Unit 1

# Energy in the Environment

## Key Words

ecosystem

contribution

respiration

biotic

abiotic



## In this unit you will learn to:

- explain photosynthesis and the contribution of scientists in this area.
- represent the transfer of energy and matter in an ecosystem.
- analyze the effects of human activity on food chains.
- plan and carry out research independently.

# What Do You Know?

Initial Evaluation

**1.** Write the function of each organism in the image: producer, consumer or decomposer.

**2.** Read the following descriptions. Then write the corresponding letters in the circles near the tree.

**a.** This is the part in charge of absorbing water and minerals.
**b.** This is where photosynthesis occurs.
**c.** This is the part that transports water and nutrients to the whole plant.

Scientific Skill: Experiment

**3.** A group of students found that two plants of the same species grew at a similar distance from a river but had the following differences:


Based on this, two students decided to research why the plants had these differences. To do so, they did the following experiments.

**Student 1** placed a seed in a jar with soil and watered it for three weeks, increasing the amount of water each day and leaving the jar in a sunlit area the whole time.

**Student 2** placed a seed in a jar with soil and watered it with the same amount of water for three weeks. Some days the plant was in a sunlit location and other days it had no light.

**a.** Which variable did the children modify in their experiments?

**Student 1:** _____ **Student 2:** _____

**b.** Which student used a more appropriate method to find the difference between the plants? Explain your answer.

_____

_____

Section 1

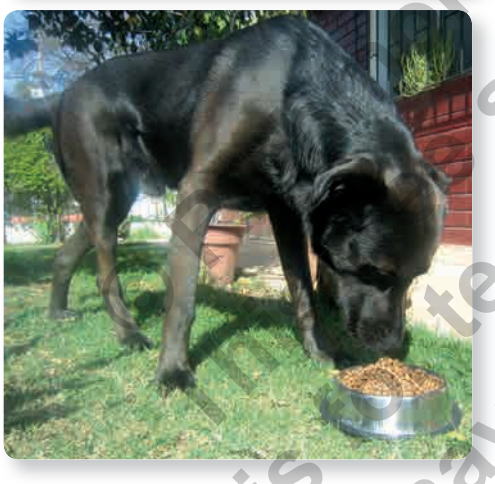
# Photosynthesis

Connecting

## Everything Needs Energy

Many living things exist on our planet. Can you think of any similarities between them? Look at the following images and try to identify some similarities.






Even though they are different, all living things share some characteristics—for example, they all need energy.

Were you able to identify any similarities? Although at first sight these living things appear to be very different, if you look more closely, it is easy to find similarities between them. For example, they are all living things and therefore consist of cells, tissues and organs. They also react to stimulants in the environment, can reproduce and need a place to grow.

Another important characteristic they have in common is the need to nourish themselves to obtain the energy necessary to stay in good shape and to carry out their normal functions. In the case of the eagle, ant and dog, it is easy to see that they obtain their energy through the food they eat, but have you ever asked yourself how plants obtain their energy?

feed

## Why Do We Need Energy?

Every morning, from the time you get up, you need energy to do your daily activities. Just like us, all living things need energy, and plants are not an exception. They also need energy to produce flowers and fruit and so that parts such as their stem and leaves can grow. We can see that energy is important for all living things to maintain and develop their vital functions.

Where do living beings get their energy? The answer is from substances called nutrients, which are consumed daily. Animals get their nutrients by eating other living things, such as parts of plants or other animals, while plants can make their own nutrients.

Living things that obtain their nutrients from other living beings are called **heterotrophs**, and those that can make their own nutrients are known as **autotrophs**.

### Fun Fact!

Nutrients are indispensable substances for life as they carry out important energetic, structural and regulatory functions in our bodies. Some examples of nutrients are carbohydrates, lipids, proteins, vitamins and minerals.

execute

Living things need energy to perform all their tasks.

### Challenge

With a partner, write down as many heterotrophs as you can think of in 30 seconds. Then do the same for autotrophs. Who thought of the most?

an animal eaten by another

Heterotrophic organisms, like lions, obtain their nutrients by hunting and feeding on their prey; autotrophs, such as trees, can make their own nutrients. What other examples of heterotrophs and autotrophs can you think of?

Connecting

## Autotrophic and Heterotrophic Organisms

Heterotrophic organisms cannot make their own nutrients, which is why they have to obtain them from the environment. This group includes all the organisms that feed on other living things, their parts or their remains. In nature, we can identify different types of heterotrophic organisms.

cadaver

Heterotrophic organisms, such as animals, feed on plants, other animals or both.

Some organisms, like dragonflies, feed on other animals.

Some organisms, such as cows, only eat plants.

Some organisms, like fungi, feed on dead organisms, their remains or their waste.

Others, such as foxes, eat both other living things and plants.

Unlike animals, but similar to algae and cyanobacteria, plants are **autotrophs** because they are capable of producing their own nutrients. In order to do so, however, there are certain requirements. Have you ever heard that plants need light? The light that comes from the sun is the energy that plants need to make their own nutrients. Plants also need **inorganic matter**, which is supplied by the environment. With these elements, autotrophic organisms can create **organic matter**, from which they obtain the nutrients that they need to live.

cyanobacteria

algae

Plants, just like algae and cyanobacteria, are autotrophic organisms that make their own nutrients from the sun's energy and inorganic matter from the environment.

### Word Focus

**Inorganic matter** does not come from living things and does not have carbon as its basic element.

**Organic matter** is related to the structures and functions of living things.

## Practicing

**1.** Mark the autotrophic organisms in **red** and the heterotrophic organisms in **blue**. Identify

**2.** An experiment was conducted where two plants were grown from seed in different terrariums. One of the plants was grown in the presence of light and the other with no light. After a month, the investigator measured them and obtained the following results:

| Plant Height | |
|---|---|
| Plant with Light (cm) | Plant without Light (cm) |
| 60 | 25 |

Using these results, answer the following questions.

**a.** Which plant grew more during the experiment? Identify

_____

**b.** Why did this plant grow more? Interpret

_____

_____

**c.** Why did the plant that did not receive any light still grow? Infer

_____

_____

## Summarizing

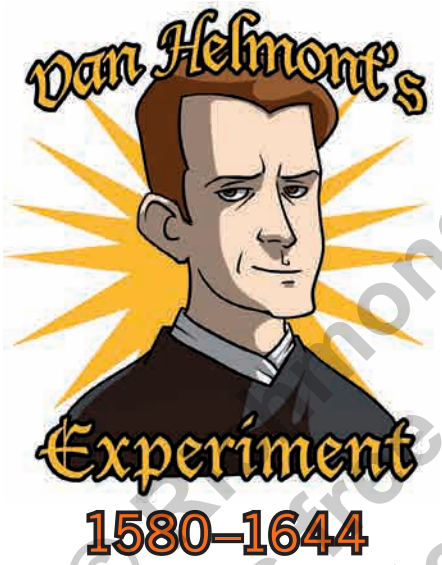
**According to the way that living things obtain their energy and nutrition, they can be classified as**

_____ **or** _____.

Connecting

# The Contribution of Van Helmont to the Study of Plant Nutrition

Four hundred years ago, it was not understood how plants received their nutrition as it was thought that, just like animals, they obtained their nutrients from the environment, specifically from soil. A Belgian scientist named Jan Baptist van Helmont, however, decided to put this hypothesis to the test by doing the following experiment.




**90.71 kg of dry soil was put into a planter, and a willow with a mass of 2.3 kg was planted.**

Why do you think that Van Helmont dried the soil before measuring its mass?

not humid

**He watered the willow periodically with rainwater, which did not contain nutrients or minerals.**

**He observed how the plant grew and he got rid of any leaves that fell.**

Why do you think Van Helmont got rid of the leaves that fell?

eliminated

**After five years, he took the tree from the planter and measured the mass of the willow and of the dry soil.**

**He observed that the willow's mass was 76.74 kg and the soil's mass was 90.66 kg.**

What happened to the mass of the soil and of the willow after five years?

What conclusion do you think that Van Helmont drew after conducting this experiment?

got smaller

got bigger

As you can see, the willow had increased in mass by 74.44 kg, while the soil had decreased in mass by 50 g. Van Helmont considered, therefore, that the difference in the willow's mass could be directly attributed to the water.

From this, he concluded that plants got nutrition and formed organic matter **only from water** as it was the only thing that had been in contact with the plant during the whole experiment, except for the soil in the planter.

Van Helmont's conclusions take into account only soil and water. What other elements are related to how plants obtain their nutrients? What about air and light? To answer these questions, let's see which factors affect the nutrition of these organisms.

