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3.1 What Is Ecology?

Lesson Objectives

- Describe the study of ecology.
- Explain how biotic and abiotic factors influence an ecosystem.
- Describe the methods used to study ecology.

Lesson Summary

Studying Our Living Planet **Ecology** is the scientific study of interactions among organisms and between organisms and their environment.

- Earth's organisms live in the **biosphere**. The biosphere consists of the parts of the planet in which all life exists.
- Ecologists may study different levels of ecological organization:
  - Individual organism
  - An assemblage of individuals that belong to the same species and live in the same area is called a **population**.
  - An assemblage of different populations that live together in an area is referred to as a **community**.
  - An **ecosystem** includes all the organisms that live in a particular place, together with their physical environment.
  - A group of ecosystems that have similar climates and organisms is called a **biome**.

Biotic and Abiotic Factors Ecosystems include biotic and abiotic factors.

- A **biotic factor** is any living part of an environment.
- An **abiotic factor** is any nonliving part of an environment.

Ecological Methods Ecologists use three basic methods of research: observation, experimentation, and modeling:

- Observation often leads to questions and hypotheses.
- Experiments can be used to test hypotheses.
- Modeling helps ecologists understand complex processes.

Studying Our Living Planet

1. What is ecology?
It is the scientific study of interactions among organisms and between organisms and their environment.

2. What does the biosphere contain?
It contains all the organisms and physical environments of Earth.

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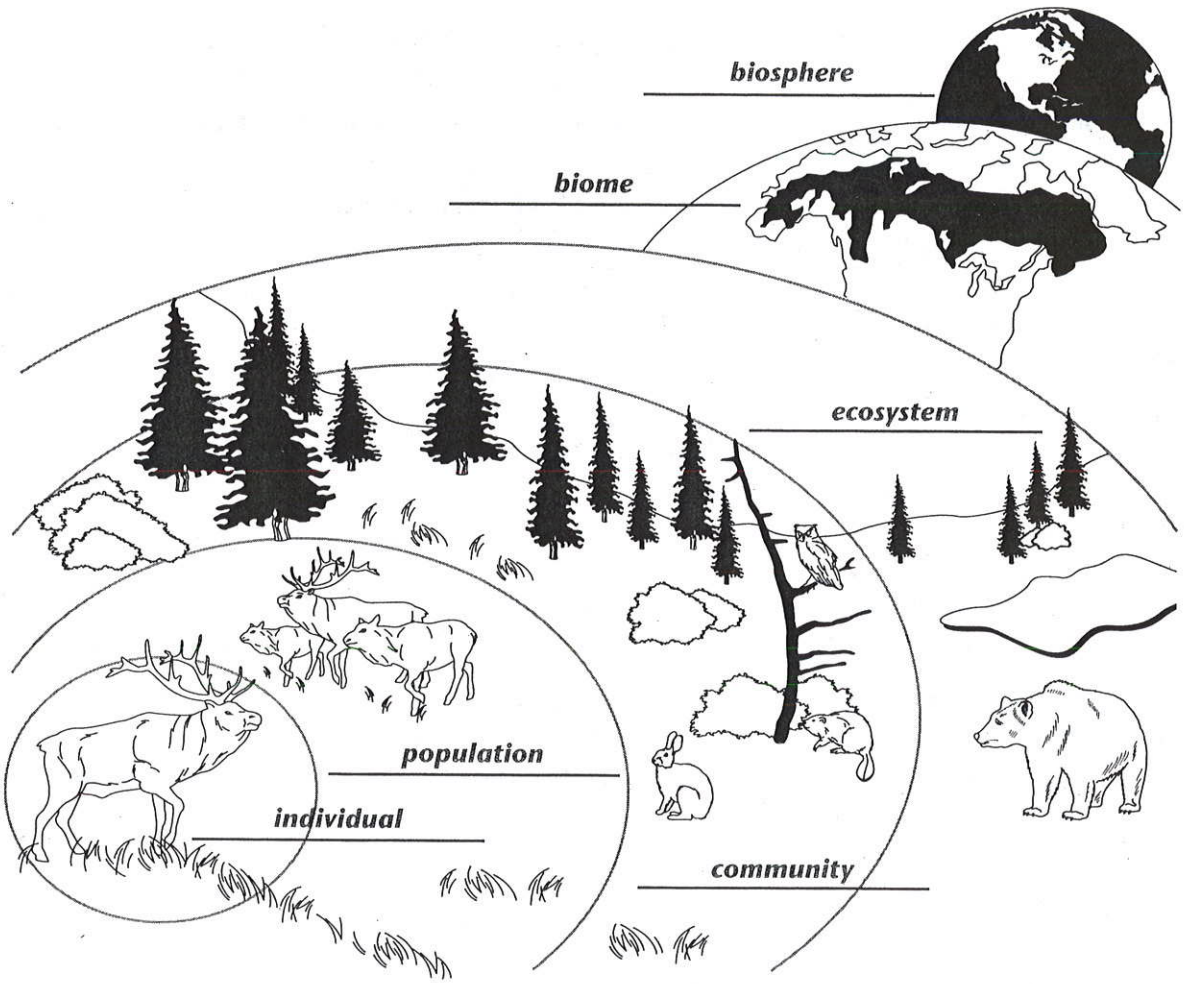
3. How are human economics and ecology linked?

