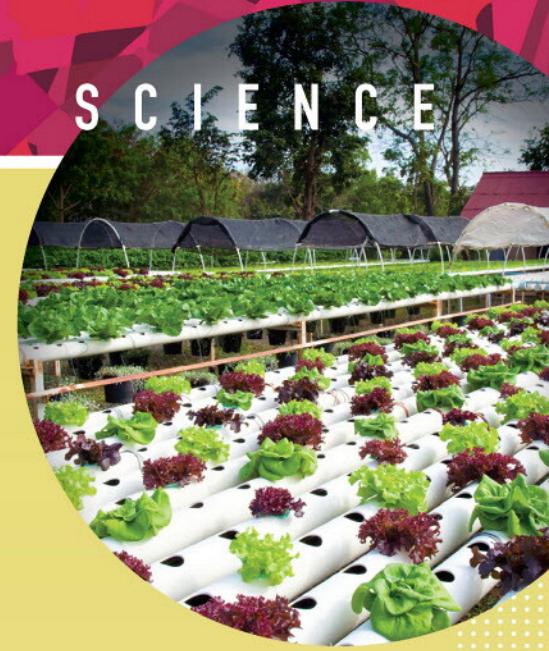


9

Farms of Tomorrow



In this unit, you will

- read about new ways of growing plants.
- learn about how hydroponics could increase our food supply.
- review using a dictionary.
- increase your understanding of target vocabulary words.

READING SKILL Identifying Contrast Signals

Self-Assessment

Think about how well you know each target word, and check (✓) the appropriate column. I have...

TARGET WORDS	never seen the word before	seen the word but am not sure what it means	seen the word and understand what it means	used the word, but am not sure if correctly	used the word confidently in either speaking or writing	used the word confidently in both speaking and writing
absorb						
achieve						
benefit						
maintain						
principle						
regulation						
require						
strategy						
theory						
transport						



Outside the Reading What do you know about hydroponics? Watch the video on the student website to find out more.

AWL Academic Word List

OXFORD 3000™ keywords

Before You Read

In small groups or with your class, discuss the following questions.

1. Have you ever visited a farm? What was growing? What kinds of equipment were used?
2. Have you ever tried to grow something at home? What did you grow? Were you successful?
3. What do plants need in order to grow?

Read

The information in this article is from a science book.

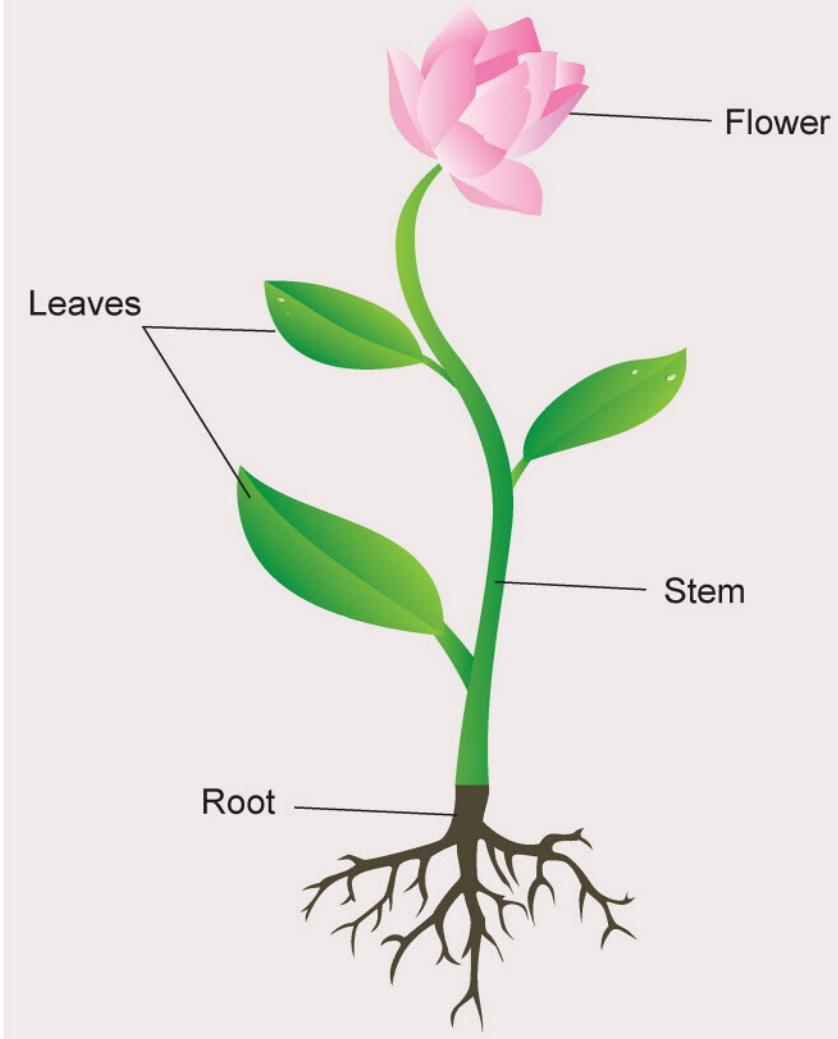
Hydroponics

Hydroponics is a way of growing plants without soil. Instead, the plants grow in water. The **principle** is simple. The water is mixed with nutrients—vitamins and minerals—that plants **require** in order to grow. The roots of the plants grow in the water mixture and **absorb** the nutrients. Hydroponics is one **strategy** to help provide food to the billions of people on our planet.