Even though Van Helmont made an error in his conclusion, the experiment followed all the steps required in scientific research. You can find these steps in the **Scientific Research Skills Foldout.**

Connecting

## Photosynthesis: The Intake of Material and Energy from the Ecosystem

Although Van Helmont observed that plants require water to make their own nutrients, water is not the only factor necessary to do this.

Over the years, numerous scientific experiments have led humans to discover the factors that are necessary for plants to produce their nutrients. Along with water, they also need **carbon dioxide** and **light**.

guided

### Word Focus

**Carbon dioxide** is the gas that living things eliminate as waste during respiration. It can be found in air and water, and plants absorb it to use for photosynthesis.

Water: The roots absorb water from the ground. Through the plant's stem, the water reaches the leaves of the plant and contributes to photosynthesis.




Along with the water absorbed by their roots, plants require light and carbon dioxide to make **glucose**, a nutrient from which they obtain energy to perform their functions. In the process called photosynthesis, plants also produce oxygen, a gas of vital importance not only for plants but also for the majority of living things.

## Did You Know...?

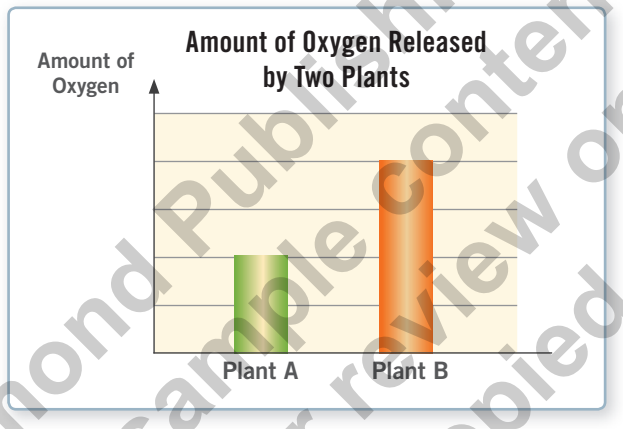
Some bacteria do not use light energy from the sun to obtain their nutrients but instead use the energy released in inorganic reactions in a process called chemosynthesis.

liberated

## Practicing

**1.** Using what you know about plant nutrition, what factors did Van Helmont not consider while doing his experiment? Explain. Apply

**2.** A group of scientists put two plants in similar conditions and obtained the following results.




**a.** Which organism performed photosynthesis more efficiently? Interpret

**b.** What caused the difference in the amount of oxygen released by both plants? Explain. Infer

**c.** In what other way can you see which plant performed photosynthesis more efficiently? Explain. Apply

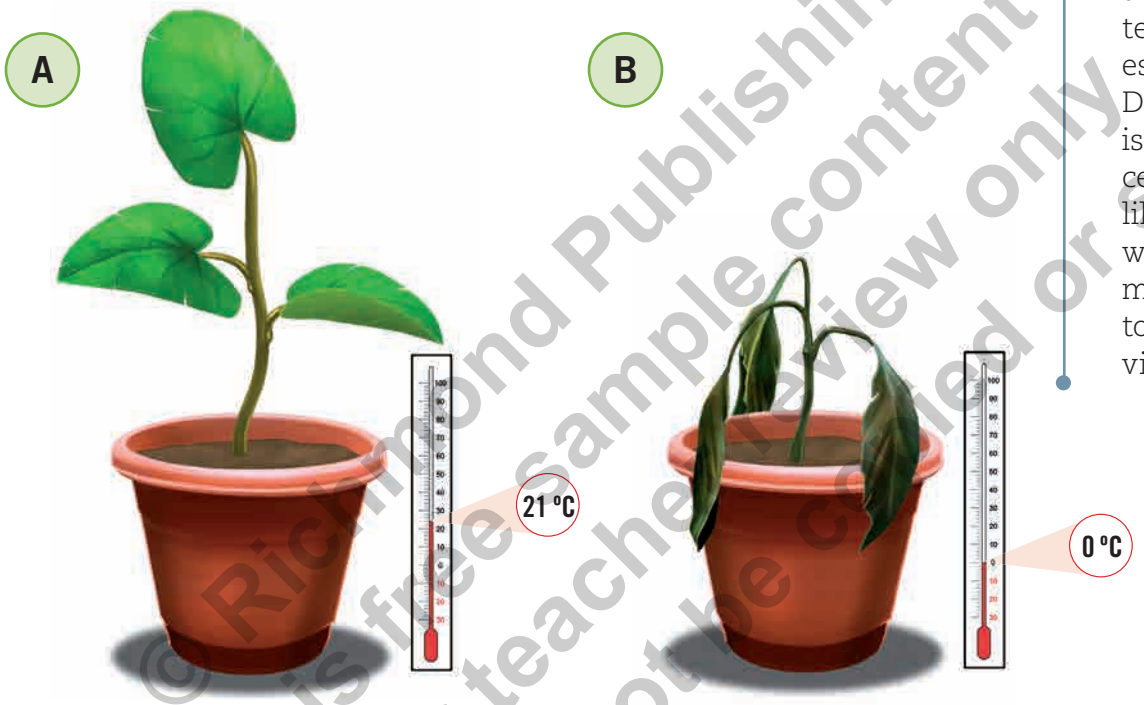
## Summarizing

**The contribution that Van Helmont made toward our knowledge of plant nutrition was his conclusion that they find nourishment exclusively in _____, even though we now know they also need other things to live. Photosynthesis is a process in which plants produce _____ and _____ from _____, _____ and _____.**

Connecting

## Factors that Affect Photosynthesis

Two identical plants were put in different locations in a house. Then they were kept at different temperatures for two weeks. Plant **A** was kept at 21 °C while plant **B** was left at 0 °C. After the two weeks, the following results were found.




Imagine if the earth's temperature suddenly rose. Surely none of us would be able to perform our daily activities because to do so humans require certain conditions, such as adequate temperature.

got higher

The same happens to photosynthetic organisms. In the experiment above, the plant that was kept at 21 °C had all the right conditions to perform photosynthesis so that it could make its own nutrients and obtain energy. On the other hand, the plant kept at a low temperature was not able to produce its own nutrients and it withered.

dried up

Plants need carbon dioxide, water and the sun's energy to perform photosynthesis. Other factors or environmental conditions also regulate this process, such as the temperature and the intensity of light a plant receives.

### Staying Healthy

Human beings, just like many other organisms, are affected when the temperature is too high, especially in the summer. During this time of year, it is very important to follow certain recommendations, like drinking a lot of water, wearing a hat and eating more fruits and vegetables to nourish your body with vitamins and minerals.

### Challenge

At what temperature do you feel most comfortable? To find out, record the daily temperature for a week and write down how you feel each day.

Connecting

## The Effects of Temperature and Light

Think about how you feel on a really hot day. You may have noticed that when it is very hot, people are less able to concentrate and do not do their daily activities as efficiently. The same occurs when it is cold. Have you ever noticed that your hands are not as dexterous when they are cold? This is not a coincidence; there are factors such as **temperature** and **light** that affect how living things, including autotrophs, function.

agile

deficiency

Plants perform photosynthesis between certain ranges of temperature. However, there is an optimal temperature for each type of plant to reach its maximum production of oxygen and glucose—for example, there are some tropical plants that can perform photosynthesis between 6 °C and 58 °C, but their optimal temperature is 39 °C.

Tropical plants have adapted to high temperatures.

In addition, the process of photosynthesis requires an optimal intensity of light. As the intensity of light increases, like on long summer days, the production of oxygen and glucose increases until it reaches a maximum level. However, an excess of light, just like a lack of light, can also produce a decrease in the photosynthetic activity of a plant.

