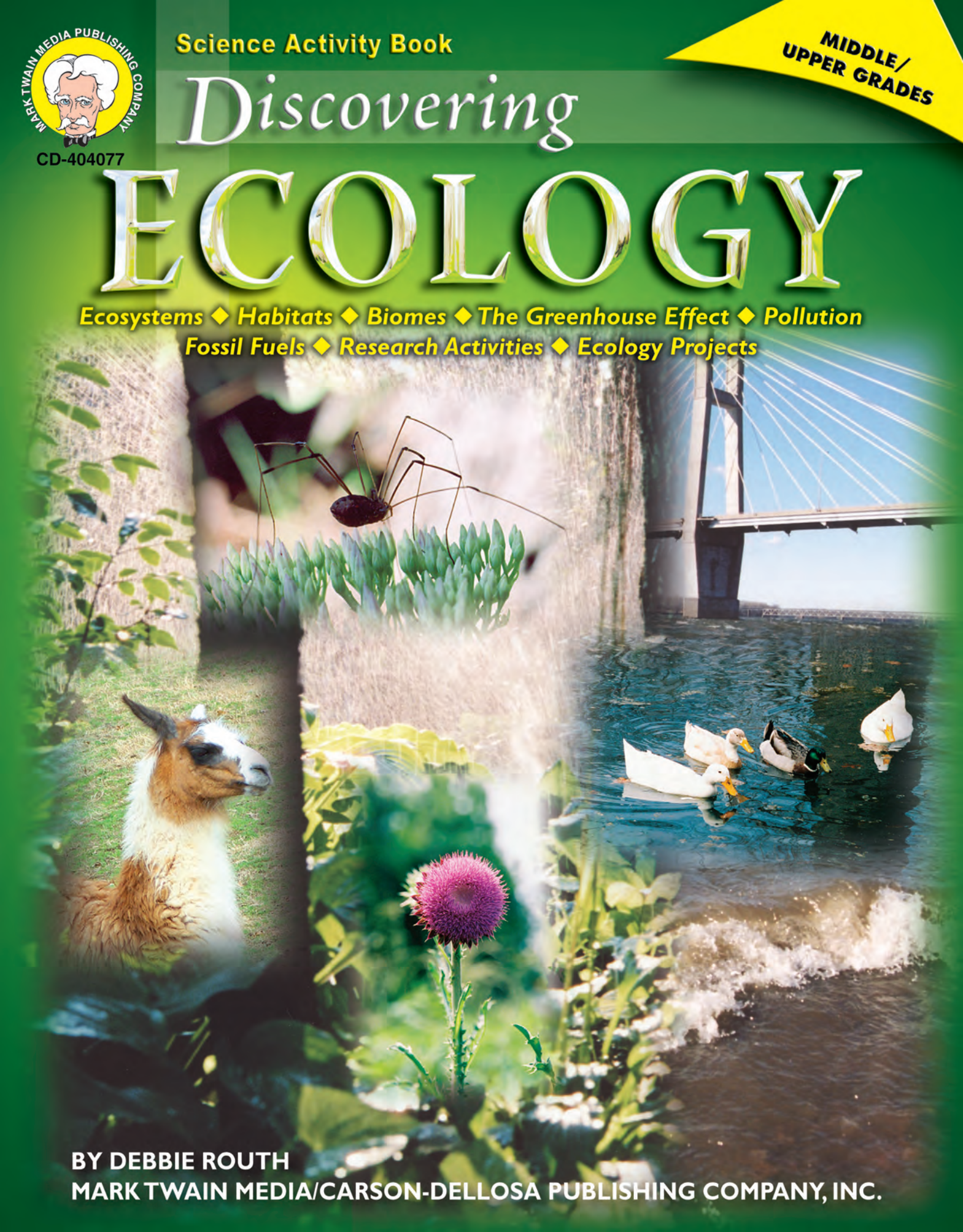
MARK TWAIN MEDIA PUBLISHING COMPANY
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Science Activity Book
MIDDLE/
UPPER GRADES
Discovering
ECOLOGY
Ecosystems ◆ Habitats ◆ Biomes ◆ The Greenhouse Effect ◆ Pollution
Fossil Fuels ◆ Research Activities ◆ Ecology Projects
BY DEBBIE ROUTH
MARK TWAIN MEDIA/CARSON-DELLOSA PUBLISHING COMPANY, INC.