WHAT PLANTS NEED TO GROW:

Plants naturally grow in soil. The soil holds the water and the nutrients that plants need. The soil surrounding the plant roots helps the plants **maintain** a vertical growth pattern. Plants naturally grow upwards toward the sun. If plants cannot grow straight up, they receive less **benefit** from the sunlight. However, soil is not **required** for plants to grow. Soil is not **required** if the plants can get water and nutrients another way. Soil is not

PARTS OF A PLANT



needed if another method is used to **maintain** a plant's vertical growth pattern. A hydroponic system provides water and nutrients to plants. It provides a way for plants to grow straight up.

HYDROPONIC SYSTEMS:

There are many different kinds of hydroponic systems. The kind of system used depends on several factors. One factor is the kind of plant that will be grown. Nearly any plant can be grown in a hydroponic system, but the methods will vary according to the type of plant and its size. Another factor is how many plants will be grown. Some people use hydroponics to grow a few vegetables in their own garden. They want to grow just enough to supply their families with fresh tomatoes and carrots, for example. In contrast, a commercial farm might use a hydroponic system to grow thousands of tomatoes and carrots that will eventually be **transported** to nearby markets and sold.

Commercial farms usually set up a hydroponic system in a greenhouse—a building made of glass or heavy, clear plastic. The greenhouse will protect the plants from insects, rain, and too much heat from the sun. Long rows of tables fill the greenhouse. Each long table has a water pipe down its center that will deliver a nutrient mixture to the plants. Large plastic trays are lined up on the tables. Each tray has a cover that has rows of holes cut out. A tiny carrot plant grows from each hole. The hole helps keep the plant vertical. Each tray is connected to the water pipe and to a drain. An automatic timer **regulates** the watering schedule. Several times a day, the roots of the plants are sprayed with a nutrient mixture from the water pipe. The extra water drains out of the tray and back into the water pipe. The carrot plants have everything they need to grow: water, nutrients, and sunlight. When the carrots **achieve** the right size, they will be removed, packaged, **transported**, and sold.

The environment inside a greenhouse can be changed according to local conditions. For example, in areas that have few daylight hours or many cloudy days, farmers can add a lighting system to provide the light that plants need to grow.

The **theory** of hydroponics is not new. A book written in 1699 described experiments to grow plants without soil. In one description, the author **maintained** that plants grown in dirty water grew better than plants in pure water. Today we recognize that the "dirty water" probably contained nutrients that helped the plants grow. ■



A commercial hydroponic farm



Inside a greenhouse

Reading Comprehension

Mark each statement *T* (True) or *F* (False) according to Reading 1.

- 1. The principle of hydroponics is simple: plants absorb nutrients from a water mixture instead of from soil.
- 2. Hydroponics may become a necessary strategy to help feed the billions of farmers in the world.
- 3. Plants need to maintain a vertical growth pattern in order to benefit from sunlight.
- 4. Early theories of hydroponics required that plants grow in dirty water.
- 5. An automatic timer regulates the schedule when vegetables are transported to nearby markets.
- 6. Commercial farmers can achieve success with hydroponics if they heat the nutrient mixture.

READING SKILL

Identifying Contrast Signals

LEARN

Writers sometimes give information and then try to show a contrasting (opposite) aspect of that information.

The apples were red and juicy, but they were sour.

Tomatoes are easy to grow; however, they attract insects.

Strawberries are best in the spring. In contrast, blueberries are best in the fall.

Words and phrases that signal a contrast include *however, instead, but, although, in contrast, and on the other hand*.

APPLY

The following sentences are from Reading 1. Underline the contrast signal in each sentence. Then answer the question in a few words. Check Reading 1 again for answers.

1. Instead, the plants grow in water.

What information is this being contrasted with? _____

2. However, soil is not required for plants to grow.

What information is this being contrasted with? _____

3. What two contrast signals appear in Paragraph 3?

REVIEW A SKILL Using a Dictionary (See p. 116)

1. Look up the adjective *commercial* in your dictionary. In your own words, describe what a *commercial* farm is.
2. Look up the verb *spray* in your dictionary. Describe the nutrient mixture that is sprayed on the plant roots.

Vocabulary Activities **STEP I: Word Level**

A *theory* is an idea that tries to explain something that has not yet been proven or that cannot be proven.

My theory is that women have more interesting dreams than men.

Einstein developed a theory about energy.

The expression *in theory* is used when a person is talking about an idea that may or may not be true.

In theory, Internet access could become available to the most isolated parts of the world.

(See Oxford American Dictionary for learners of English, p. 756)



- A.** Work with a partner. Match the scientist on the left with the theory he or she developed. Look in your dictionary for new words. Take turns making sentences with the information.

A nutritionist developed a theory about eating pizza for good health.

- | | |
|--------------------|------------------------------------|
| 1. An astronomer | ___ a. the long life of elephants. |
| 2. A botanist | ___ b. the size of rain drops. |
| 3. A geologist | ___ c. plants being able to hear. |
| 4. A meteorologist | ___ d. the moon growing smaller. |
| 5. A zoologist | ___ e. the cause of earthquakes. |
| 6. A chemist | ___ f. creating safer fuels. |

The verb *absorb* has several meanings. One meaning is “to take in something and hold it.”

*The towel **absorbed** all of the water that I spilled.*

*The cup is too hot to hold. It’s **absorbing** heat from the coffee inside.*

To *absorb* something also means “to take information into the mind.”