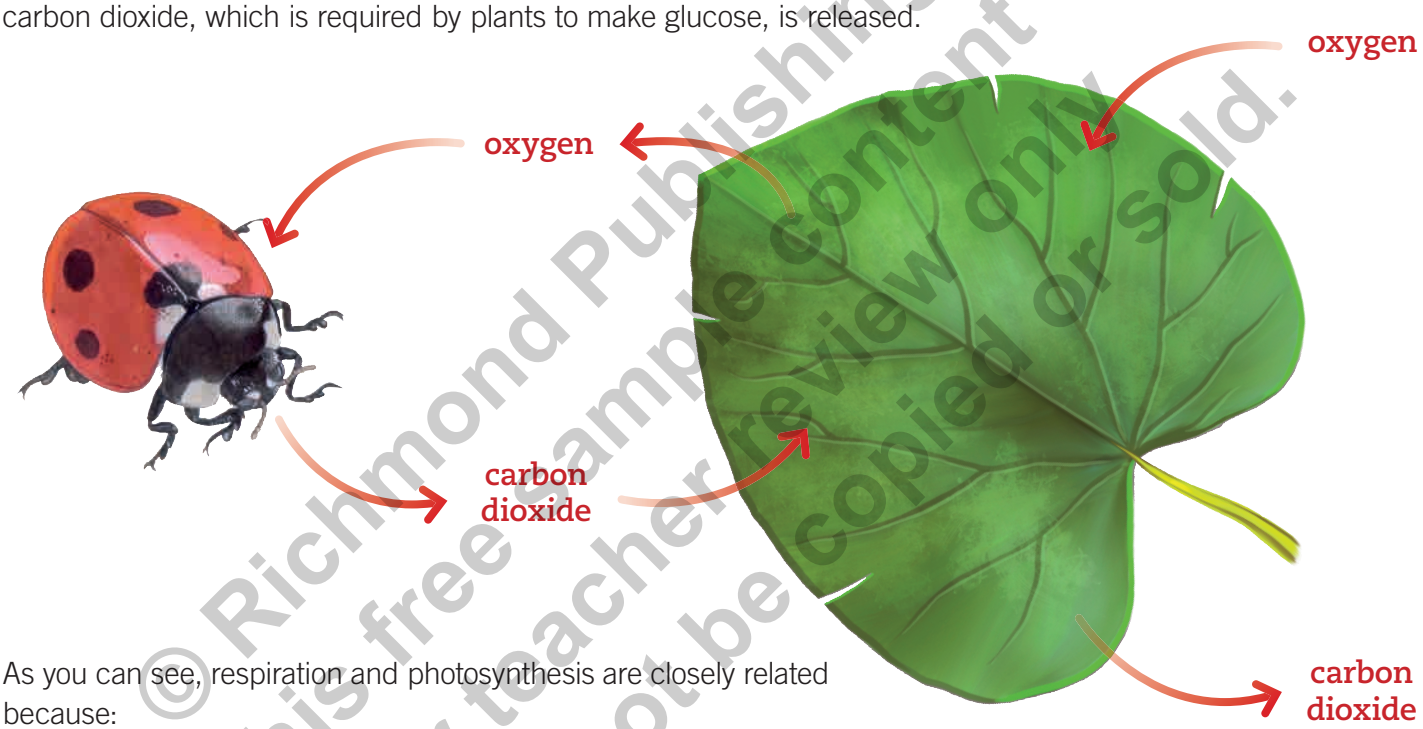
During the summer, plants perform more photosynthesis than in the winter because there is more light.

As you can see, in order for photosynthesis to occur, plants need to receive the correct amount of light and grow in an adequate temperature.

## Respiration and Photosynthesis

Have you ever heard that forests and jungles are the earth's lungs? Do you know why? Well, the oxygen that plants in these places produce through photosynthesis is vital for the respiration of the majority of living things across the planet, including plants.

During photosynthesis, plants release oxygen into the environment, which is then used by the majority of living things to breathe; as a result of breathing, carbon dioxide, which is required by plants to make glucose, is released.






As you can see, respiration and photosynthesis are closely related because:

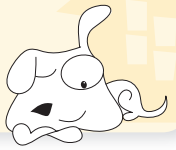
- Photosynthesis consumes carbon dioxide and releases oxygen.
- Respiration consumes oxygen and releases carbon dioxide.

Therefore, there is a balance between both processes because the oxygen released into the environment during photosynthesis is utilized by living things during respiration, and the carbon dioxide produced during respiration is utilized by plants to perform photosynthesis.

### Education through Values

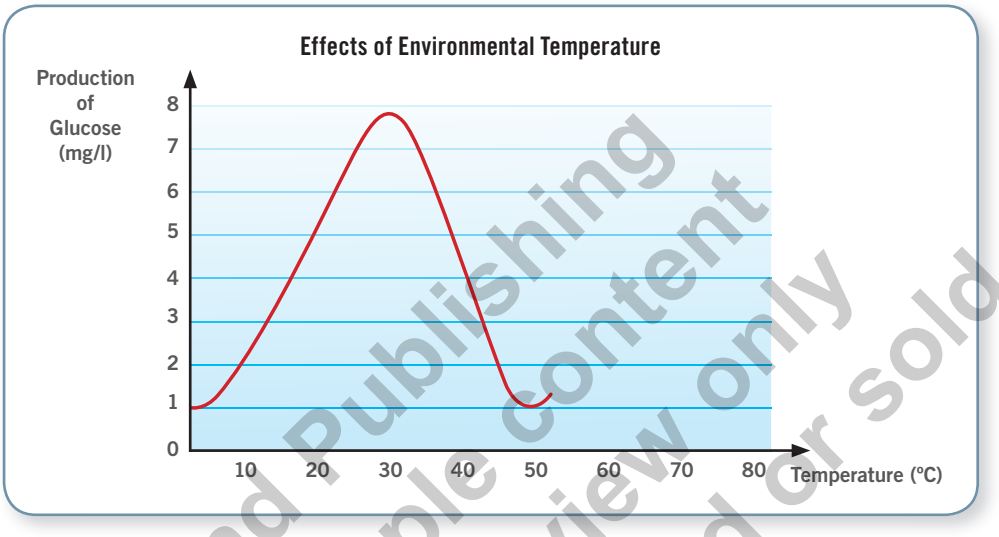
Given the importance of plants, it is vital to protect our green areas, including forests and jungles, as they give us the oxygen that we need to live. They also provide food and shelter to a large number of organisms.

protection from the weather and other animals



## Practicing

**1.** Look at the following graph and respond.




**a.** What happens to the production of glucose as the temperature increases? Interpret

**b.** What is the optimal temperature to perform photosynthesis? Interpret

**c.** Do you think the plant of the graph is from a warm or cold climate? Explain. Infer

**2.** Read the following sentence and answer.

"Respiration and photosynthesis are simultaneous processes that support life on our planet."

**a.** Why does it say that respiration and photosynthesis are simultaneous processes? Apply

## Summarizing

**Among the factors that affect photosynthesis are _____ and _____.**

**Photosynthesis is a process that uses _____ and releases _____, while respiration uses _____ and releases _____.**

# Quiz Yourself

**1.** Describe the contribution that Van Helmont made to the study of plant nutrition.

**2.** Explain briefly the substances that are required for and produced by photosynthesis. Remember to include the parts of the plants that participate in this process.

| Photosynthesis | |
|---|---|
| **Requires** | **Produces** |
| | |

**3.** Analyze the situations and respond.

| Situation A | Situation B |
|---|---|
|  |  |

**a.** In which situation do you think the insect will survive? Explain.

# The Effect Light Intensity Has on Photosynthesis

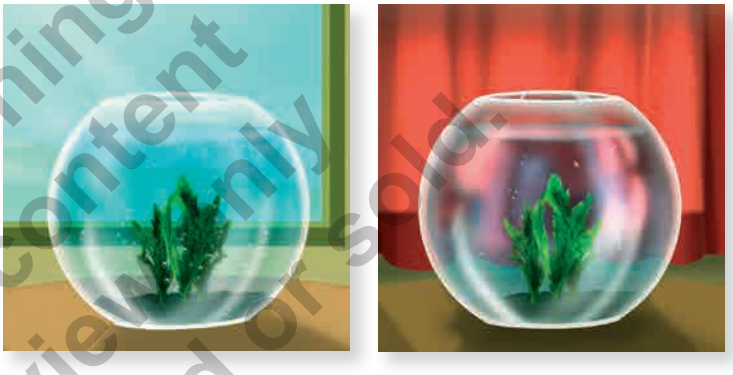
## Basic Framework

Photosynthesis allows autotrophic organisms to make their own nutrients and obtain the energy needed to live. Some factors, such as temperature, intensity of light or the presence of certain substances, can either help or harm the photosynthetic process. Evidence of this can be found by measuring the substances produced during this process: glucose and oxygen.

affect negatively

## Observation

What do you think the differences between the plants in the bowls are caused by?



## Research Question

Mark the correct research question based on the previous observation.

- ☐ How does light intensity affect photosynthetic activity?
- ☐ How does the quantity of nutrients affect photosynthetic activity?

## Hypothesis

Mark the correct hypothesis based on the research question.

- ☐ As light intensity increases, photosynthetic activity increases.
- ☐ As light intensity increases, photosynthetic activity decreases.

## Predictions

What will happen to the plant if it receives a large amount of light?

