

# Principles of Ecology Worksheets

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Printed: August 12, 2012

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## CHAPTER

## 1

# Principles of Ecology Worksheets

## CHAPTER OUTLINE

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- 1.1 The Science of Ecology
  - 1.2 Flow of Energy
  - 1.3 Recycling Matter
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### Chapter 15: Principles of Ecology

- Lesson 15.1: The Science of Ecology
- Lesson 15.2: Flow of Energy
- Lesson 15.3: Recycling Matter

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## 1.1 The Science of Ecology

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### Lesson 15.1: True or False

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Write true if the statement is true and false if the statement is false.*

- \_\_\_\_\_ 1. Ecology is usually considered to be a branch of biology.
- \_\_\_\_\_ 2. The environment of an organism includes only nonliving physical factors.
- \_\_\_\_\_ 3. The biosphere extends from sea level to about 11,000 meters above sea level.
- \_\_\_\_\_ 4. An important ecological issue is the rapid growth of the human population.
- \_\_\_\_\_ 5. A community is the biotic component of an ecosystem.
- \_\_\_\_\_ 6. An ecosystem is always closed in terms of energy.
- \_\_\_\_\_ 7. An ecosystem depends on continuous inputs of matter from outside the system.
- \_\_\_\_\_ 8. Organisms that depend on different food sources have different niches.
- \_\_\_\_\_ 9. Mammals that live in very cold habitats must have insulation to help them stay warm.
- \_\_\_\_\_ 10. Different species cannot occupy the same niche in the same geographic area for very long.
- \_\_\_\_\_ 11. Field studies refer to the collection of data in a field, meadow, or other open area.
- \_\_\_\_\_ 12. Ecologists use inferential statistics to describe the data they collect.

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### Lesson 15.2: Critical Reading

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Read this passage from the lesson and answer the questions that follow.*

#### **Ecosystem**

An ecosystem is a natural unit consisting of all the living organisms in an area functioning together with all the nonliving physical factors of the environment. The concept of an ecosystem can apply to units of different sizes. For example, a large body of fresh water could be considered an ecosystem, and so could a small piece of dead wood. Both contain a community of species that interact with one another and with the abiotic components of their environment.

Like most natural systems, ecosystems are not closed, at least not in terms of energy. Ecosystems depend on continuous inputs of energy from outside the system. Most ecosystems obtain energy from sunlight. Some obtain energy from chemical compounds. In contrast to energy, matter is recycled in ecosystems. Elements such as carbon and nitrogen, which are needed by living organisms, are used over and over again.

#### **Niche**

One of the most important ideas associated with ecosystems is the niche concept. A niche refers to the role of a

species in its ecosystem. It includes all the ways species' members interact with the abiotic and biotic components of the ecosystem. Two important aspects of a species' niche include the food it eats and how it obtains the food.

### **Habitat**

Another aspect of a species' niche is its habitat. A species' habitat is the physical environment to which it has become adapted and in which it can survive. A habitat is generally described in terms of abiotic factors, such as the average amount of sunlight received each day, the range of annual temperatures, and average yearly rainfall. These and other factors in a habitat determine many of the traits of the organisms that can survive there.

Consider a habitat with very low temperatures. Mammals that live in the habitat must have insulation to help them stay warm. Otherwise, their body temperature will drop to a level that is too low for survival. Species that live in these habitats have evolved fur, blubber, and other traits that provide insulation in order for them to survive in the cold.

Human destruction of habitats is the major factor causing other species to decrease and become endangered or go extinct. Small habitats can support only small populations of organisms. Small populations are more susceptible to being wiped out by catastrophic events from which a large population could bounce back.

### **Questions**

1. What is an ecosystem? Give an example.

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2. How do ecosystems obtain energy?

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3. What happens to matter in ecosystems?

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4. Define niche. What are two aspects of a niche?

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5. What factors make up a species' habitat?

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## **Lesson 15.1: Multiple Choice**

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Circle the letter of the correct choice.*

- a. Abiotic components of the environment include
  - a. air temperature.
  - b. other species.
  - c. producers.
  - d. all of the above.
- b. The chief food producers in the ocean are
  - a. plants.
  - b. zooplankton.
  - c. phytoplankton.
  - d. fish.
- c. Coyotes and rabbits that live in the same area
  - a. are in direct competition with each other.
  - b. have a predator-prey relationship.
  - c. belong to the same population.
  - d. have the same niche.
- d. Aspects of a species' habitat include
  - a. the average rainfall it receives.
  - b. the amount of sunlight it gets.
  - c. the range of temperatures it experiences.
  - d. all of above.
- e. The niche of a plant includes all of the following except its
  - a. role as a producer.
  - b. need for sunlight.
  - c. use of soil nutrients.
  - d. genetic makeup.
- f. According to the competitive exclusion principle, if two species occupied the same niche in the same area, they would
  - a. outcompete species in other niches.
  - b. move to a different habitat.
  - c. be in competition with each other.
  - d. both go extinct.
- g. An example of a descriptive statistic is a(n)
  - a. hypothesis.
  - b. summary.
  - c. inference.
  - d. mean.