*The professor talked so fast that I couldn’t **absorb** all the information.*

*After studying all night, I finally **absorbed** the meaning of Einstein’s theory.*

Another meaning of *absorb* is “to hold a person’s attention.”

*The book completely **absorbed** me.*

*I was so **absorbed** in my reading that I forgot to eat dinner.*

(See Oxford American Dictionary for learners of English, p. 3)



B. Work with a partner. Check (✓) all of the things on the right that might be *absorbed* by the person or thing on the left. Take turns making sentences with the information.

1. My T-shirt absorbed
___ the smell of smoke from the fire.
___ the information in the book.
___ the sweat on my shoulders.
2. The book absorbed
___ the coffee I spilled.
___ my attention.
___ the meaning of Einstein’s theory.
3. I was absorbed
___ by the professor’s lecture.
___ in the television program.
___ by the towel.

Vocabulary Activities STEP II: Sentence Level

To *maintain* something means “to keep something the same.”

I’ve **maintained** the same weight all my adult life.

Diet and exercise have helped me **maintain** my good health.

To *maintain* something also means “to keep something in good condition,” especially an object or a place.

We pay a custodian **to maintain** the office for us.

It’s expensive **to maintain** the three cars in our family.

To *maintain* an idea or belief means “to believe something to be true even if others disagree.”

I know you don’t agree, but I **maintain** that wearing wet shoes causes head colds.

The man on trial **maintained** that he did not steal the painting.

(See Oxford American Dictionary for learners of English, p. 432)



C. Rewrite these sentences in your notebook with a form of *maintain*. Take turns reading your sentences with a partner.

1. Plants need to stay in a vertical position to grow well.
2. The farmer said over and over that foods grown in soil taste better.
3. The farmer’s son helped keep the greenhouse clean.
4. An automatic timer keeps the same spraying schedule every day.
5. I believe that hydroponics is a recent discovery.
6. The farmer keeps a record of his costs.

To *achieve* something means “to gain something through personal effort or skill.” The noun form is *achievement*.

He had a distinguished life and **achieved** much.

But his finest **achievement** was his involvement in our organization.

To *achieve* something also means “to complete something.”

A horse doesn’t **achieve** its full size until it is about two years old.

In spite of being sick, Ian managed **to achieve** a lot today.

An *achievement* is the act of finishing something special.

You read five books this week? What an **achievement!**

After taking her first steps, the baby smiled at her **achievement**.

(See Oxford American Dictionary for learners of English, p. 6)



- D.** Imagine that you have just created a new vegetable called a “squarrot”—a combination of a squash and a carrot. A newspaper reporter is asking you questions. Rewrite the answers in your notebook with the given form of achieve. Take turns reading your sentences with a partner.

1. Are you proud of what you invented?
Yes, I am very proud of what I invented. (achievement)
2. How long did it take you to get good results from your experiments?
I got good results in about a year. (achieved)
3. What was the secret of your success?
I was successful because I worked hard. (achieved)
4. I understand that you will be given an award.
I will receive an award for scientific success. (achievement)
5. What are your plans for the future?
I want to win a Nobel Prize. (achieve)

A *principle* is a basic rule about society or about a certain subject.

I believe in the principle of being kind to others.

New drivers must learn the principles of safe driving.

A *principle* is also a standard that a person believes in.

Of course I wouldn't cheat on an exam. I have principles.

It's against my principles to tell lies.

On principle, he always wears a coat and tie to business meetings.

A *principle* is a general law of science or another academic field.

This chapter covers the principle of heat transfer.

(See Oxford American Dictionary for learners of English, p. 554)



- E.** Write three sentences in your notebook with *principle* or *principles*. Take turns reading your sentences with a partner.

1. Write a sentence that describes a rule that your family believes in.
2. Write a sentence that describes something you will or will not do because of your personal beliefs.
3. Write a sentence about a rule of English grammar or punctuation.

F. Use the following words to complete the paragraph.

absorb	benefit	principle	require	in theory
achieve	maintain	regulated	strategy	transport

The Green Valley Farm supplies fresh vegetables to an expensive restaurant that is located about 75 miles away.

Early each Friday morning, farm workers pick the vegetables and clean them. Then they load them onto a truck to

- (1) _____ them to the restaurant. The farm's
- (2) _____ is to get the vegetables to the restaurant as quickly as possible so they will still be fresh.
- (3) _____, a vegetable begins to spoil as soon as it is picked. For this reason, the farm follows the basic principle that a cool temperature helps preserve foods. The temperature inside of the truck is
- (5) _____ to (6) _____ a temperature of 55°F (about 13°C). The workers load the vegetables onto the truck carefully. Some vegetables
- (7) _____ special handling. Lettuce, for example, loses its crispness if it becomes warm, so they place it near the air blower. Other vegetables easily (8) _____ odors. They
- (9) _____ from being placed far from strong-smelling items such as garlic or onions. Careful handling of the vegetables helps the company
- (10) _____ its goal of delivering fresh vegetables to its customers.



Many farms supply fruits and vegetables to restaurants.

Before You Read

In small groups or with the whole class, discuss the following questions.

1. Name some of the vegetables that your family eats. Where do you get them?
2. What are some areas in the world where farmers cannot grow things?
3. What kinds of foods should humans eat to get the nutrients they need?

Read

Information for this article is from an Internet website.