The experimental procedure stage is when an experiment is planned to verify whether the hypothesis is correct or not. To conduct a successful experiment, it is necessary to consider the variables that you need to control, the supplies you will use and the procedure that you will follow. Below, you will write the experimental procedure to prove if light intensity favors photosynthesis.

if

## Experimental Procedure

### What variables can you control?

In an experiment, you must determine which factor or variable can affect or influence the results. In this case, you have two variables: light intensity, which corresponds to the independent variable, and photosynthetic activity, which is the dependent variable. Which of these two variables do you think influences the results of the experiment?

- ☐ light intensity
- ☐ photosynthetic activity

### What materials should you use?

In an experiment, it is necessary to reproduce the conditions in which a phenomenon occurs in order to observe it. To do this, you need to use the correct supplies. In this case, we want to observe the intensity of the light. Here is a list of possible supplies necessary for the experiment. Mark the ones you think you will need:

provisions

- ☐ a garden plant
- ☐ a glass jar
- ☐ a 20 watt lightbulb
- ☐ water
- ☐ test tubes
- ☐ airtight bags

impermeable to air

- ☐ elodea branches (an aquatic plant)
- ☐ an 80 watt lightbulb

### One or two glass jars?

You need to use two glass jars to conduct this experiment. This is because we need to validate the results from one of the jars by comparing it with another jar in which the variables have not been manipulated. This second jar is called the control group, which is necessary in every experiment.

## What procedure should you follow?

With the supplies selected, you must now define the experimental procedure. In other words, you need to decide what steps you are going to take. To do this, complete the instructions below.

The procedure is fundamental for the experiment to be successful. Remember to follow each step closely and respect the indications given.

1. With a marker, label two _____ with the letters **A** and **B**.
2. Take a _____, put it in the jar labeled **A** and fill the jar with _____, making sure that it does not overflow.
3. Repeat the same procedure with jar **B**.
4. Put the _____ in one lamp and the _____ in the other.
5. Put the glass jars and lamps on two separate desks.
6. Place the glass jars at least 15 centimeters away from the lamps, and then turn both lamps on and watch what happens over an hour and a half.
7. Write down your observations in the **Results** section.

When the time is up, what do you think will have happened to each plant?

This experiment must be done in a place where there is little natural light because light is the variable that we are manipulating.

## Results

Draw what you observed of each plant and briefly describe the changes.

**A**

**B**

## Interpreting and Analyzing Results

**1.** What differences can you see in each plant after the experiment?

**2.** Using your knowledge of photosynthesis, what do the bubbles that come out of the elodea branches correspond to?

## Conclusions

**1.** Was the hypothesis from the beginning of the experiment confirmed? Explain.

**2.** What effect does light intensity have on elodea plants? Support your ideas.

**3.** If we could measure the amount of glucose generated by each plant during the experiment, in which do you think we would find more? Explain.

**4.** If you did the same experiment with a plant adapted to less light, do you think that the results would be the same? Explain.

Section 2

# Systems of a Food Chain

Connecting

## Understanding Organization in Nature

Do you think that there is organization in nature? This seems like a difficult question to answer considering that all living things develop freely. For example, think of a wild, natural place that you have visited—is there any organization to this place? Do the organisms there only occupy a certain space? Do they behave in a certain way? At first glance, it is difficult to detect any order in nature, but if you look carefully at the following image, perhaps you can identify some forms of organization.

act

Living things are organized at diverse levels in nature.

So did you identify any type of organization? As you might have realized, there are many different species present, like elephants and gazelles. Animals of the same species often live close to each other, but they also interact with organisms of other species, like the cheetah hunting the gazelles. In nature, we can distinguish various **levels of organization**, which we will study in this section.

noticed

## The Components of an Ecosystem

As you saw previously, living beings are organized in nature in a certain way. Within this organization, we can distinguish individuals, populations, communities and ecosystems.

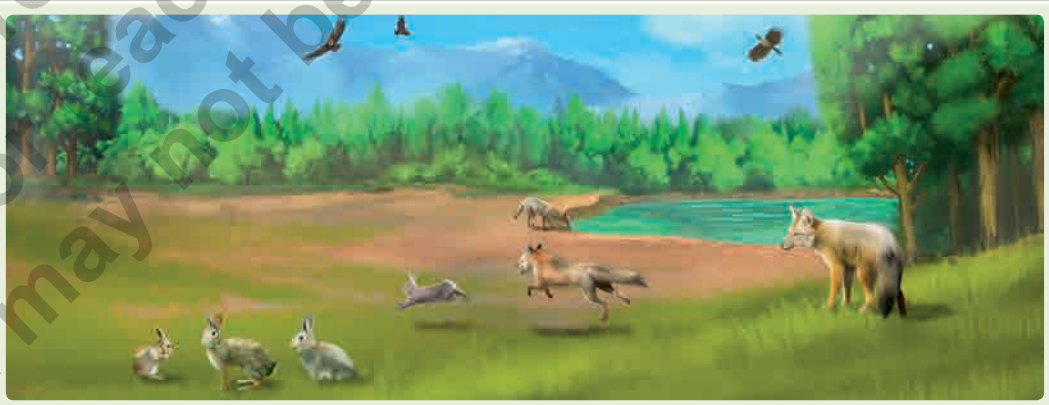
An **individual** refers to each living thing, unicellular or multicellular, that belongs to a particular **species**.

is a part of

A **population** is a group of individuals of the same species that live in the same space and at the same time.

A **community** includes all the populations that inhabit a common environment and interact.

An **ecosystem** consists of the living things in a certain place, the conditions of the place (temperature, light and humidity, among other things) and the interactions that occur between them.





If you think of a natural environment you have visited, you will realize that different ecosystems exist. In an ecosystem, it is possible to find different environmental conditions and diverse organisms, populations and communities, all of which represent the different levels of organization of the ecosystem.

### Word Focus

A **species** is a group of living things that have similar characteristics and that can reproduce fertile descendants.

## The Components of a Specific Ecosystem

Look at the following ecosystem.

In this ecosystem, we can find two basic types of components: alive and inert. Complete the following table, listing the living things and the nonliving things that you can identify.

| Living Things | Nonliving Things |
|---|---|
| | |

As you can see, there are always living and nonliving things in an ecosystem. All living things are called biotic factors. In this case, the worms, insects and plants in the ecosystem are **biotic factors**.

In an ecosystem, you will also find other elements, such as water, air and rocks. These are not alive and are called **abiotic factors**.

Biotic and abiotic factors interact permanently in nature and give each ecosystem certain characteristics.

## Practicing

**1.** A student observed the following situation through binoculars.

**a.** Write down a population and a community that you can identify in the image. Differentiate

Population: _____

Community: _____

**b.** What abiotic factors are present in the image?

_____

**c.** Can you confirm that the student observed an ecosystem? How? Explain

_____

_____

## Summarizing

**In an ecosystem, living things are organized into levels. Some of these levels are _____, _____ and _____.**

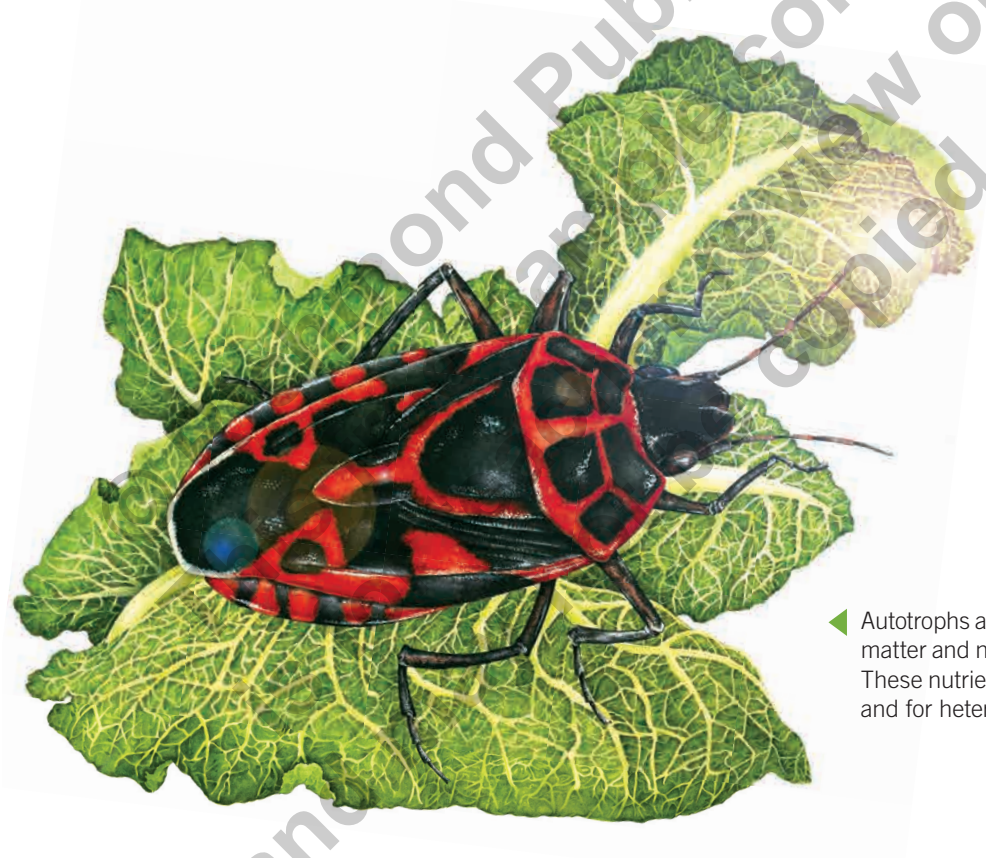
**In an ecosystem, you can find two types of components: _____ and _____.**