Economics has to do with human "houses" and interactions based on money and trade. Ecological interactions have to do with nature's "houses" and are based on energy and nutrients. Humans depend on ecological processes to provide nutrients that can be bought or traded.

Use the diagram to answer Questions 4–5.



4. Label each level of organization on the diagram.

5. Explain the relationship between ecosystems and biomes.

An ecosystem describes all of the organisms that live in a place, together with their physical environment. A group of ecosystems that share similar climates and organisms is considered a biome.

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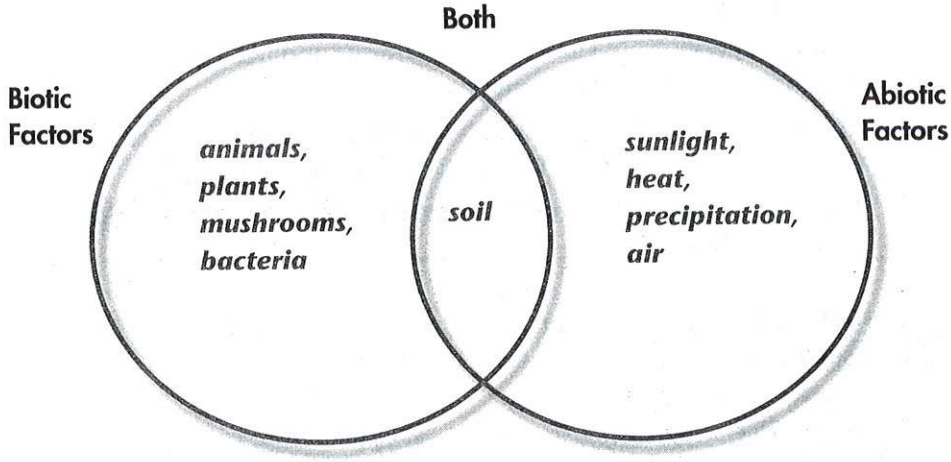
Biotic and Abiotic Factors

6. Use the terms in the box to fill in the Venn diagram. List parts of the environment that consist of biotic factors, abiotic factors, and some components that are a mixture of both.

air	heat	precipitation
animals	mushrooms	soil
bacteria	plants	sunlight



Ecological Methods

7. Why might an ecologist set up an artificial environment in a laboratory?

An ecologist might do that to imitate and manipulate conditions that organisms would encounter in the natural world.

8. Why are many ecological phenomena difficult to study?

They occur over long periods of time or over large areas.

9. Why do ecologists make models?

They make models to gain insights into complex phenomena.

Apply the Big idea

10. What makes a planet living? Explain your answer by comparing Earth with Mars.

Earth is a living planet because it contains organisms. Life exists on Earth on the land, in the water, and in the atmosphere. Earth's environments can be described based on biotic and abiotic factors. In contrast, Mars is a planet void of life. Mars can be described based only on abiotic factors such as sunlight, heat, wind, soil type, and so on.

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3.2 Energy, Producers, and Consumers

Lesson Objectives

- Define primary producers.
- Describe how consumers obtain energy and nutrients.

Lesson Summary

Primary Producers Sunlight is the main energy source for life on Earth. Organisms that can capture energy from sunlight or chemicals and use that energy to produce food are called **autotrophs**, or **primary producers**.