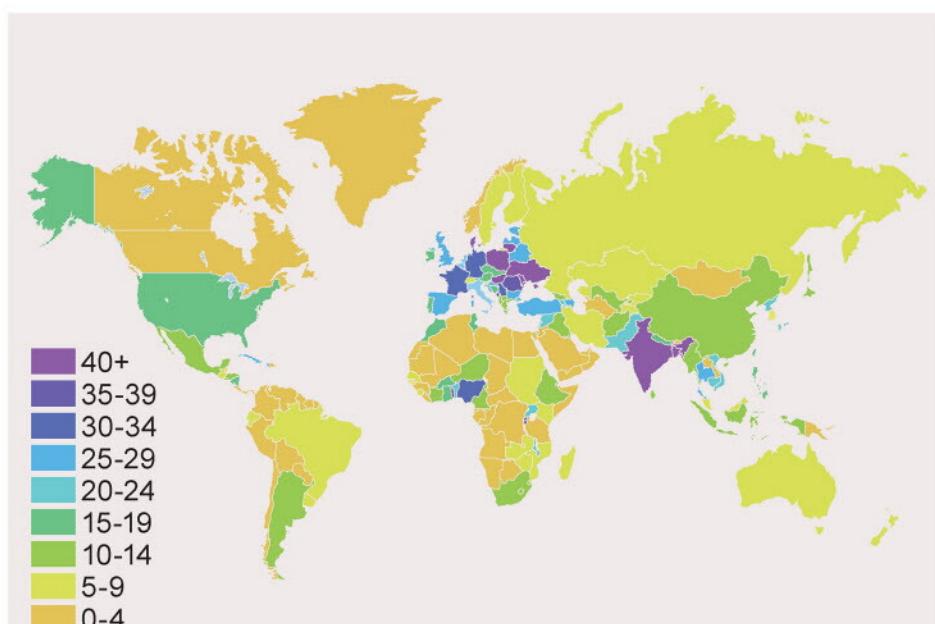
FARMING IN MANY PLACES

The population of the world has already reached 7 billion. Some experts estimate that by 2050, the world population will reach 9 billion. If this is true, we need a **strategy** for increasing the food supply to feed those 9 billion people. Some experts **maintain** that hydroponic farming could be an answer.

About 71% of the Earth's surface is covered with water, and about 29% of the surface is land. However, only about 10% of that land is suitable for farming. The rest of the Earth's land is in areas that are too hot or too cold for farming, or that have poor soil, not enough water, or not enough sun. Also, cities now occupy much of the land that was once farmland.

However, experts believe that hydroponic farming techniques would make it possible to grow food in all of these areas.

Hydroponic farming has various **benefits**. First, of course, is that no soil is needed. Also, greenhouses would allow food plants to grow almost anywhere in the world. Artificial lighting and climate systems inside greenhouses would allow food plants to grow throughout the year. Another **benefit** is that hydroponic



Percent of land that is suitable for farming, by country.

farming uses very little water compared to traditional farming. Hydroponic systems **require** only about 5% of the water used in soil-based farming to produce the same amount of food. In part, this is because the water in a hydroponic system is recycled again and again. Finally, hydroponic farming could increase the nutritional value of food plants by adjusting the nutrients that the plants **absorb** as they are growing.

A hydroponic system would make it easy for families to grow their own vegetables in a small space. The **principles** of hydroponics are simple, and very little special knowledge or equipment is needed to **achieve** success.

Over half of the world's 7 billion people now live in cities. This number will grow as the world population increases. The people who live in large cities depend on food that is **transported** into the city from distant farms. This sometimes leads to problems. For example, often raw fruits and vegetables are not fresh after the long ride. They are expensive because the cost of **transporting** them is added to the price. Also, in winter there are fewer fresh fruits and vegetables in markets.

Having farms in the city would solve these problems. Hydroponics might make it possible to farm inside of cities by using a system called *vertical farming*.

Vertical farming could be done inside city skyscrapers. Many farming experts believe that, **In theory**, vertical farming is possible. They suggest that old skyscrapers could become vertical farms. Each floor could be a greenhouse where vegetables and fruits could grow without soil in a hydroponic system. The light and heat on each floor could be **regulated** according to the time of year and the needs of certain plants. A crew of farming experts could **Maintain** the plants. One tall skyscraper might provide as much growing space as a large farm. Vertically farmed foods would **benefit** people in the city by being fresh, cheap, and available all year.

Is relying on hydroponics a good **strategy** for feeding people in the future? If so, we should begin today to teach people the **principles** and **benefits** of hydroponics. ■



A hydroponic farm



Vertically farmed vegetables have many advantages.

Reading Comprehension

Mark each statement *T* (True) or *F* (False) according to Reading 2.

- 1. Hydroponic farming requires less water than soil-based farming to produce the same amount of food.
- 2. In theory, the principles of hydroponic farming are simple.
- 3. One benefit of vertical farming is that fresh fruits and vegetables don't have to be transported long distances.
- 4. Farm experts maintain that using hydroponic techniques is a good strategy for increasing the world's food supply.
- 5. A hydroponic system can regulate the cost of transporting foods.
- 6. Growing plants absorb nutrients from artificial lighting systems.
- 7. A family using a hydroponic system to grow vegetables needs special knowledge to achieve success.

READING SKILL

Identifying Contrast Signals

APPLY

1. These ideas are from sentences in Paragraph 2 in Reading 2.

About 29% of the earth's surface is land. However, only about 10% of that land is suitable for farming.

Circle the two contrasting ideas. What signal is used to connect the two contrasting ideas?