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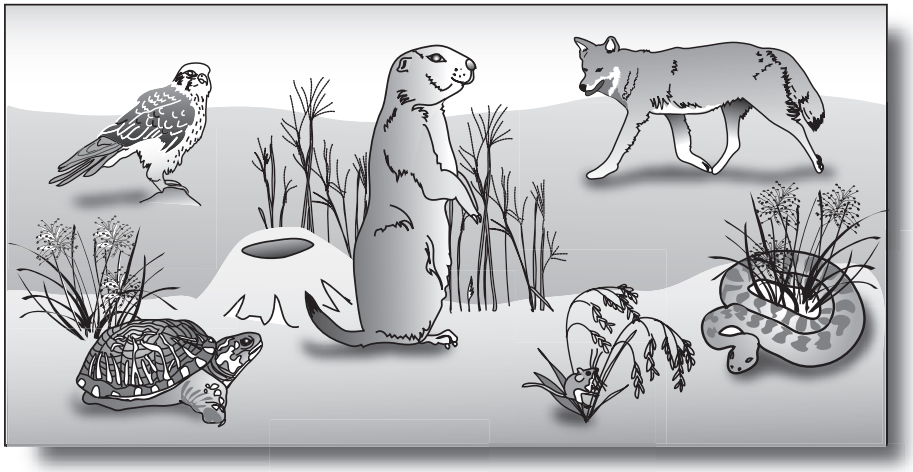
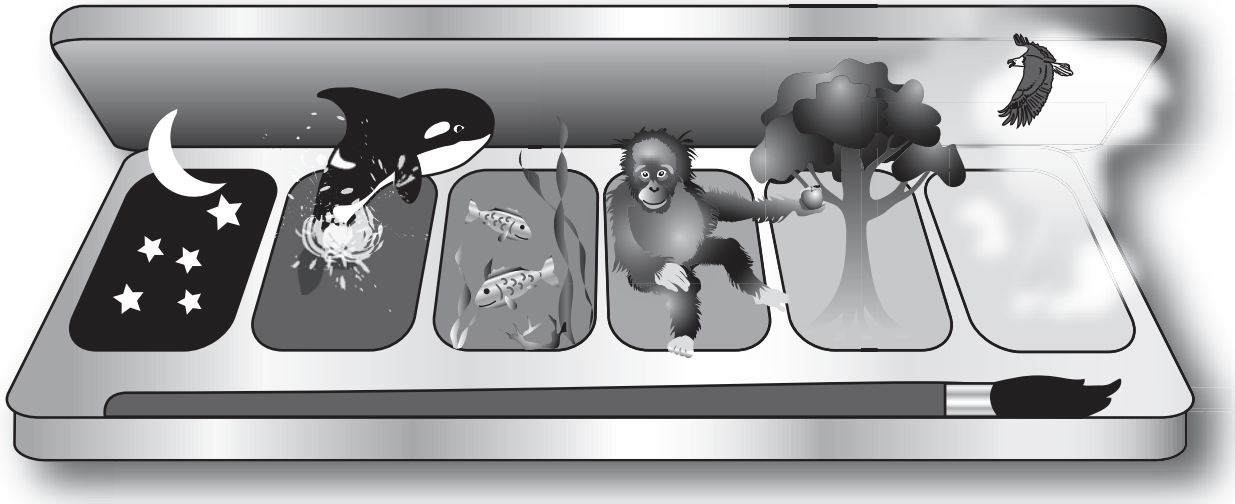


Introduction

Welcome, student observers, to some amazing Earth facts. In this unit, you will learn what you can do to make a difference in your environment and help protect the future of Earth. Topics covered in this unit include air, water, and land pollution and their effects. You will explore environmental topics including acid rain, the greenhouse effect, and biomes, and you will reflect on population studies. You will learn about the various factors that determine each environment. Each environment has it own unique characteristics. The organisms (living things) that live in each area of our diverse biosphere are adapted or well suited to live in each of these areas.

You will learn about biotic and abiotic factors and their importance to life on earth. Biotic factors are the living parts of an environment. These are things like plants, animals, and other organisms in the area. Abiotic factors shape global and regional climates—these include physical factors, such as temperature, light, water, and soil.

Student observers, you will use many science process skills to discover the influence humans have on the environment. This book on habitats (the places where living things live), niches (the role organisms play within their habitats), and food chains (the interdependence of organisms—predators and prey) makes this important natural science called ecology come alive.



Teacher Note: This book supports the National Science Education Standards and is designed to supplement your existing science curriculum or to be taught as a thematic unit on ecology. Each lesson opens with a manageable amount of text for the student to read. The succeeding pages contain exercises and illustrations that are varied and plentiful. The lessons may be used as a complete unit for the entire class or as a supplement for the reluctant learner. The tone of the book is informal; a dialogue is established between the book and the student. Use this book to keep your students informed of local and global issues affecting the environment. Get your students involved in community projects, whether it is recycling, tree planting, or educating others about the dangers to our environment.

What Is Ecology?

Ecology (ee-KAHL-uh-jee) is the study of living things in their **environment** (in-VY-run-munt), or natural surroundings. This is everything **biotic** (living) and **abiotic** (nonliving) that is around them. All living things are affected by their environment and have an effect on their environment. The word *ecology* came from the Greek word *okologie*, meaning the study of homes and estates. This refers to the home or surroundings in which an **organism** (living thing) lives. A German naturalist, Ernst H. Haeckel, was the first person to use the term in its present meaning. An **ecologist** is a scientist who studies the relationships between living things and their environment. An ecologist investigates how plants and animals, including people, live with and affect each other and their surroundings.