**Biotic factors are those that are _____ and abiotic factors are those that are _____.**

Connecting

## Organisms and Their Role in an Ecosystem

Autotrophic organisms, such as plants, algae and some microorganisms, use light for photosynthesis, which produces organic matter and oxygen. Through this process, heterotrophic organisms can obtain the nutrients that they need from the leaves, roots and fruits of plants. However, what do you think would happen if the sun disappeared and the earth stopped receiving light and heat? All the ecosystems would suffer changes and eventually life on earth, as we know it, would disappear. This would happen because plants would not be able to perform photosynthesis and the rest of the living things would not have the oxygen or nutrients required for their vital functions.



Autotrophs are organisms that produce organic matter and nutrients with energy from the sun. These nutrients are useful both for themselves and for heterotrophic organisms.

When autotrophs capture the sun's energy and produce organic matter, they not only use it for themselves but it also becomes available to other living things. Autotrophs are called **producers** because of their role within an ecosystem.

From this point of view, heterotrophic organisms, which do not produce their own food, are called **consumers**.

## Types of Consumers

As you already know, consumers obtain the nutrients and energy that they need to grow and develop by feeding on other living things. According to the type of elements that they consume, they can be classified as:

| Types of Consumers | | |
|---|---|---|
| **Herbivores** | These are consumers that eat plants, including leaves, flowers, fruit, pollen, nectar, seeds and roots. For example, butterflies, termites and elephants are herbivores. |  |
| **Carnivores** | These are organisms that feed on other animals. Some examples are the praying mantis, lions and tigers. |  |
| **Omnivores** | These are organisms that consume both animals and vegetables. Examples are pigs, foxes, dogs and human beings. |  |
| **Scavengers** | These are organisms that consume waste and dead animals, or **carrion**. Some examples are vultures, hyenas and some species of beetles. |  |
| **Parasites** | These are consumers that feed on other animals but without killing them. They can live inside or outside the body that they consume. Examples are ticks and fleas. |  |

Connecting

## Energy Flow in an Ecosystem

To perform your daily activities, like breathing or practicing sports, you need a constant supply of energy. Human beings are heterotrophic organisms—in other words, we obtain our nutrients from feeding on other organisms, and with the help of oxygen, we obtain energy from food.

All the energy that human beings require comes from the sun. When it reaches the earth, the sun's energy is captured by producer organisms (autotrophs)—the living things that utilize light energy to produce the nutrients they need. These nutrients also become available for consumer organisms. So in every ecosystem, **energy is constantly flowing from producers to consumers**.

accessible

Think about the following situation: if a plant like the one in the image uses a certain amount of energy from the sun, how much of that energy reaches the caterpillar? It would be difficult to determine that with precision, but one thing is certain: the caterpillar will only receive a part of the energy available in the plant because the other part is used by the plant itself to grow leaves and fruits.

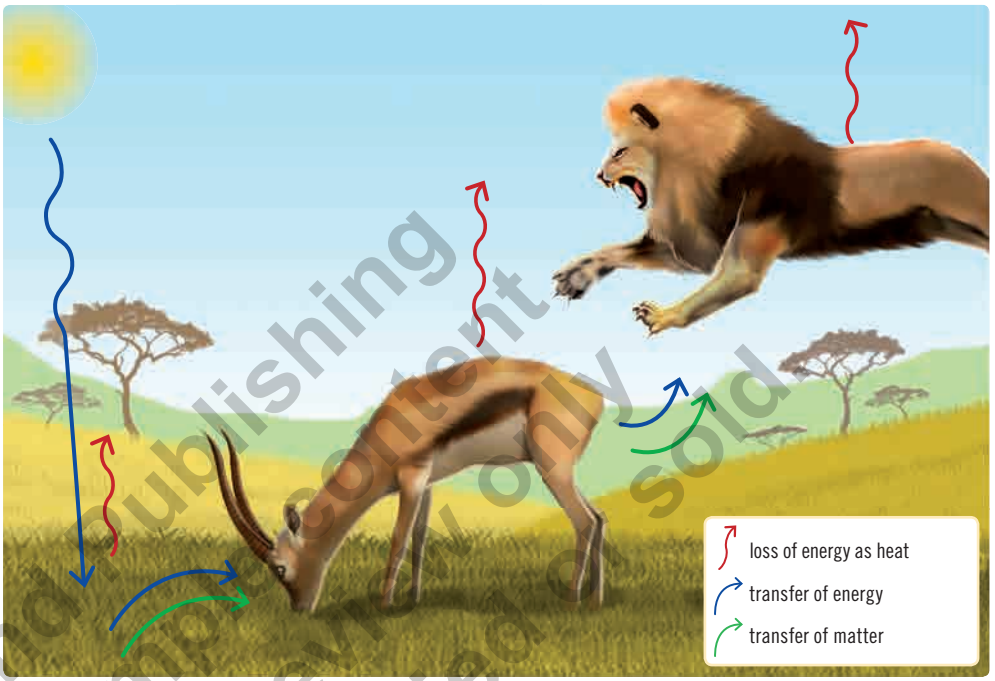
the larva of a butterfly

## Not All Energy Is Used

Each time an animal feeds on a plant or another animal, it receives only **part of the energy** that the element contains. This is because organisms use only some of the energy to carry out their activities, while the rest is **lost** or **dissipates as heat**.

conduct

In the situation in the image, the grass (a producer) captures energy from the sun and uses part of it to make its own leaves, stems and roots. Therefore, the deer can only consume part of the plant's total energy. The deer also uses up energy while doing activities such as running and reproducing. In this way, the lion that feeds on the deer can only consume part of the deer's energy.




During the transfer of energy, part of it is lost or dissipates as heat.

What do you think would happen if an even larger predator ate the lion? The amount of energy that the predator has access to from the lion is even smaller. The lion, just like all living things, uses energy while performing its daily activities and also loses energy through heat. In other words, the transfer of energy between organisms is never completely efficient.

an animal that eats other animals

### Practicing

1. Go to **Activity Card 1** and classify the organisms as producers or consumers. Remember to consider how they obtain their food. Identify
2. Draw arrows of different sizes to represent the direction energy moves and the amount that is transferred. Apply

### Summarizing

**Producers are** _____.

**Consumers are** _____ **and can be classified as** _____.

Connecting

## Trophic Levels, Chains and Systems

Food chains are a representation of how living things interact in an ecosystem. In them, we can see the relationships that organisms establish while feeding and how energy and matter circulate in nature. A food chain consists of links called **trophic levels**.

connections


The **first trophic level** is represented by producers that take the sun's energy and inorganic matter from the environment and incorporate them into the food chain.

The **second trophic level** corresponds to organisms that feed on producers—in other words, herbivores and omnivores. These animals are called primary consumers.

The **third trophic level** includes animals that feed on herbivores. This group includes carnivores and omnivores called secondary consumers. A **fourth trophic level** can also exist, which is represented by animals called tertiary consumers.

**Decomposers**, like fungi and bacteria, feed on waste and the remains of living things of all trophic levels. They return inorganic matter to the soil, making it available again for the producers.