-
2. These sentences are from Paragraph 2 in Reading 2.

The rest of the Earth's land is in areas that are too hot or too cold for farming, or that have poor soil, not enough water, or not enough sun. Also, cities now occupy much of the land that was once farmland.

The sentences describe six kinds of land areas where farming is not possible.
Circle the six kinds of land areas.

Write the sentence from Reading 2 that has information that contrasts with the above information.

REVIEW A SKILL Using a Dictionary (See p. 116)

These words appear in Paragraph 3.

Artificial lighting inside of greenhouses would allow food plants to grow throughout the year.

Look up the word *artificial* in your dictionary. Which of these are examples of artificial lighting?

candlelight sunlight light bulb moonlight neon light

Vocabulary Activities STEP I: Word Level

A **strategy** is a plan that is made to achieve a particular goal.

*Little Carlito had a **strategy** for stealing a cookie from the table.*

*The company's **strategy** for increasing sales was to advertise more.*

(See Oxford American Dictionary for learners of English, p. 720)



- A.** Work with a partner. Match a restaurant worker on the left with his or her goal and the **strategy** he or she would use to reach that goal. Take turns making sentences with the information.

*My mother's **strategy** for getting us kids to eat vegetables is to put sugar on them.*

- | | | |
|---------------------|--------------------------|-----------------------------|
| 1. The chef's | ___ increasing business | ___ make soup. |
| 2. The waitress's | ___ getting a tip | ___ soak them in hot water. |
| 3. The dishwasher's | ___ using leftover meat | ___ always smile. |
| 4. The owner's | ___ cleaning greasy pans | ___ offer free desserts. |

A **regulation** is an official rule that controls how something is done. The verb form is **regulate**.

*Markets must follow government **regulations** in how they package meat.*

*The government **regulates** how markets package meat.*

Regulation refers to the control of something through rules or laws.

*The Health Department is responsible for the **regulation** of hospitals.*

To **regulate** something means "to control a machine or piece of equipment."

*You can **regulate** the temperature of your oven with this dial.*

(See Oxford American Dictionary for learners of English, p. 592)



- B.** Work with a partner. Write an R in front of the items the driver of a car can **regulate**. Take turns making sentences with the information.

*The driver can **regulate** the height of the driver's seat.*

- | | |
|-------------------------------|---------------------------|
| ___ the speed of the car | ___ the size of the seats |
| ___ the loudness of the radio | ___ the windshield wipers |
| ___ the air conditioner | ___ the age of the car |
| ___ the color of the car | ___ the headlights |
| ___ how much gasoline costs | |

Vocabulary Activities STEP II: Sentence Level

To *require* something is to need something.

New babies **require** 14 or more hours of sleep every day.

A bank **requires** your signature to open an account.

The verb *require* is often used in the passive form, especially when a law or any authority makes it necessary for you to do something.

A passport **is required** to enter a foreign country.

A *requirement* is something that you must have in order to do something.

One **requirement** for this job is being able to speak Arabic.

(See Oxford American Dictionary for learners of English, p. 601)



- C. Use a form of *require* in each space to complete this letter. Share your letter with a partner.

SKYSCRAPER FARMS

June 23, 2053

Dear Miss Song,

Thank you for your interest in a job at Skyscraper Farms. We are looking for smart, enthusiastic plant scientists to help us get started. A (1) _____ for employment is a degree in agriculture. We also (2) _____ experience in hydroponics. The Farming Commission (3) _____ everyone who works with food plants to be in good health. You will be (4) _____ to be examined by our company doctor to meet that (5) _____. Finally, all of our workers will be (6) _____ to work on a different schedule each week. Our growing plants (7) _____ care every day, so workers must be available seven days a week.

Sincerely,

Fred Greenleaf, President

Skyscraper Farms

To transport someone or something means “to move something or someone from one place to another in a vehicle.” *Take* and *carry* are common synonyms.

Taxis **transport** visitors from the airport to downtown hotels.

I hired a truck to **transport** my furniture to my new apartment.

The noun *transportation* refers to the vehicles that transport people or things.

Public **transportation** in my city includes buses, trams, and trains.

My car is the only **transportation** I use.

Transport is sometimes used as a noun.

Transport by airplane is an expensive way to ship food products.

(See Oxford American Dictionary for learners of English, p. 775)



D. Rewrite each of these sentences in your notebook with *transport* or *transportation*. Share your answers with a partner.

1. Modern ways of moving people will allow people to travel anywhere in the world. (transportation)
2. The fastest way to travel across the ocean is by airplane. (transportation)
3. The least expensive way to carry products across the ocean is by ship. (transport)
4. A modern airplane can carry hundreds of people at a time. (transport)
5. Most large cities have developed good systems to move people from place to place. (transportation)

The verb *benefit* means “to have a good effect.”

The new park will **benefit** everyone in the community.

Schools have **benefited** from the new law.

The noun form is also *benefit*. It refers to the good effect or advantage of something.

We are enjoying the **benefits** of having a new park.

One **benefit** of living in a warm climate is lower heating costs.

(See Oxford American Dictionary for learners of English, p. 6)



E. Look in Reading 2 to find answers to these questions. Answer in complete sentences and include a form of *benefit*. Share your answers with a partner.