The Biosphere

The part of the earth that supports life is called the **biosphere**. The top portion of the earth's crust, all the water on the earth's surface, and the surrounding atmosphere make up the very thin layer called the biosphere. All the different environments that are home to different kinds of organisms are found in the biosphere.

Importance

All living things need materials to carry out their life processes. These materials come from the environment. Organisms get nutrients, water, oxygen, carbon dioxide, and energy from their environments. **Nutrients** (NOO-tree-unts) are used for growth, repair, and energy. Plants get their nutrients and water from the soil. Plants take in carbon dioxide from the air. They obtain energy directly from the sun. Sunlight is the source of energy that fuels most life on Earth. They then use sunlight and carbon dioxide to make food for energy. Animals get nutrients and energy by eating plants. Some animals also obtain energy by eating other animals. Many animals get their oxygen from the air. Aquatic animals with gills get their oxygen from the water. Water is a key component allowing organisms to process these materials from the environment. All living things need and use water.

Interactions

Start with any **habitat** (natural home) of an organism. The group of animals and plants that live there make up a **community**. Lift up a stone, and you will most likely find a spider, centipede, woodlouse, or earthworm. These are all a part of the stone habitat. Together, they make a community. The stone may lie next to a pond and become a part of the pond community. The pond may be in a forest and be part of the woodland community. Smaller habitats are usually a part of bigger habitats. A different community lives in each larger habitat. The organisms interact or act upon each other and the nonliving parts of the environment. Waste that is produced by the animals enriches the soil. This helps the plants grow and thrive in the community. As you see, observers, everything is connected and stretches into a vast web. When the community is healthy, it is stable and balanced. You can try to find some different habitats in your area. Be sure to look everywhere, and leave everything the way you found it.

Name: _____ Date: _____

What Is Ecology?: Reinforcement Activity

To the student observer: Can you list some ways you affect your environment?

_____

_____

_____

Analyze: Can you identify the various environments that make up your everyday life?

_____

_____

_____

Completion: Write the term that best completes each statement in the space provided.

environment	**materials**	**community**	**ecology**	**habitat**	**biosphere**
carbon dioxide	**nutrients**	**abiotic**	**biotic**	**interact**	**plants**

1. The study of living things and their environment is _____.
2. Everything that surrounds a living thing makes up its _____.
3. Living things get the _____ they need to survive from their environment.
4. Animals get their energy by eating _____ and other animals.
5. Plants use sunlight and _____ to grow and make food.
6. Living things use materials called _____ for growth and energy.
7. All living things act upon, or _____ with, their environments.
8. The _____ factors are the living things in the environment.
9. The _____ factors are the nonliving things in the environment.
10. The part of the earth that supports life is the _____.
11. A _____ is the natural home of an organism.
12. All the organisms that live in an area make up a _____.

Think About It:
Can you list five things all living things get from their environments?

1. _____ 2. _____
3. _____ 4. _____
5. _____

What Is an Ecosystem?

An **ecosystem** consists of a given habitat and its community. A community is all the populations living in a certain place. A population is all of the same kind of organisms living in that certain place. The living (biotic) and nonliving (abiotic) things in an environment together with their interactions make up the ecosystem. The habitat and all the interactions going on inside form a self-contained ecological unit.

Populations

A **population** is all of the same kind of organism living in a certain place. Different populations may live in the same environment. Study or visualize a pond near your home. Are there different organisms that live in the pond? Do you see frogs and toads? Maybe you see a few cattails, some fish, and overhead you hear ducks as they come in for a fantastic landing. There are 5 toads, 10 frogs, 20 minnows, 15 catfish, 10 blue gill, 6 ducks, and a lot of cattails. The five toads make up one population within the community. The 15 catfish make up another population in the community. What is the duck population of the pond community? If you could get a microscope and a drop of the pond water, you would see many other **microorganisms** (tiny living things) living in the pond community.

Communities

All the different populations living together and reacting in the habitat make up a unique community. Organisms interact with each other and the other things in the environment. There are many kinds and sizes of ecosystems. A rotting log, puddle of water, or even something as big as a desert can be an ecosystem. All ecosystems must be able to support all the organisms that live in or on that habitat. To support organisms, these four processes must occur:

1. The production of energy is one process that must occur inside the community. The sun is a source of energy in most ecosystems.
2. Energy must be transferred to plants that make their own food. The stored energy then is passed on to animals when they eat the plants.
3. When organisms die, they must decay, or break down, so that other living things can reuse these nutrients (raw materials).
4. This decomposition of dead materials is then recycled. As the materials break down, they return to the soil and are reused over and over.