- The process in which autotrophs capture light energy and use it to convert carbon dioxide and water into oxygen and sugars is called **photosynthesis**.
- The process in which autotrophs use chemical energy to produce carbohydrates is called **chemosynthesis**.

Consumers Organisms that rely on other organisms for their energy and food are called **heterotrophs**. Heterotrophs are also referred to as consumers. There are many different types of heterotrophs:

- **Herbivores**, such as cows, obtain energy by eating only plants.
- **Carnivores**, such as snakes, eat only animals.
- **Omnivores**, such as humans, eat both plants and animals.
- **Detritivores**, such as earthworms, feed on dead matter.
- **Decomposers**, such as fungi, break down organic matter.
- **Scavengers**, such as vultures, consume the carcasses of other animals.

Primary Producers

1. What do autotrophs do during photosynthesis?

They use light energy to power chemical reactions that convert carbon dioxide and water into oxygen and energy-rich carbohydrates such as sugars and starch.

2. Can some organisms survive without energy from the sun? Explain your answer.

Yes, some deep-sea ecosystems do not depend on the sun for their energy source. Primary producers can harness chemical energy from inorganic molecules such as hydrogen sulfide to produce carbohydrates through chemosynthesis.

3. Can organisms create their own energy? Explain your answer. ***No, primary producers harness energy from the sun or chemicals to produce carbohydrates. They do not produce their own energy. Other organisms obtain their energy from primary producers.***

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Consumers

4. Complete the table about types of heterotrophs.

Types of Heterotrophs		
Type	**Definition**	**Examples**
Herbivore	***Heterotroph that obtains energy by eating only plants***	cows, rabbits
Carnivore	Heterotroph that eats animals	***snakes, dogs, owls***
Omnivore	***Heterotroph that eats both plants and animals***	humans, bears, pigs
Detritivore	***Heterotroph that feeds on detritus***	***mites, earthworms, snails, crabs***
Decomposer	***Heterotroph that breaks down organic matter***	***bacteria, fungi***
Scavenger	Heterotroph that consumes the carcasses of dead animals but does not typically kill them itself	***vulture, hyena***

5. What is a consumer?

A consumer is any organism that relies on other organisms for energy and nutrients.

6. How would you categorize a consumer that usually catches and eats prey, but also eats dead animal carcasses? ***a carnivore***

Apply the Big idea

7. What role do producers play in establishing Earth as a living planet? ***Energy enters the biotic portion of Earth's ecosystems through primary producers. Primary producers convert nonliving, abiotic factors, such as sunlight or chemicals, into carbohydrates. In this way, producers make the energy accessible to other organisms on the planet. Photosynthetic producers also give off oxygen, a gas that is required by most other organisms, during photosynthesis.***

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3.3 Energy Flow in Ecosystems

Lesson Objectives

- Trace the flow of energy through living systems.
- Identify the three types of ecological pyramids.

Lesson Summary

Food Chains and Food Webs Energy flows through an ecosystem in one direction from primary producers to various consumers.

- A **food chain** is a series of steps in which organisms transfer energy by eating and being eaten. Producers, such as floating algae called **phytoplankton**, are at the base of every food chain.
- A **food web** is a network of all the food chains in an ecosystem. Food webs are very complex. Small disturbances to one population can affect all populations in a food web. Changes in populations of **zooplankton**, small marine animals that feed on algae, can affect all of the animals in the marine food web.

Trophic Levels and Ecological Pyramids Each step in a food chain or food web is called a **trophic level**. Producers make up the first trophic level. Consumers make up higher trophic levels. Each consumer depends on the trophic level below it for energy.

An **ecological pyramid** is a diagram that shows the relative amounts of energy or matter contained within each trophic level in a food chain or food web. Types of ecological pyramids are pyramids of energy, pyramids of biomass, and pyramids of numbers:

- Pyramids of energy show relative amounts of energy available at different trophic levels.
- Pyramids of **biomass** show the total amount of living tissue at each trophic level.
- A pyramid of numbers shows the relative numbers of organisms at different trophic levels.

Food Chains and Food Webs

1. Complete the table about feeding relationships.

Feeding Relationships	
Relationship	**Description**
Food Chain	***A series of steps in which organisms transfer energy by eating and being eaten***
Food Web	***A network of complex interactions formed by the feeding relationships among the various organisms in an ecosystem***