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## Lesson 15.1: Vocabulary

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Match the vocabulary term with the correct definition.*

**Term**

- \_\_\_\_ 1. ecology
- \_\_\_\_ 2. organism
- \_\_\_\_ 3. abiotic components
- \_\_\_\_ 4. biotic components
- \_\_\_\_ 5. biosphere
- \_\_\_\_ 6. population
- \_\_\_\_ 7. community
- \_\_\_\_ 8. ecosystem
- \_\_\_\_ 9. niche
- \_\_\_\_ 10. habitat

**Definition**

- a. living organisms in the environment
- b. physical environment to which an organism has become adapted
- c. populations of different species that live in the same area and interact with one another
- d. scientific study of the interactions of living things with each other and their environments
- e. role of a species in its ecosystem
- f. areas of Earth where all organisms live
- g. life form consisting of one or more cells
- h. natural unit consisting of all the living organisms in an area together with all the nonliving physical factors of the environment
- i. nonliving physical aspects of the environment
- j. organisms of the same species that live in the same area and interact with one another

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## 1.2 Flow of Energy

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### Lesson 15.2: True or False

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Write true if the statement is true and false if the statement is false.*

- \_\_\_\_\_ 1. All organisms use organic compounds for energy.
- \_\_\_\_\_ 2. Plants are the most important heterotrophs in terrestrial ecosystems.
- \_\_\_\_\_ 3. Zooplankton are the chief aquatic producers.
- \_\_\_\_\_ 4. Archaea make food using energy in sunlight.
- \_\_\_\_\_ 5. A few plants trap and digest animals.
- \_\_\_\_\_ 6. Energy flows from producers and consumers to decomposers.
- \_\_\_\_\_ 7. Saprotrophs complete the breakdown of any remaining organic matter.
- \_\_\_\_\_ 8. Bacteria are the only organisms that can decompose dead wood.
- \_\_\_\_\_ 9. A fish that eats zooplankton is a primary consumer.
- \_\_\_\_\_ 10. Hawks have more energy than plants in a terrestrial ecosystem.
- \_\_\_\_\_ 11. Multiple intersecting food webs make up a food chain.
- \_\_\_\_\_ 12. Cows eat grass, so they are secondary consumers.

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### Lesson 15.2: Critical Reading

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Read this passage from the lesson and answer the questions that follow.*

#### Producers

Producers are organisms that produce organic compounds from energy and simple inorganic molecules. Producers are also called autotrophs, which literally means “self nutrition.” This is because producers synthesize food for themselves. They take energy and materials from the abiotic environment and use them to make organic molecules. Autotrophs are a vital part of all ecosystems. The organic molecules they produce are needed by all the organisms in the ecosystem. There are two basic types of autotrophs: photoautotrophs and chemoautotrophs. They differ in the type of energy they use to synthesize food.

#### Photoautotrophs

Photoautotrophs are organisms that use energy from sunlight to make glucose from carbon dioxide and water by photosynthesis. Glucose, a carbohydrate, is an organic compound that can be used by autotrophs and other organisms for energy. Photoautotrophs include plants, algae, and certain bacteria. Plants are the most important photoautotrophs in land-based, or terrestrial, ecosystems. There is great variation in the plant kingdom. Plants



include organisms as different as trees, grasses, mosses, and ferns. Nonetheless, all plants are eukaryotes that contain chloroplasts, the cellular “machinery” needed for photosynthesis.

Algae are photoautotrophs found in most ecosystems, but they generally are more important in water-based, or aquatic, ecosystems. Like plants, algae are eukaryotes that contain chloroplasts for photosynthesis. Algae include single-celled eukaryotes, such as diatoms, as well as multicellular eukaryotes, such as seaweed.

Photoautotrophic bacteria, called cyanobacteria, are also important producers in aquatic ecosystems. Cyanobacteria were formerly called blue-green algae, but they are now classified as bacteria. Other photosynthetic bacteria, including purple photosynthetic bacteria, are producers in terrestrial as well as aquatic ecosystems.

Both cyanobacteria and algae make up phytoplankton. Phytoplankton refers to all the tiny photoautotrophs found on or near the surface of a body of water. Phytoplankton usually is the primary producer in aquatic ecosystems.