1. How would vertical farming benefit people who live in cities?
2. What is one benefit of hydroponic farming?

F. Use the following words to complete this paragraph.

absorb	benefit	principles	required	strategy
achievement	maintain	regulate	theory	transported

As our world becomes more crowded, perhaps humans will develop a
(1) _____ to live on the moon. This would be a major scientific
(2) _____ for humanity. Space ships have already
(3) _____ humans to the moon for short visits. But would it be
possible for a community of people to make it their home? Would it be possible to
(4) _____ a community on the moon? What would be
(5) _____ to make the moon a place where humans could live?
A major problem would be supplying food to the residents. It would be too
expensive for a space ship to transport food to the moon every week. But maybe
people could grow food on the moon by using the (6) _____ of
hydroponics. A space ship could bring building materials, seeds, water, and plant
nutrients. People could set up a hydroponic farm. Residents would maintain the
farm. The plants would (7) _____ light and heat from the sun to help
them grow. The people would (8) _____ by having a dependable
supply of fresh food. A moon commission could use international laws to
(9) _____ the operation of the new community. Space scientists
agree that, in (10) _____, people could live on the moon. Would you
like to live there?

Writing and Discussion Topics

Discuss the following topic in small groups.

Some farming experts say that vertical farming in skyscrapers could supply
fresh fruits and vegetables to people who live in big cities. Some also say that
raising animals in skyscrapers could supply meat to people who live in big
cities. Would it be a good idea to raise animals in skyscrapers?

Choose one of the following topics. Write six to eight sentences about the topic. Use
some of the target vocabulary words from this unit.

1. What are some changes that might occur in international trade if humans grew most of their own food with hydroponic farming?
2. What are some ways that the work of traditional farmers is like the work of a hydroponic farmer? What are some ways their work is different?
3. What are some things that could go wrong in a hydroponic system that could hurt the growing plants?

UNIT

10

The Forces of Nature



In this unit, you will

- learn about alternative sources of energy.
- study renewable energy sources.
- review identifying signals of contrast.
- increase your understanding of target vocabulary words.

READING SKILL Identifying Signal Words for Comparisons

Self-Assessment

Think about how well you know each target word, and check (✓) the appropriate column. I have...

TARGET WORDS	never seen the word before	seen the word but am not sure what it means	seen the word and understand what it means	used the word, but am not sure if correctly	used the word confidently in either speaking or writing	used the word confidently in both speaking and writing
❖ affect						
❖ AWL ❖ approach						
❖ AWL ❖ concept						
❖ consume						
❖ AWL ❖ data						
❖ AWL ❖ derive						
❖ AWL ❖ indicate						
❖ obtain						
❖ potential						
❖ AWL ❖ source						



Outside the Reading What do you know about alternative energy? Watch the video on the student website to find out more.

AWL Academic Word List

❖ Oxford 3000™ keywords

Before You Read

In small groups or with the whole class, discuss the following questions.

1. What tools or machines do you use every day that are powered by electricity?
2. How did people travel before machines were invented?
3. What are some ways that people can warm their houses during cold weather?

 **Read**

The information in this article is from a technology magazine.

Sun, Wind, and Water

NATURE HELPS HUMANS

For all of human history, humans have depended on the powers of nature to help them survive. The sun warmed them and was a **source** of light. Rain filled lakes and rivers where they could **obtain** water to drink and catch fish to eat. Sun and rain combined to help plants grow. The plants became food for the humans to **consume**. The plants were also food for the animals that humans hunted. Wind blew the seeds of trees and grasses to new fields. Wind filled the sails of small boats, so humans could travel on rivers or across oceans.

NATURE BRINGS DIFFICULTIES

However, sometimes nature did not help humans. In some years, the rain did not come. The hot sun baked the earth. Plants dried up because they had no **source** of water. Hot winds blew the soil away, so future plants could not grow. This left humans without food to eat, and they starved. In some years, too much rain fell. Homes were washed away when gentle rivers grew into **potential** killers. Often people drowned. Farm animals drowned. Towns disappeared in the flood waters.

Similarly, the ocean was often a **source** of death. Without any **indication** of danger, a giant ocean wave might suddenly sink boats. Likewise, a wave might **approach** land, where it washed away houses and drowned people. Powerful cyclones and hurricanes



With the help of wind, humans were able to travel across oceans.

sometimes brought strong ocean winds over land. Sometimes they destroyed buildings, uprooted trees, and killed humans. The powers of nature have always **affected** human life.

HUMANS USE MACHINES

Then, about 200 years ago, humans learned how to create machines to help them do work. These machines needed fuel to work. Humans burned wood and coal to run the machines. They built steam engines to move ships and trains. They built automobiles and airplanes that were powered by gasoline engines. They learned how to produce electricity to light their homes. They built washing machines and telephones and refrigerators and computers. All of these machines **consumed** fuels **obtained** from the Earth.

CHANGES IN CLIMATE

As the world population grew, so did the number of machines, and so did the use of fuels to power the machines. Recent scientific **data indicate** that the Earth is warming. The sun has melted ice near the North Pole and the South Pole. The level of the oceans is rising. Cyclones and floods are happening more often. The **concept** of climate change worries humans.

Many scientists blame humans for this change in the Earth's climate. They believe that humans have not used the fuels that we **derived** from nature in a good way. They believe we should instead use natural powers to produce energy. They suggest that using sun, wind, and water to produce energy will help preserve the Earth. The sun, wind, and water are considered *renewable energy sources* because they will always be there.

Ancient humans depended on the powers of nature to help them survive. Now modern humans want to use these powers to help them survive in today's machine-based world. ■



Even gentle waves can quickly become dangerous.



