearrange the manner in which energy flows through and matter cycles in an ecosystem.

EXTENSION

Introduced Species Research Project: Explain how the introduction of the species you are investigating impacts the flow of energy and cycling of matter in the ecosystem.

Student responses will vary. One sample response is shown here:

Asian carp consume a lot of the food that other native species would eat, and prevent the flow of energy and cycling of matter to those species. Because the carp have no predators, the energy gained from items lower on the food chain is released into the abiotic parts of the environment. After the carp die, their matter is taken in by decomposers before being returned to the abiotic components of the environment.