### Did You Know...?

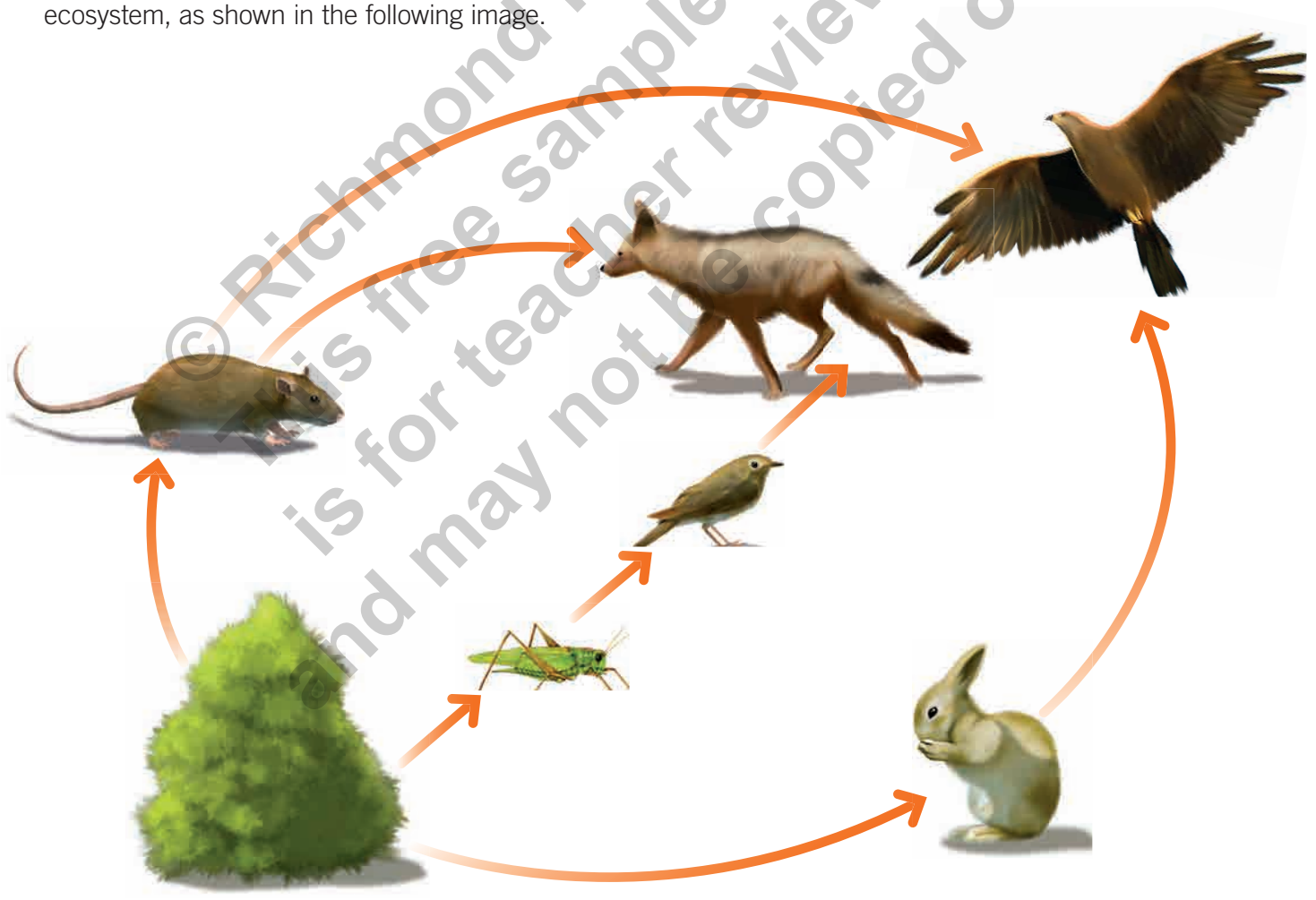
A food chain cannot exist without producers and decomposers as the producers put the energy into the ecosystem and the decomposers return matter to the producers.

In the facing image, the → show the direction energy flows from the producers to the consumers. Notice that the arrows get thinner to indicate that the amount of energy available in each level decreases.

The → represent the transfer of matter, which flows equally from producers to consumers to reach the decomposers. Then the decomposers return it to the environment so that it can be reused.

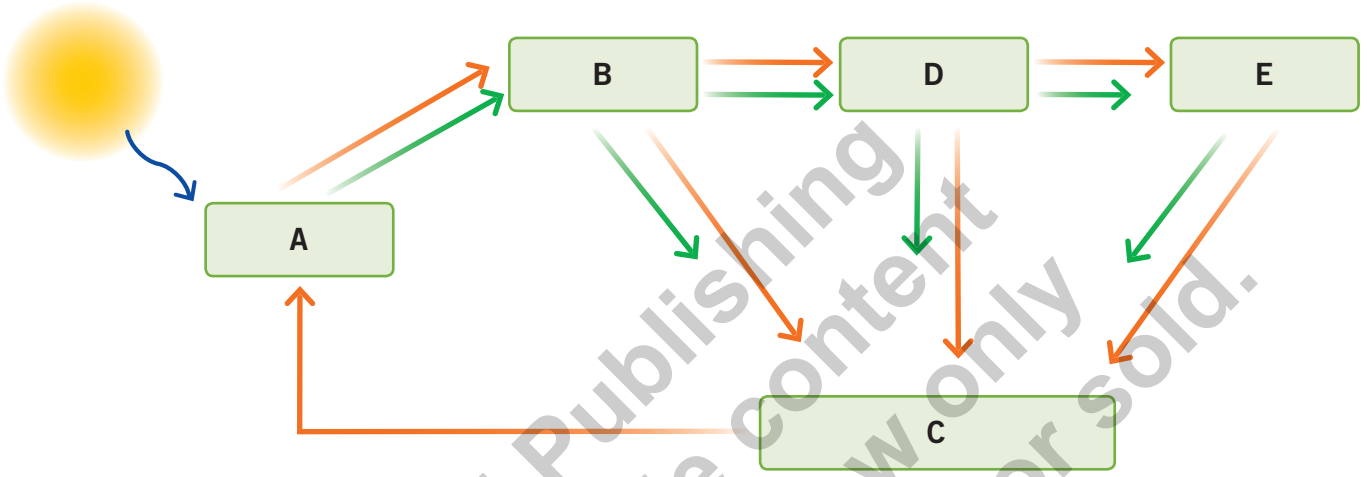
In nature, food chains are not isolated as organisms from one species can serve as food to many other organisms. For example, the vegetation in the image can be consumed by rabbits, insects and rodents, while insects can be consumed by toads, lizards and birds, and rodents can be food for snakes, owls, eagles and foxes.

In this way, trophic chains cross over to form food chain systems, or food webs, that serve to illustrate the multiple interactions between the organisms in an ecosystem, as shown in the following image.



## Practicing

**1.** Look at the following diagram of a food system and do the activities.




**a.** Choose a food chain you see within the system and draw it. Replace the letters with the names of organisms. Illustrate

**b.** What trophic levels are represented by **A** and **C**? Identify

**A**: _____ **C**: _____

**c.** Explain which arrow represents the transfer of energy and which represents the transfer of matter. Apply

Transfer of energy: _____

_____

Transfer of matter: _____

_____

## Summarizing

**One way of representing how living things interact in an ecosystem is through _____,**

**_____ and _____.**

**In them, we can see how _____ and _____ flow in an ecosystem.**

# Quiz Yourself

**1.** Look at the following list of organisms and create a food chain, taking into consideration producers, consumers and decomposers. In your diagram, represent the flow of energy and matter within the chain with colored arrows.

- **wheat**
- **grasshopper**
- **fungus**
- **blackbird**
- **eagle**



**a.** How many trophic levels are present in the food chain?

**b.** From which organism does the energy flow in the food chain?

**c.** What would happen to the flow of matter if we took out the fungus from the food chain? Explain.

**d.** Do you think that tertiary consumers obtain less energy than primary consumers? Explain.

# Let's Check!

**1.** It was observed that a group of fish preferred to eat algae located in a sunlit sector than algae located in a zone with less light. Considering that both plants had the same carbon dioxide and water conditions, answer the questions.