The sun has melted ice near the North Pole and the South Pole.

Reading Comprehension

Mark each sentence as **T** (True) or **F** (False) according to Reading 1.

- ___ 1. Recent scientific data indicate that the climate of the Earth is warming.
- ___ 2. The machines created by humans consume fuels obtained from rivers and lakes.
- ___ 3. Human lives are affected by the sun, wind, and water.
- ___ 4. Modern humans derive most of their fuels from renewable energy sources.
- ___ 5. An approaching hurricane or cyclone is a potential danger to humans.
- ___ 6. Humans invented the concept of climate change about 200 years ago.

LEARN

When writers compare two or more things, they show how the things are alike. Sometimes writers compare objects or people. Sometimes they compare places or events.

Brazil is in South America. So is Argentina.

Marco is as tall as his father.

Both restaurants were crowded and noisy.

Some common words and phrases that signal comparisons are listed below.

both	similarly	likewise	like..., so is...
all	too	the same as	like..., ...is too.
as... as	so is/so are	so does/did	also

APPLY

The sentences below are from Reading 1. Circle the comparison signals.

1. Similarly, the ocean was often a source of death. Without any indication of danger, a giant ocean wave might suddenly sink boats. Likewise, a wave might approach land, where it washed away houses and drowned people.
2. All of these machines consumed fuels obtained from the Earth.
3. As the world population grew, so did the number of machines, and so did the use of fuels to power the machines.

What three things grew?

REVIEW A SKILL Identifying Contrast Signals (See p. 132)

There is one sentence in Paragraph 2 that shows contrast. Write the sentence below.

Vocabulary Activities STEP I: Word Level

To *derive* something means “to get something from a certain source.” It is often used to describe feelings.

Humans **derive** many materials from animals, such as wool and leather.

Ming **derived** great pleasure from her flower garden.

To *derive* something also means “to be taken from a related source, such as a word or substance.” The passive form, with *from*, is usually used with this meaning.

Gasoline **is derived from** oil.

English words **are derived from** words in many other languages.

(See Oxford American Dictionary for learners of English, p. 196)



- A.** Work with a partner. Match the English word on the left with the foreign word it is *derived from*. Take turns making sentences with the information.

The English word **camera** **is derived from** the Greek word kamara.

- | | | |
|--------------|--------------|---------------------------------------|
| 1. algebra | — a. Latin | <i>petr</i> (rock) <i>oleum</i> (oil) |
| 2. golf | — b. French | <i>obtenir</i> |
| 3. canyon | — c. Arabic | <i>jabara</i> |
| 4. petroleum | — d. Greek | <i>enérgeia</i> |
| 5. obtain | — e. Spanish | <i>cañon</i> |
| 6. energy | — f. Dutch | <i>kolf</i> |

Data is information or facts that have been collected for a particular purpose. It is a formal word, and it is not often used in conversation.

Now that I have the **data** I need, I can begin writing my final report.

Computers help businesses analyze complex **data**.

The word **data** is the plural form of datum. However, the word datum is rarely used. A verb that agrees with the plural form is usually used only in formal or scientific writing. In nonscientific use, especially when the meaning is information stored by a computer, a singular verb is used.

Are the **data** complete? (plural usage)

Is the **data** complete? (singular usage)

(See Oxford American Dictionary for learners of English, p. 184)



- B.** Work with a partner. Match the type of *data* on the left with what that *data* might show. Take turns making sentences with the information.

Geological data show that South America and Africa were once connected.

1. Population data a. oranges are a good source of vitamin C.
2. Communication data b. more people are traveling by airplane.
3. Historical data c. our city received less rainfall this year than last.
4. Weather data d. about 19% of the people in the world live in China.
5. Nutritional data e. early humans used fire to cook foods.
6. Transportation data f. nearly half of South Koreans under 40 have smart phones.

A *concept* is a basic understanding about a broad topic.

The concept of climate change is explained in this textbook.

The manager explained her concept of how to make the office more efficient.

No concept is often used to suggest that someone does not understand or know something.

I have no concept of the enormous size of our solar system.

You have no concept of how hard I work.

(See Oxford American Dictionary for learners of English, p. 148)



- C.** Work with a partner. Match the type of people on the left with the *concept* they seem to lack. Take turns making sentences with the information.

People who are rich seem to have no concept of going to bed hungry.

1. People who eat only fast food a. time.
2. People who commit crimes b. good nutrition.
3. People who are always late c. danger.
4. People who drive too fast d. right and wrong.

Vocabulary Activities STEP II: Sentence Level

The verb *approach* means “to come near something or someone.”

I can see the bus approaching.

The profits this year approach the company’s profits from last year.

The verb *approach* also means “to speak to someone, usually to ask for something.”

He didn’t want to approach his friends for money.

To approach something also means “to plan a way to solve a problem or to create a plan of action.” The noun form is also *approach*.

The students discussed several ways to approach the assignment.

Each student took a different approach.

One approach was to ask people their opinions and report the results.

(See Oxford American Dictionary for learners of English, p. 34)



D. Imagine a professor and her students are discussing climate change. Rewrite each question or answer on a separate sheet of paper with a form of *approach*. Share your questions and answers with a partner.

1. What is the best way to solve the problem of energy shortages?
2. I’m glad that you came to me to ask for information.
3. In a few years the world population will be nearing 8 billion.
4. What plan do you recommend?
5. The best plan is developing more renewable energy sources.