What Is an Ecosystem? (cont.)

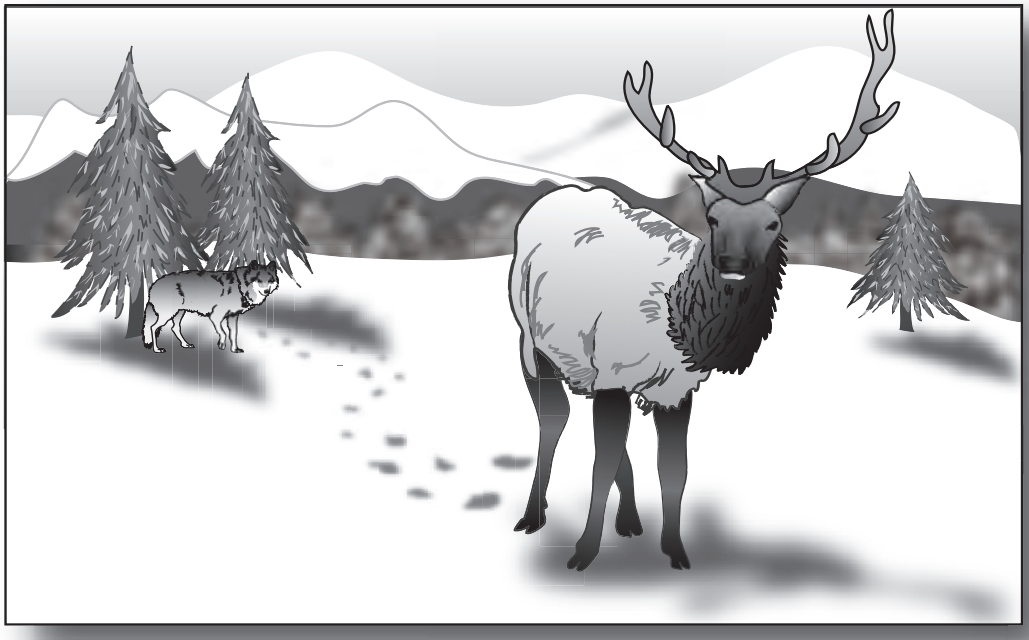
Habitats

A **habitat** is where an organism lives. The habitat provides everything an organism needs in order to survive. It has the food and water supply necessary to live. It also provides suitable shelter and a place to reproduce. As we said earlier, it may be very large or very small. There are water habitats and land habitats. The entire ocean is the habitat for whales. A habitat for a woodpecker may be as small as one tree in the forest. Even an anthill is a habitat.

Niches

Every organism has a certain role or job they perform within the community. What is your role or job right now? Did you answer "a student"? That is the job you have right now where you live. The job each organism fills within the community is its **niche** (NITCH or NEESH). This includes everything the organism does or needs.

Since many kinds of organisms share the same habitat, they must have certain roles within the community so that everything stays balanced. Each performs a different role and has different needs so the habitat can support everything living there. Wolves and elk share the same habitat, but they do not have the same niche. They do not eat the same thing or require the same shelter. If they did, they would not be able to live together for very long. One would be able to do the job better and end up crowding out the other one. What would happen if the elk and the wolves ate the same food? There might not be enough for both, and one would eventually perform the job better and take over the food supply. The other population would need to leave and find a new habitat or end up starving. If two populations shared the same niche, the one best suited to the role would survive and reproduce. Two populations may share the same habitat, but they cannot share the same niche.



Name: _____ Date: _____

What Is An Ecosystem?: Reinforcement Activity

To the student observer: Study the image on page 5, and see if you can identify the community.

The image represents a _____ community.

Analyze: Observe the image again and see if you can identify the largest population and the smallest population. What other populations might exist there?

Largest: _____ Smallest: _____

Other: _____

Completion:

1. A _____ is all the different kinds of organisms that live in a certain place.
2. All the biotic and abiotic things in an environment and their interactions make up an _____.
3. The _____ is the main source of energy in most ecosystems.
4. When an organism dies, its body _____, or breaks down.
5. The anthill is the _____ for the ants in your backyard.
6. The role of an organism in the habitat is its _____.
7. Two populations may share the same _____ but not the same _____.
8. All ecosystems must be self-supporting. Can you identify the four processes that occur in an ecosystem?

   a. _____ b. _____

   c. _____ d. _____

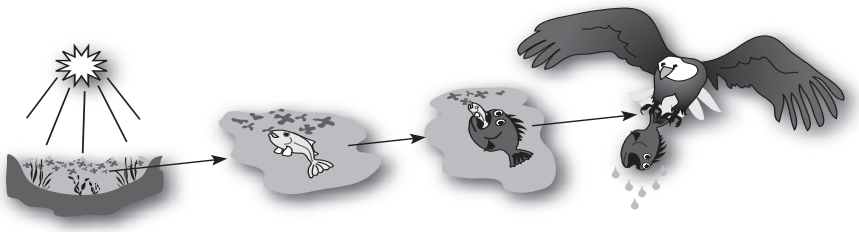
Making an Inference: Polar bears live in a cold, arctic habitat. Could this animal live in a hot, dry desert? Why or why not?

