

Teacher Guide

Ecosystems



Grade Level: 4th – 8th Grade

Time Requirement: 30 – 45 minutes

Introduction

An **ecosystem** is an area in which living things interact with each other and their environment. They include both **abiotic factors** and **biotic factors**. To sustain itself, an ecosystem needs energy to constantly enter and flow through it and nutrients to cycle throughout. In this activity, students will explore ecosystems through the lens of the early San Antonio River Valley. They will then create their own self-sustaining ecosystems, planting two seeds in them to model how ecosystems sustain themselves.

Required Materials

- 24-oz. Plastic Cups (25)
- Dome Lids (25)
- Coffee Filters (50)
- Spray Bottles (3)
- Cilantro Seeds (1 pack)
- Sugar Snap Pea Seeds (1 pack)
- Potting Soil
- Sand

Science Standards

- 4.12(A) investigate and explain how most producers can make their own food using sunlight, water, and carbon dioxide through the cycling of matter
- 4.12(B) describe the cycling of matter and flow of energy through food webs, including the roles of the Sun, producers, consumers, and decomposers
- 5.12(A) observe and describe how a variety of organisms survive by interacting with biotic and abiotic factors in a healthy ecosystem
- 6.12(A) investigate how organisms and populations in an ecosystem depend on and may compete for biotic factors such as food and abiotic factors such as availability of light and water, range of temperatures, or soil composition
- 7.12(B) describe how ecosystems are sustained by the continuous flow of energy and the recycling of matter and nutrients within the biosphere

Objectives

- Identify the components of an ecosystem.
- Explain how ecosystems sustain themselves through nutrient cycling and energy flow.
- Outline how nutrients cycle and how energy flows in an ecosystem.

Art Extension: Visual Journal

Students can track the growth of their plants and the changes within their ecosystems by keeping a visual journal. In each journal entry, students sketch and label their ecosystem and answer three reflection questions.

Historical Context

Situated at a crossroads of multiple distinct ecological regions, San Antonio is home to a rich community of diverse plants and animals. Likely drawn to the area's water sources and wildlife, Native Americans began living in the San Antonio River Valley as early as 12,000 years ago. The region's climate was much colder then, and these early inhabitants' diets would have consisted of large animals like mammoths and ancient bison, as well as edible plants.

By the 1500s, the climate of San Antonio was much like it is today, and this environment played a huge role in the Native American's way of life. While humid and subtropical, rainfall in the region was often unpredictable, making large-scale, year-round **agriculture** difficult. However, it is likely that **horticulture**, or small-scale gardening, was practiced. With horticulture, people would have had small household plots growing plants that were in season, like beans, maize, and squash. As they moved throughout Central and South Texas, Native Americans would have used plants naturally growing in each location. In addition to these **cultivated** plants, many others were collected, like pecans, mesquite beans, *nopal* (prickly pear cactus), and *tuna* (the fruit of the prickly pear).

Because of the grasses in Central Texas, it was home to a variety of **game**. People hunted many of these animals, including deer, rabbit, squirrel, and bison. Proximity to water sources like the San Antonio River and San Pedro Springs meant that fish, mussels, and even shrimp were food sources for the Native Americans.

As seasons changed, the Native Americans moved along the San Antonio River in small **bands**, which were generally groups made of an extended family with less than thirty people. In the fall, as temperatures cooled and waterfowl flew to the coast for winter, bands traveled south as well. In the spring, as animals were on the move to find mates, bands would come back north, staying along the river.

Background

An **ecosystem** is an area in which living things interact with each other and their environment. There are many types of ecosystems, like marine, desert, and forest, that are characterized by the organisms in the area and the environment. They can vary greatly in size, from as small as a pond to as large as a desert. Our bodies are home to ecosystems, too!

An ecosystem includes both living and nonliving things. The living things, or **biotic factors**, include animals, plants, fungi, and even microorganisms such as bacteria and protists. The nonliving things, or **abiotic factors**, include things such as water, rocks and minerals, sunlight, and climate. For example, a freshwater ecosystem, like a lake, will have a variety of **biotic factors**: algae, fish, frogs, and bacteria. This community of organisms will interact with the surrounding **abiotic factors**: temperature, water, rocks, humidity, and sunlight, among others.