points 8

**a.** Why do you think the fish preferred one group of algae to the other? Explain.

**b.** Which group of algae will produce more oxygen? Support your ideas.

**c.** How does light intensity influence photosynthesis in this case?

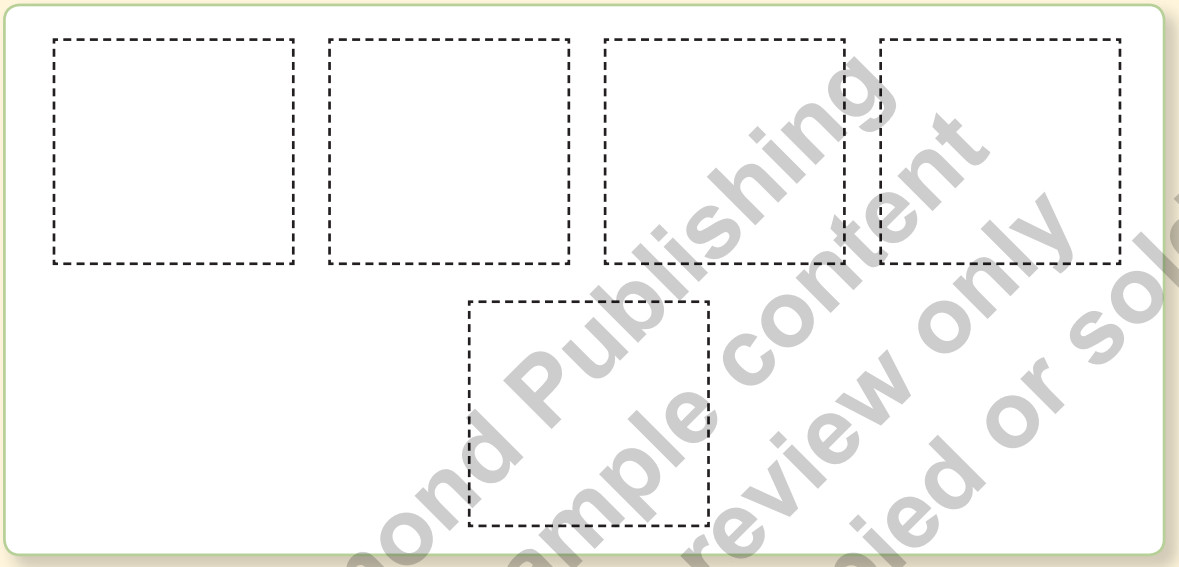
**d.** What do you think would happen if both groups of algae were in the same light intensity? Explain.

**2.** Applying your knowledge of photosynthesis, do you think the conclusions that Van Helmont obtained with his experiment were accurate? Explain.

points 3

**3.** Go to **Cutout 1** on **page 171**. Form a food chain using a → to show the flow of energy and a - - → to show the flow of matter.

points 10



Answer using the information above.

**a.** Which population of organisms obtains the most energy?

**b.** Which population of organisms obtains the least energy?

**c.** What function do the decomposers serve in this ecosystem?

**d.** What would happen if we took the producers out of the food chain?

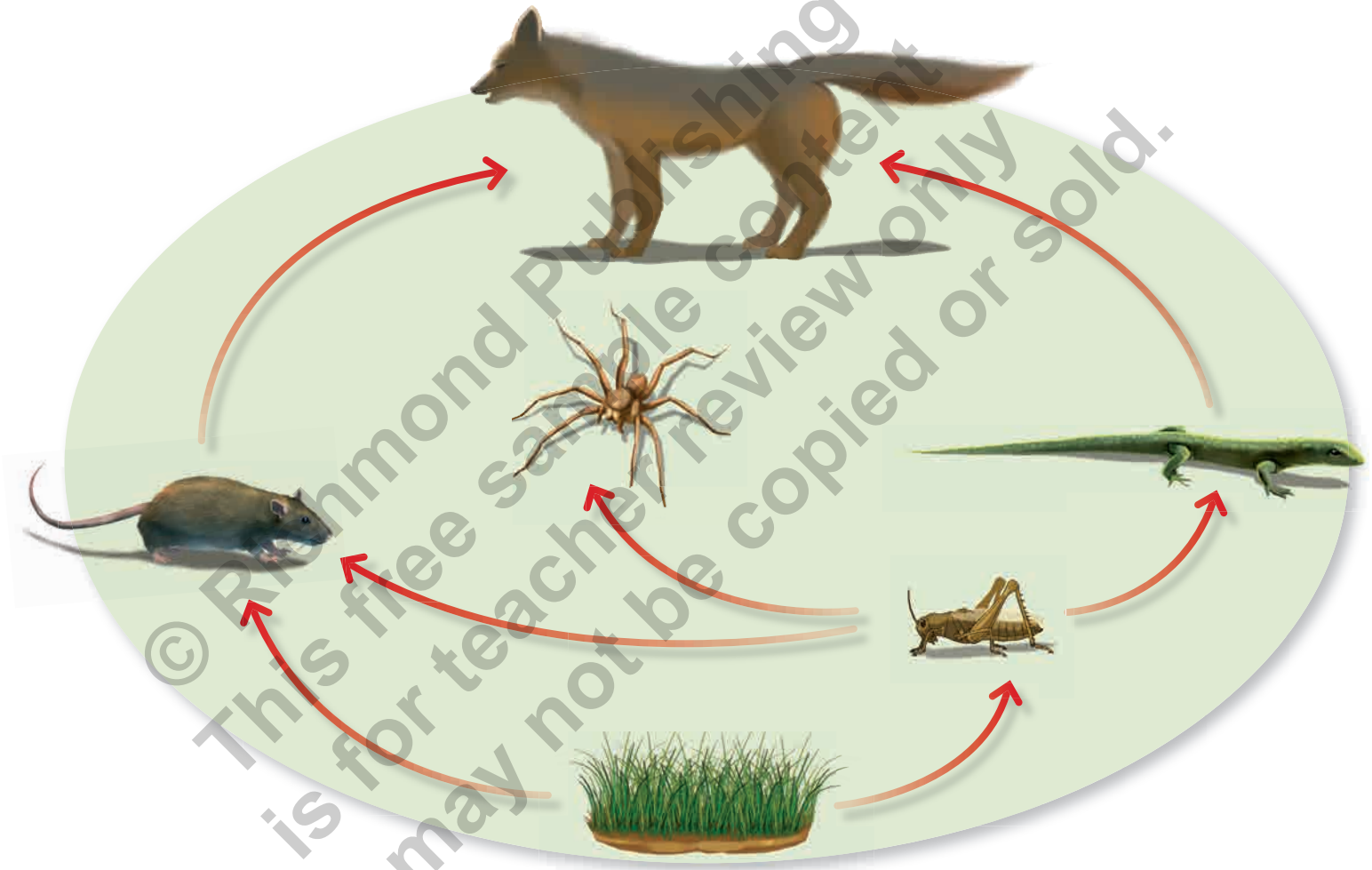
Section 3

# The Effect of Human Activity on Food Chains

Connecting

## Can a Food System Be Changed?

Look at the following food chain.





In this chain, we can recognize many different relationships related to food. Imagine that all the foxes disappear from an ecosystem. What do you think would happen? Foxes obtain their energy from consuming rats and lizards. If there were no foxes to consume these organisms, surely their numbers would increase and they would eat more grasshoppers, while the rats would also eat more grass, leaving less energy available for the grasshoppers. With the decrease in the grasshopper population, spiders and lizards would be directly affected and could disappear completely.

Alterations within food systems happen every day in nature, both **naturally** and caused by **human activity**.

Regardless of the cause, the damage done to a food chain or a food system can be so serious that it can lead to the disappearance of an entire ecosystem.

without consideration

## Natural Causes That Alter Food Systems

There is a natural balance between all the organisms within an ecosystem. However, what do you think would happen if there were a volcanic eruption close to a forest? This balance, which is very delicate, would surely be affected by the disappearance of producers or other members of the food chain.

Among the natural causes that could harm food chains, we find:

**Glacial periods** are times when the global temperature of the earth's surface decreases, which causes the **migration** of animals and the **extinction** of species that do not adapt to the new environmental conditions.

**Volcanic eruptions** expel ash, rocks and lava and gravely damage many animals and plants that are part of a food chain.

**Floods** can leave plants and animals submerged in water, thus altering their food chains.

**Droughts** are caused when the amount of water necessary for living things to survive is not available. Many plants die because they cannot perform photosynthesis, and as a result, consumers are not able to obtain energy from them.

These, among other natural phenomena, cause the deaths of many animals and plants, directly damaging the food chains and systems they are a part of and even causing the extinction of entire species.

### Word Focus

**Migration** is the movement of populations from one place to another.

**Extinction** is the total disappearance of a species from the planet.

## The Harmful Effects of Human Activity

Think of the foods that make up your breakfast or lunch. Bread, cereal, milk, meat and rice probably all come to mind. What do all these foods have in common? Along with supplying us with nutrients and energy, the majority come from natural resources. Now, if you think about the chairs or desks at your school and even the pages in your schoolbooks, they also come from natural resources, in this case trees.

Therefore, to meet our needs, it is common to use resources found in nature. However, a problem emerges when these resources are overexploited or used without the necessary precautions to protect the ecosystems and food chains that they are a part of.