_____

_____

_____

Learning About the Web of Life



Algae floating on top of a pond capture the energy from the sun. The algae use this energy to create sugar (food) and other molecules. A small fish eats the algae, and then a bigger fish eats the small fish. A bird then swoops down and eats the bigger fish. This is the beginning of a feeding order called a food chain. A **food chain** is the feeding order of organisms in a community. All food chains begin with plants or other organisms that can collect energy from sunlight. These organisms that capture the energy from the sun are called **producers**

Producers

Plants, some protists, and some kinds of bacteria are all producers. These organisms can make or produce their own food. Every food chain begins with a producer. Producers use sunlight to make their food by a process called **photosynthesis**.

Consumers

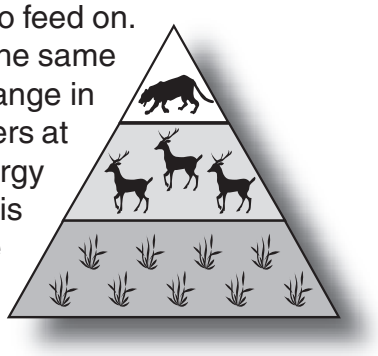
Any organism that cannot make its own food through photosynthesis must obtain its food from outside its body. **Consumers** get their food by eating, or consuming, other organisms. All animals and fungi, as well as some protists and bacteria, are consumers.

Consumers may eat plants or other consumers. Consumers that eat only plants, such as rabbits, are **herbivores**. Consumers that eat other animals, such as wolves, are **carnivores**. Some consumers, such as bears, are omnivores. **Omnivores** eat both plants and animals.

Consumers in a food chain are classified into different feeding levels, called **orders**, depending on what they consume. **First-order consumers** eat plants, **second-order consumers** eat animals that eat plants, and **third-order consumers** eat animals that eat other animals. Rabbits (first-order consumers) eat carrots. Snakes (second-order consumers) eat the rabbits. Hawks (third-order consumers) eat snakes.

Pyramid of Producers and Consumers

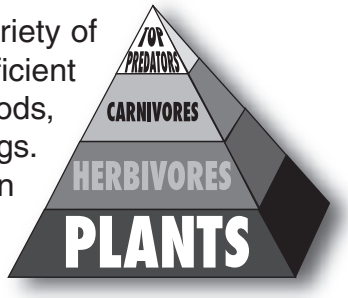
You might think of a food chain as a pyramid. The plains are covered with various species of grass plants. This makes plenty of food for the herds of antelope to feed on. The number of antelope is less than the number of grass plants. In the same area there may be a few dozen mountain lions. Lions need a wide range in which to hunt. The food chain pyramid has the highest-level consumers at the top. Each time you go up the pyramid, the original source of energy that was trapped by the plants decreases each time the energy is passed on to the next order of consumers. As a result, the size of the population decreases.



Learning About the Web of Life (cont.)

Food Webs

Most consumers eat more than one kind of food. Eating a variety of foods helps ensure the survival of the organism by providing a sufficient food supply. Within a pond community, the frog eats a variety of foods, including insects and worms. Both snakes and birds then eat the frogs. Frogs become part of two different food chains, with each food chain linked together at certain points. All the food chains in the community that are linked together become a **food web**.

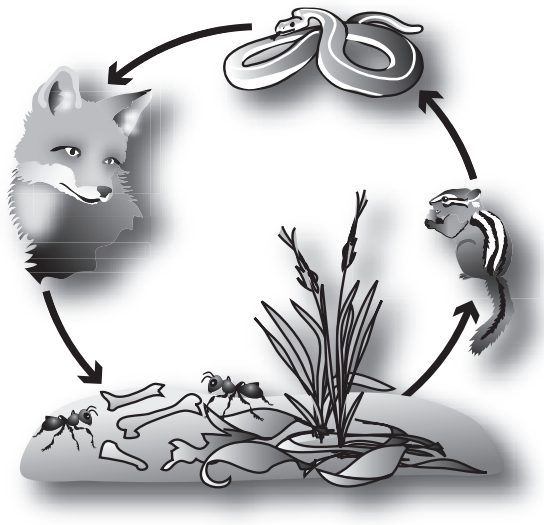


Decomposers

What happens when a high-level consumer, such as a mountain lion, dies? Do you think the food chain stops there? No, **decomposers** continue the food chain by feeding on the dead animal. Decomposers get their food by breaking down complex chemicals in dead organisms into simple chemicals that become part of the soil. Decomposers can be bacteria, fungi, and some protists. They feed on producers and consumers at each level of the pyramid. Plants take in the chemicals from the soil through their roots and use them to grow. Over time, these chemicals are used over and over again by plants, transferred to herbivores and carnivores, and returned to the soil by decomposers. The chemical's location and form changes, but the amount of the chemical stays the same.