The living things in an ecosystem can be categorized based on how they acquire **nutrition** and **energy**. Each organism and category plays a key role in supporting the ecosystem. **Producers**, also known as autotrophs, make their own food. They are important in an ecosystem because the nutrients they produce provide energy and nutrition for the rest of the organisms in the ecosystem. Many producers use sunlight, water, and carbon dioxide to create food (*glucose*) in a process called photosynthesis. Examples of photosynthetic producers include most plants, algae, and some bacteria.

Consumers, also known as heterotrophs, must get nutrition and energy from eating other organisms. For example, **herbivores**, like rabbits and sea turtles, get nutrition by eating producers, whereas **carnivores**, like cats and frogs, eat other animals. Some consumers, like the brown bear and hedgehog, eat other consumers and producers. These are called **omnivores**.

Decomposers are a special type of heterotroph that get their energy and nutrients by breaking down the remains of dead plants and animals. Decomposers are a critical part of ecosystems because they ensure that nutrients, like nitrogen, phosphorus, and carbon, are recycled and available for producers to use.

Detritivores, like earthworms and dung beetles, are a type of decomposer that eat organic material called **detritus**. Detritus can include dead plant material, animal remains, and animal feces. **Saprotrophs**, another kind of decomposer, obtain nutrition by excreting digestive enzymes which break organic matter down into

smaller units. These smaller units can then be absorbed by the saprotroph. Many fungi are saprotrophs, as well as some bacteria.

For an ecosystem to sustain itself and survive, energy must constantly enter and flow throughout it. Energy generally enters an ecosystem when **producers** capture light energy from the sun during **photosynthesis**. During photosynthesis, producers create their own food (glucose), and the energy stored in this food is transferred through the ecosystem when consumers eat producers or other consumers. Unlike nutrients, energy is not recycled in an ecosystem, as a large amount of energy is lost as heat.

In addition to energy flow, ecosystems also need nutrients, such as carbon, nitrogen, and phosphorus, to cycle throughout. **Producers** create their own food during **photosynthesis**, and these nutrients are passed to **consumers** after eating producers or other consumers. When **producers** and **consumers** die, **decomposers** break down the organic matter into other forms that can be recycled in the ecosystem and used again.

Procedures

Teacher Notes

Once students close their ecosystems, they should not need to be opened. If, after several days, you do not see any condensation on the sides of the cup, you may need to open it to add more water.

Student Procedures

1. Write your names on the side of your cup with a marker.
2. Add a small layer of sand, about 0.75in – 1in, to the bottom of your cup.
3. Use a spray bottle to moisten the sand. Be careful not to add too much. You don't want the sand to be fully saturated.
4. Cut a circle out of your coffee filter.
5. Add the circle on top of the sand.
6. Add a layer of soil, about 1.5 in, on top of the coffee filter.
7. Add a few sprays of water to moisten the soil. Don't add so much that you have water dripping into the sand.
8. Make a small indentation in the soil, about 1in deep and about 1in from the side of the cup.
9. Place a pea seed in the indentation and lightly cover it with soil.
10. Make another small indentation in the soil, about 0.25in deep. This should be from 0.5in to 1in from the sides of the cup AND the pea seed.
11. Place a cilantro seed in the small indentation and lightly cover it with soil.
12. Before placing the lid on your cup, breathe gently into it, like you would when fogging up a window or mirror.
13. Place the lid on your cup and leave it in a well-lit area.

Safety and Disposal

It is recommended that students wear gloves, goggles, and aprons during this activity. Plants can be transplanted to a school, community, or home garden. Plastic containers can be re-used for other terrariums or recycled.

Contributors

Tom Castaños
Tiffany Lindley, PhD, RPA
Ernesto Rodriguez III

Morgan Oldham
Brianna Echavarria
Rosemary Kriegel

Alexander Rivard
Caryn Condello
Carla Perrio