### Agriculture and the Use of Pesticides

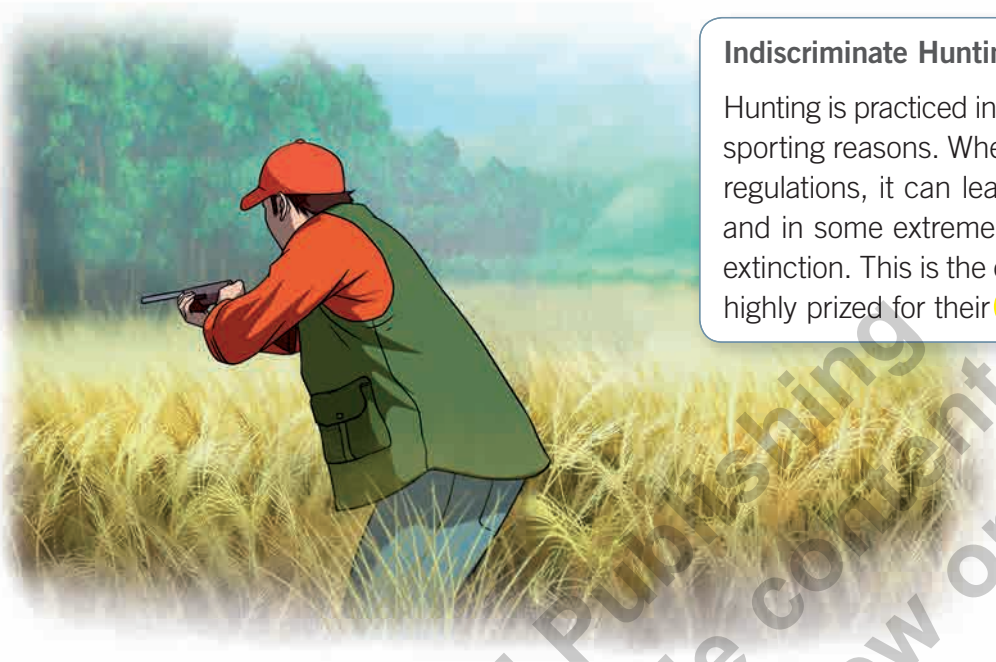
collecting cultivated plants

Farmers often intervene in an ecosystem by harvesting in order to obtain a greater crop. However, this intervention can gravely damage the food chains and systems that are a part of the ecosystem by eliminating the producers.

Also, to protect their crops, many farmers utilize chemical substances called **pesticides**. These products are often toxic for humans and can cause illness and even death in addition to damaging the crops themselves.

### Word Focus

A **pesticide** is a chemical substance created to control, kill or repel organisms that cause economic loss or transmit disease to crops.



### Indiscriminate Hunting

Hunting is practiced in many countries for commercial and sporting reasons. When hunting does not have adequate regulations, it can lead to a decrease in animal species and in some extreme cases, leave them on the edge of extinction. This is the case with chinchillas, small rodents highly prized for their fur.

hair

limit

The chinchilla is a mammal that was on the edge of extinction because of indiscriminate hunting.



## Word Focus

**Native** means an animal species or type of vegetation typical of a region or a given ecosystem.

### Introduction of a New Species

Whenever humans introduce a new species into an ecosystem where it does not belong and without the appropriate care, it will most likely cause a change in the normal functions of the ecosystem. For example, when cane toads were introduced into Australia in order to control a type of beetle that destroyed sugarcane plantations, the populations of several native reptile species that started feeding on these poisonous toads declined drastically.

# What Did You Learn?

**1.** Draw arrows according to the flow of energy. Consider the plant's needs and what is produced during photosynthesis.

points 8

Oxygen

Glucose

Light

Water

Carbon Dioxide

**a.** According to the above diagram, explain the process of photosynthesis.

**2.** Explain Van Helmont's experiment using the following points.

points 10

Hypothesis:

Supplies:

Procedure:

Results:

Conclusions:

**3.** Go to **Cutout 2** on **page 173**. Use the space below to create a food web, and draw the flow of energy within it.

points 12

Answer according to the food web above.

**a.** What food chains can you identify in this system? List two.

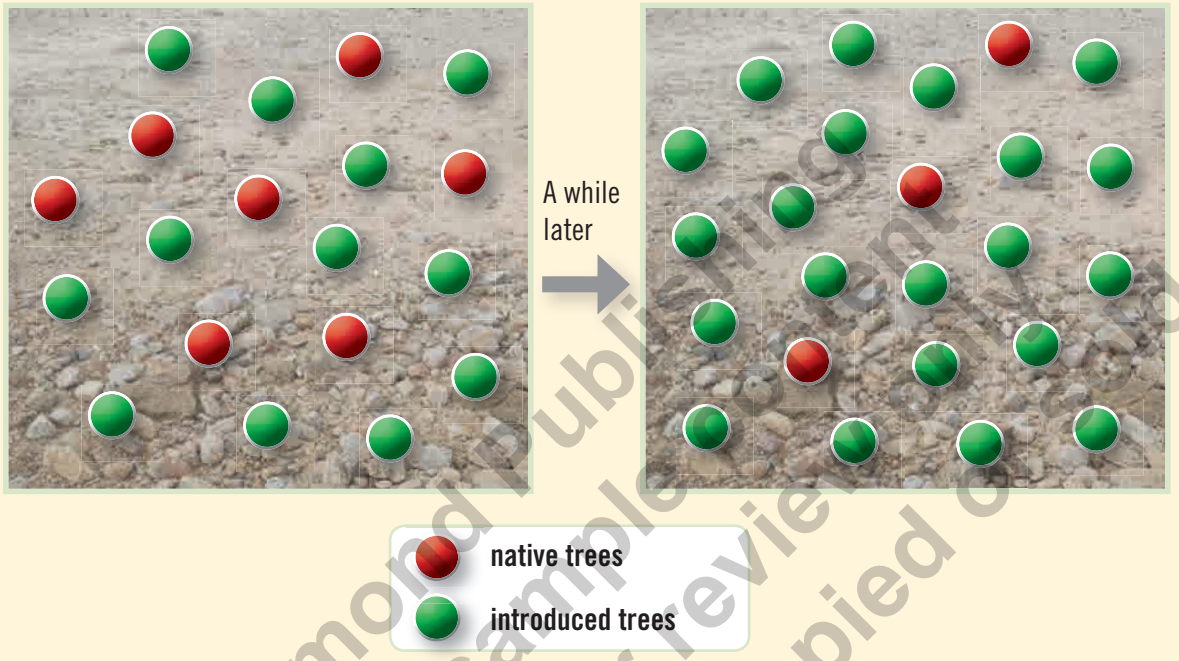
**b.** Which of the organisms in the system is an omnivore?

**c.** What trophic levels can you identify in this web?

**d.** Would the system be affected if the mouse disappeared? Explain.

**4.** A group of farmers planted an exotic tree species where there were only a few native trees in this area. This diagram illustrates what happened to the vegetation of the zone after a while.

points 6




**a.** What damaging effect is human intervention causing in this case?

**b.** What was the effect of planting exotic trees in the ecosystem?

**c.** A beetle fed exclusively off the native trees in this place. The beetle was also food for a few secondary consumers. What effects would the introduction of the exotic species of trees have on the food system in this area?

**5.** Carnivores, such as lions, obtain their energy from the food they eat. What is the original source of this energy?

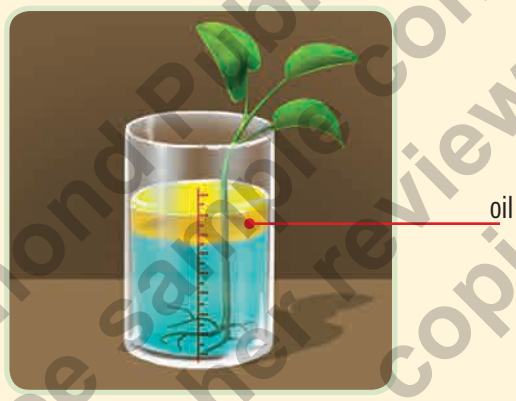
point 1

**A.** Herbivores.
**B.** Plants.
**C.** Soil.
**D.** The sun.

Scientific Skill: Experiment

**6.** A group of students wanted to challenge Van Helmont's conclusion and demonstrate with the following experiment that plants do not obtain their food exclusively from water.

points 12




**a.** Write the supplies that they used to complete this experiment.

_____ _____ _____

_____ _____ _____

**b.** What procedure should the students have followed to carry out this experiment? Show it in three steps.

Step 1: _____

Step 2: _____

Step 3: _____

**c.** What do you think would happen with the level of oil in this experiment?

_____

_____

Find Test 1 Study Page