### **Chemoautotrophs**

In some places where life is found on Earth, there is not enough light to provide energy for photosynthesis. In these places, producers called chemoautotrophs make organic molecules from carbon dioxide and water by chemosynthesis. Instead of energy from sunlight, chemosynthesis depends on energy from the oxidation of inorganic compounds, such as hydrogen sulfide (H<sub>2</sub>S). Oxidation is an energy-releasing chemical reaction in which a molecule, atom, or ion loses electrons. Chemoautotrophs include bacteria called nitrifying bacteria. Nitrifying bacteria live underground in soil. They oxidize nitrogen-containing compounds and change them to a form that plants can use. Chemoautotrophs also include archaea. Archaea are a domain of microorganisms that resemble bacteria. Most archaea live in extreme environments, such as around hydrothermal vents in the deep ocean floor. They use the toxic chemicals released from the vents to produce organic compounds. The organic compounds can then be used by other organisms, such as tube worms.

### **Questions**

1. What are producers? Name two types of producers.

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2. How do photoautotrophs produce food?

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3. What are the components of phytoplankton, and what is the role of phytoplankton in aquatic ecosystems?

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4. How do chemoautotrophs produce food?

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5. What are examples of chemoautotrophs?

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## Lesson 15.2: Multiple Choice

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Circle the letter of the correct choice.*

- a. What is the main contribution of autotrophs to ecosystems?
  - a. organic molecules such as glucose.
  - b. elements such as nitrogen.
  - c. carbon dioxide.
  - d. water.
- b. All of the following are true of algae except
  - a. all algae are eukaryotes.
  - b. some algae are single-celled.
  - c. most algae are aquatic.
  - d. some algae are bacteria.
- c. What do carnivores eat?
  - a. herbivores
  - b. other consumers
  - c. other carnivores
  - d. all of the above
- d. Fungi are the main decomposers of dead
  - a. animals.
  - b. plants.
  - c. bacteria.
  - d. protozoa.
- e. A food web is best described as a diagram of
  - a. feeding relationships in an ecosystem.
  - b. energy flow among producers.
  - c. Calories available to primary consumers.
  - d. nutrients present in certain foods.
- f. The broadest level of an energy pyramid consists of
  - a. producers.
  - b. decomposers.
  - c. scavengers.
  - d. saprotrophs.
- g. Which trophic level of an ecosystem has the least biomass?
  - a. tertiary consumers
  - b. secondary consumers
  - c. primary consumers
  - d. producers

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## Lesson 15.2: Vocabulary

Name\_\_\_\_\_ Class\_\_\_\_\_ Date\_\_\_\_\_

*Match the vocabulary term with the correct definition.*

### Term

- \_\_\_\_ 1. producers
- \_\_\_\_ 2. photoautotrophs
- \_\_\_\_ 3. phytoplankton
- \_\_\_\_ 4. consumers
- \_\_\_\_ 5. herbivores
- \_\_\_\_ 6. zooplankton
- \_\_\_\_ 7. scavengers
- \_\_\_\_ 8. carnivores
- \_\_\_\_ 9. omnivores
- \_\_\_\_ 10. decomposers

### Definition

- a. organisms that eat a diet consisting mainly of herbivores or of other organisms that eat herbivores
- b. all organisms that depend on other organisms for food
- c. organisms that eat both plants and animals as primary food sources
- d. small organisms that consume producers on or near the surface of a body of water
- e. organisms that consume dead plants and animals and other organic waste
- f. all organisms that produce organic compounds from energy and simple inorganic molecules
- g. tiny photoautotrophs found on or near the surface of a body of water
- h. carnivores that mainly eat the carcasses of dead animals
- i. organisms that consume only producers such as plants or algae
- j. organisms that use energy from sunlight to make food by photosynthesis

## 1.3 Recycling Matter

### Lesson 15.3: True or False

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Write true if the statement is true and false if the statement is false.*

- \_\_\_\_\_ 1. All chemical elements that are needed by living things are recycled in ecosystems.
- \_\_\_\_\_ 2. The deep ocean is a reservoir for water in the water cycle.
- \_\_\_\_\_ 3. Earth's gravity is the driving force behind the water cycle.
- \_\_\_\_\_ 4. Rain that flows over the ground is called groundwater.
- \_\_\_\_\_ 5. The water cycle ends when precipitation falls and returns to the ocean.
- \_\_\_\_\_ 6. Carbon is stored in the ocean as carbon dioxide.
- \_\_\_\_\_ 7. All organisms release carbon dioxide as a byproduct of cellular respiration.
- \_\_\_\_\_ 8. When volcanoes erupt, they return carbon from the mantle to the atmosphere.
- \_\_\_\_\_ 9. Of living things, only producers need nitrogen.
- \_\_\_\_\_ 10. Plants absorb nitrogen gas through their root hairs.
- \_\_\_\_\_ 11. Some nitrogen-fixing bacteria live in the root nodules of legumes.
- \_\_\_\_\_ 12. The anammox reaction of the nitrogen cycle occurs in water.