Flow of Energy

You and other organisms need energy to live. Your muscles use energy as you work. Sometimes, you may feel like you have "run out of energy." If so, you take a break and eat some food to replenish your energy supply. Food contains chemical energy that was produced during photosynthesis. During photosynthesis, light energy is converted to chemical energy that is stored in the sugar molecules. As plant cells break down nutrients, the stored energy is released. The energy is used for their life processes. As plants use this energy, some is changed to heat. The heat becomes part of the environment. The rest of the energy is stored in the plants' tissues. When you eat foods, such as potatoes and other vegetables, you take in the plants' stored chemical energy. Each time the energy stored in plants is passed on from one organism to another, some of the energy is used up or lost as heat. The rest is stored as chemical energy in the nutrients of the organism's body. Each time the energy is passed up the food chain, some energy is lost as heat, some is used for life processes, and the rest is stored in the organism.



Name: _____ Date: _____

Learning About the Web of Life: Reinforcement Activity

To the student observer: Do you know the difference between a consumer and a producer? Explain.

_____

_____

Analyze: What kind of consumer are you when you eat a cheeseburger with the works? Explain or diagram the different food chains you are a part of when you eat your sandwich.

_____

_____

Completion:

1. Producers use energy from the _____ to make their own food.
2. Food chains always begin with a _____.
3. _____ are organisms that eat the remains of dead animals.
4. _____ are producers in lakes and oceans.
5. Organisms that eat only producers are _____-order consumers.
6. Consumers get food by _____ other organisms.

Identify:
Classify the organisms below as A. herbivores, B. carnivores, or C. omnivores.

1. _____ Bear
2. _____ Hawk
3. _____ Horse
4. _____ Giraffe
5. _____ Human
6. _____ Wolf

Prove You Can:

1. On your own paper, diagram a food chain that includes three levels or orders of consumers. Which order (level) of consumer has the smallest population size?
2. Explain the relationship between food chains and food webs. _____

   _____
3. Why is less energy available at each higher level of a food chain?

   _____

   _____

   _____
4. What is the role of decomposers in the community? _____

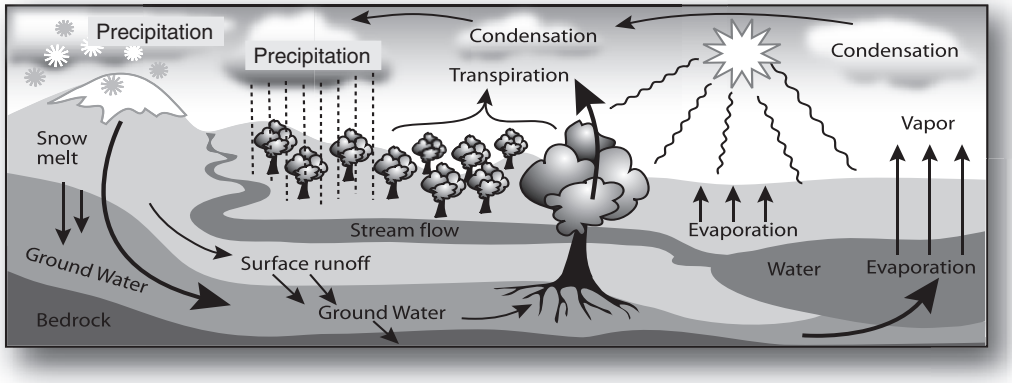
   _____

Round and Round We Go: Cycles in the Ecosystem

There are many cycles in nature. A **cycle** is something that happens over and over again in the same way. The earth is sometimes compared to a spaceship. The planet Earth is isolated in space like a spaceship. All the materials we need to build our homes, to make our tools, and to grow the food we eat come from the biosphere. Materials in the biosphere must be used over and over again. The materials we need to live must be continuously cycled between the living and the nonliving parts of the earth. If a material is in short supply, we may not be able to get more of it. Rocks move through a cycle changing from one kind of rock to another. Chemicals important to life are also cycled through the environment. Some cycles important to life are water, carbon dioxide, oxygen, and nitrogen.

The Water Cycle

Water falls to the earth as precipitation, or rain, snow, sleet, and hail. The most noticeable water in the ecosystems is in lakes, rivers, and the ocean. There is also **groundwater,** or water just beneath the surface of the land. What happens when a puddle dries up? The liquid water changes to a gas, or evaporates, forming water vapor. **Evaporation** is the water vapor that rises from oceans, rivers, and lakes and becomes part of the air. Organisms produce water as they get energy from the food they eat through cellular respiration. Plants release water vapor from their leaves. Animals release water vapor with their breath and liquid water with their wastes. Water vapor is always in the air, but you cannot see it.