### Lesson 15.3: Critical Reading

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Read this passage from the lesson and answer the questions that follow.*

#### Nitrogen Cycle

The atmosphere is the largest reservoir of nitrogen on Earth. It consists of 78 percent nitrogen gas. The nitrogen cycle moves nitrogen through abiotic and biotic components of ecosystems.

#### Absorption of Nitrogen

Plants and other producers use nitrogen to synthesize nitrogen-containing organic compounds, including chlorophyll, proteins, and nucleic acids. Consumers also make use of the nitrogen in these compounds. Plants absorb nitrogen from the soil through their root hairs. However, they cannot absorb nitrogen gas directly. They can absorb nitrogen only in the form of nitrogen-containing ions, such as nitrate ions.

#### Nitrogen Fixation

The process of converting nitrogen gas to nitrate ions that plants can absorb is called nitrogen fixation. It is carried out mainly by nitrogen-fixing bacteria. Some nitrogen-fixing bacteria live in soil. Others live in the root nodules of legumes such as peas and beans. In aquatic ecosystems, some cyanobacteria are nitrogen fixing.

**Ammonification and Nitrification**

After being used by organisms, nitrogen is released back into the environment. When decomposers break down organic remains and wastes, they release nitrogen in the form of ammonium ions. This is called ammonification. Certain soil bacteria, called nitrifying bacteria, convert ammonium ions to nitrites. Other nitrifying bacteria convert the nitrites to nitrates, which plants can absorb. The process of converting ammonium ions to nitrites or nitrates is called nitrification.

**Denitrification and the Anammox Reaction**

Still other bacteria, called denitrifying bacteria, convert some of the nitrates in soil back into nitrogen gas in a process called denitrification. It is the opposite of nitrogen fixation. Denitrification returns nitrogen gas back to the atmosphere, where it can continue the nitrogen cycle. In the ocean, an anammox reaction returns nitrogen to the atmosphere. The reaction involves certain bacteria, and it converts ammonium and nitrite ions to nitrogen gas.

**Questions**

1. What is the only form of nitrogen that plants can absorb?

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2. What do nitrogen-fixing bacteria do, and where do they live?

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3. What role do decomposers play in the nitrogen cycle?

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4. Describe what happens during nitrification.

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5. What is the anammox reaction, and when does it occur in the nitrogen cycle?

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**Lesson 15.3: Multiple Choice**

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Circle the letter of the correct choice.*

- a. Water that infiltrates the ground is called

- a. runoff.
  - b. groundwater.
  - c. reservoir water.
  - d. discharge water.
- b. Water vapor condenses as it rises high in the atmosphere because it
- a. cools down.
  - b. gains energy.
  - c. is under more pressure.
  - d. is pulled by gravity.
- c. Methane gas released by landfills is
- a. burned in car engines.
  - b. used to heat homes.
  - c. released into the air.
  - d. added to fertilizers.
- d. Calcium carbonate that settles out of ocean water forms
- a. bicarbonate ions.
  - b. carbon dioxide.
  - c. natural gas.
  - d. limestone.
- e. Nitrogen-fixing organisms in aquatic ecosystems are
- a. plants.
  - b. large fish.
  - c. zooplankton.
  - d. cyanobacteria.
- f. Ammonium ions are converted to nitrites or nitrates by
- a. nitrifying bacteria.
  - b. denitrifying bacteria.
  - c. nitrogen-fixing bacteria.
  - d. all of the above.
- g. The anammox reaction changes ammonium ions to a form that can enter the
- a. atmosphere.
  - b. mantle.
  - c. biosphere.
  - d. ocean.

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## Lesson 15.3: Vocabulary

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Match the vocabulary term with the correct definition.*

### Term

- \_\_\_\_ 1. sublimation
- \_\_\_\_ 2. transpiration
- \_\_\_\_ 3. infiltration

- \_\_\_\_ 4. cellular respiration
- \_\_\_\_ 5. subduction
- \_\_\_\_ 6. nitrogen fixation
- \_\_\_\_ 7. ammonification
- \_\_\_\_ 8. nitrification
- \_\_\_\_ 9. denitrification
- \_\_\_\_ 10. anammox reaction

**Definition**

- a. process by which plants lose water through their leaves
- b. process in which the ocean floor is pulled down into the mantle
- c. process of converting ammonium ions to nitrites or nitrates
- d. transformation of snow and ice directly into water vapor
- e. release of ammonium ions by decomposers as they break down organic remains and wastes
- f. chemical reaction in which ammonium and nitrite ions combine to form water and nitrogen gas
- g. general process of converting nitrates into nitrogen gas
- h. process of rainwater soaking into the ground
- i. process of converting nitrogen to nitrate ions that plants can absorb
- j. process by which cells oxidize glucose and produce energy