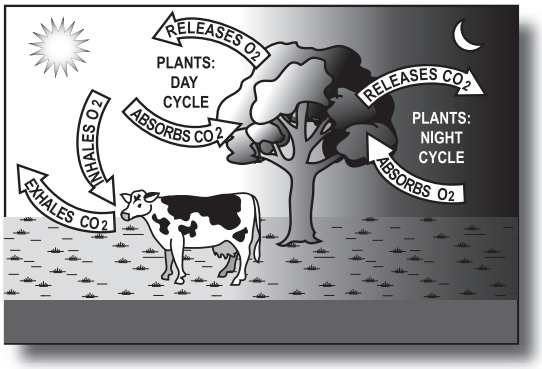


Have you ever noticed how the outside of your glass of ice water becomes wet? The water vapor in the air condenses, or changes into a liquid, on the outside of the glass. This happens when the air next to the glass cools from the ice and condenses. **Condensation** occurs as water vapor in the air cools and condenses into water droplets in the clouds. When enough water gathers in the clouds, precipitation falls in the form of rain, snow, sleet, or hail. The water is returned to the earth to be reused by organisms.

Water is essential for life, making up 75% of all organisms. Organisms need water for various life processes. Water is cycled by falling as a liquid, evaporating as a gas, and then cooling enough to become a liquid again. Water is continuously recycled between the bodies of water, air, and land, creating suitable conditions for life to exist.

Round and Round We Go: Cycles in the Ecosystem (cont.)

The Oxygen-Carbon Dioxide Cycle



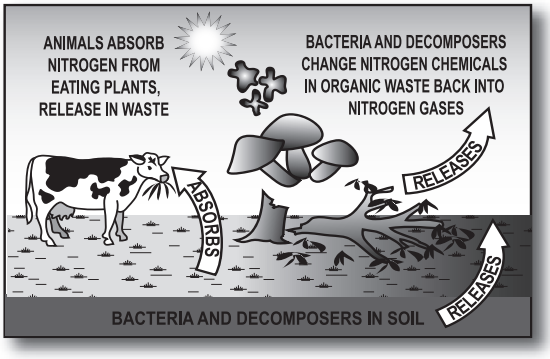
Like water, oxygen and carbon dioxide also cycle through the ecosystem. All living things are made up of the life substance **carbon**. Chemicals that contain carbon are carbohydrates, fats, and proteins. Carbon can also be found in the nonliving parts of the environment. Carbon dioxide gas is in the air, bodies of water, and fossil fuels such as coal and oil.

Oxygen is a gas that is essential to almost every life form. Oxygen is also found in air and bodies of water. Most of the oxygen that organisms use comes from producers (plants). The oxygen is used to release energy that is stored in food.

During photosynthesis, plants use (take in) carbon dioxide to make food and give off oxygen as a waste product. During **respiration**, animals use or take in oxygen and give off carbon dioxide as waste. During cellular respiration, plants and other organisms produce carbon dioxide. Decomposers release carbon dioxide as they break down dead organisms. People release carbon dioxide when they burn fossil fuels. As you can see, through respiration and photosynthesis, carbon dioxide and oxygen are continuously recycled in our ecosystems.

Nitrogen Cycle

Nitrogen is a gas that makes up 78% of the air. All living things need nitrogen to make proteins. Unfortunately, the most abundant gas in the atmosphere cannot be used in its natural form. It is used and reused in the atmosphere with the help of a certain kind of bacteria. These nitrogen-fixing bacteria live in the soil and in the roots of some plants. Nitrogen-fixing bacteria change nitrogen gas into nitrogen compounds, or **nitrates**. Plants take in the nitrates through their roots and use it to make chemicals they need.



Animals get the nitrogen they need by eating plants. Some kinds of bacteria will change any nitrates not used by the plant back to nitrogen gases. When an organism dies, decomposers will also change the nitrogen chemicals found in the organism back into nitrogen gases. The nitrogen cycle continues as the nitrogen gases are released back into the air.

System of Cycles

Cycles in an ecosystem are linked to one another by photosynthesis and cellular respiration. Plants take in carbon dioxide (CO_2) and water (H_2O) for photosynthesis and release oxygen (O_2). Animals and plants use O_2 for cellular respiration and release CO_2 and H_2O. Scientists may study one cycle at a time to make it easier for them to understand what is happening independently. However, each cycle is only a small part of the system of cycles that interact with one another.

Name: _____ Date: _____

Cycles in the Ecosystem: Reinforcement Activity

To the student observer: Do you know what four substances are recycled continuously?

_____

_____

Analyze: Can you explain why certain materials must be cycled in our environment?

_____

_____

_____

Completion:

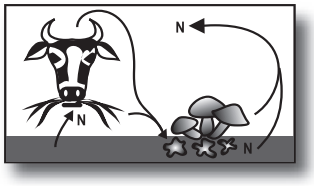
1. During _____, plants use carbon dioxide from the air.
2. All organisms need nitrogen to make _____.
3. _____ change nitrogen into a form that can be used by plants.
4. The _____ we need must be cycled continuously.
5. During photosynthesis, plants use carbon dioxide and release _____ as waste.
6. Water is cycled through the environment by falling as a _____ and then _____ as a gas.
7. _____ and _____ are cycled through the environment by photosynthesis and respiration.
8. During respiration, animals use oxygen and release _____ as waste.
9. Animals get the nitrogen they need by eating _____.

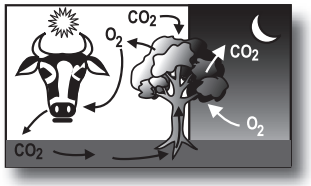
Predict:
If all the plants on Earth began to die, what would happen to the oxygen content of the air?

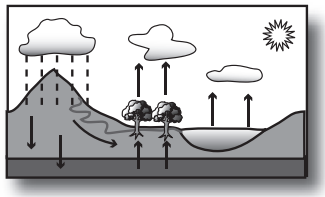
_____

_____

Name That Cycle: Study the illustrations below and properly identify them.







a. _____ b. _____ c. _____

Answer Keys

What Is Ecology? (pg. 3)

To the student observer: Accept all logical answers.

Negative effects: Pollution—air, land, or water (litter, exhaust fumes by driving cars)

Positive effects: Ride your bike or walk more, plant some trees, recycle and reuse trash

Analyze: Accept all logical answers—school, swimming pool, camping, home, neighborhood, the city park

Completion:

1. ecology	2. environment	3. materials
4. plants	5. carbon dioxide	6. nutrients
7. interact	8. biotic	9. abiotic
10. biosphere	11. habitat	12. community

Think About It: (in any order)

1. water	2. oxygen	3. carbon dioxide
4. nutrients	5. energy	

What Is an Ecosystem? (pg. 6)

To the student observer: Answers will vary but should indicate a forest community.

Analyze: Answers will vary.

Largest: microorganisms

Smallest: top predators like wolves

Other: elk, trees, mice, birds, etc.

Completion:

1. community	2. ecosystem	3. sun
4. decomposes (decays)		5. habitat
6. niche	7. habitat, niche	

8. a. production of energy (sunlight)
   b. energy must be stored or transferred
   c. dead things break down or decay into raw materials
   d. raw materials are returned to the soil or reused

Making an Inference: No, it has a thick coat of fur. It is "well suited" for life in the cold arctic region. It would not be able to survive in the desert heat.

Learning About the Web of Life (pg. 9)

To the student observer: Consumers eat other organisms—they obtain their food from outside their body. Producers have the ability to convert the sun's energy into food—they make their own food inside special cell structures in a process called photosynthesis.

Analyze: omnivore—eating meat and cheese that come from animals, and lettuce, tomato, onions, and pickles from plants.

Completion:

1. sun	2. producer	3. Decomposers
4. Algae	5. first	6. eating

Identify:

1. C 2. B 3. A 4. A 5. C 6. B

Prove You Can:

1. Answers will vary. Third-order or top level is the smallest—the energy has decreased as it flows through the food chain.
2. A food web is a combination of many food chains within the community. Several food chains make a food web.
3. Some of it (the original source of energy) has been used up by the organism (carrying out life processes) or it has escaped as heat before that organism is consumed by the next order consumer. Each time it is passed from one level or order consumer to the next order, the amount of the sun's original energy decreases.
4. They feed on dead organisms (cleaning our environment) and enrich the soil by returning the nutrients. They are responsible for recycling raw materials to be used over and over again by plants and animals.

Round and Round We Go: Cycles in the Ecosystem (pg. 12)

To the student observer: Water, carbon, oxygen, and nitrogen (students may suggest rock)

Analyze: Over time we might use up these needed substances

Completion:

1. photosynthesis	2. proteins	3. Bacteria
4. materials	5. oxygen	
6. liquid, evaporating	7. Oxygen/Carbon dioxide	
8. carbon dioxide	9. plants	

Predict: The oxygen content would begin to decrease.

Name That Cycle:

a. nitrogen b. carbon dioxide/oxygen c. water

Habitat Activity (pg. 13)

Accept all logical answers. Students should stress adaptations animals have that would make it impossible for them to live in their mixed-up habitats.

What are Biomes? (pg. 17)

To the student observer: A biome is a large region on earth with its own unique climate, plants, animals, and soil.

Analyze: Answers will vary.

Identify:

1. Tundra	2. Desert	3. Tropical Rain Forest
4. Grasslands	5. Saltwater (ocean)	