To indicate something means “to show or point to something.”

A sign indicates where the restrooms are located.

A policeman indicated when the cars could move forward.

To indicate something means “to give a sign that has meaning.” The noun form is *indication*.

Babies cry to indicate they are hungry.

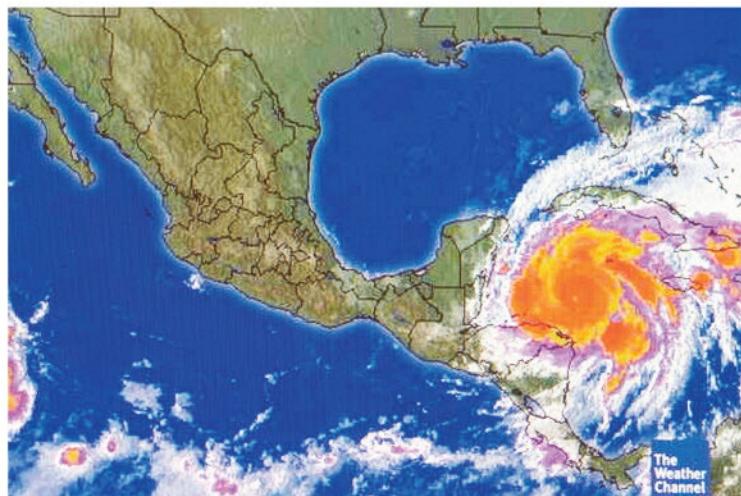
Babies’ cries are an indication that they are hungry.

(See Oxford American Dictionary for learners of English, pp. 370–371)



E. Complete this paragraph by using a form of *indicate* in each blank space.

A popular feature of television news programs is a report from a weather reporter. The weather reporter (1) _____ on a large map what the temperatures were that day in local cities. Falling temperatures often (2) _____ an approaching storm. If there is an (3) _____ of rain, such as falling temperatures, he or she will (4) _____ the direction of the storm on the map. He or she uses a large calendar to (5) _____ what kind of weather to expect for the next few days. There is a picture on each day of the week. A picture of a dripping cloud (6) _____ rain, and a picture of a smiling sun (7) _____ sunshine.



A TV weather map

F. Use the following words to complete this paragraph.

affect	concept	data	indication	potential
approached	consumed	derive	obtained	source

Throughout history, sailors have reported seeing giant waves in the ocean. Giant waves were blamed for damage to many ships. Sometimes the giant waves even caused ships to sink. Sailors had no (1) _____ of why these giant waves occurred in mid-ocean. Recently, the study of giant waves has (2) _____ the time and attention of ocean scientists. They carefully analyzed the (3) _____ that they could (4) _____ from reports of giant waves. They concluded that earthquakes are not the (5) _____ of these waves. They learned that both the size of a giant wave and its shape (6) _____ its energy. The amount of energy in a wave is an (7) _____ of its (8) _____ danger. Reports that scientists (9) _____ from sailors indicated that the waves (10) _____ very quickly. There was no time to warn other ships of the approaching wave. Scientists hope to find some way to predict the approach of a giant wave and develop a warning system.

Before You Read

In small groups or with the whole class, discuss the following questions.

- What are some machines or toys that depend on wind to make them work?
- What are some ways that individuals use heat or light from the sun in their daily activities?
- We often say that machines help us do work. What is *work*?

 **Read**

The information in this article is from an online technology magazine.

USING RENEWABLE ENERGY SOURCES

Over the last 200 years, humans created many machines to help them do work. Most machines were powered by burning fuels such as coal, gasoline, and natural gas. Other machines were powered by electricity. Now scientists are suggesting that we look for ways to use natural forces to help us do work. The scientists are suggesting that we use wind, water, and the sun as **sources** of power to create electricity. Sun, wind, and water are all renewable resources. They will always be available to our growing world population.

USING WAVE POWER

The power of ocean waves as they **approach** land is very strong. For this reason, engineers believe ocean waves have great **potential** as a force to create electricity. Engineers are developing technology to use that force. One plan for a wave farm includes putting several large fiberglass tanks in the ocean and securing them to the ocean floor. The tanks would be connected to each

Traditional Fuels	Renewable Energy Sources
 gasoline	 solar
 wood	 wind
 natural gas	 ocean waves
 kerosene	 nuclear
 coal	 organic materials

other. They would float on top of the water. As powerful ocean waves **approached** land, the tanks would rise and fall with the water. The motion would spin turbines inside the tanks to generate electricity. The wave farm would be connected to shore. Engineers estimate that one tank would generate enough electricity to power one house. This **approach** would work in most areas that have a sea coast.

USING WIND POWER

A similar **concept** is now being used to create electricity using wind power. This **approach** works best in areas that have strong, steady winds. Engineers have created wind farms to collect the power of the strong winds. They put hundreds of wind machines in windy places. A wind machine is a very tall pole. At the top is a propeller with several long blades. When strong winds blow, the blades of the wind machines turn. The turning blades power machinery in nearby turbines to generate electricity. The electricity **derived** from a wind farm is then sent to nearby **consumers**.

USING SOLAR POWER

Another **concept** uses the sun to generate electricity. In areas that are sunny throughout the year, hundreds of collection devices are put into a large field. Each solar collection device consists of a pole with a large mirror on top. The mirrors reflect heat from the sun. The heat **obtained** from the mirrors is used to boil water. Steam from the boiling water turns machinery in a turbine to generate electricity for nearby **consumers**.

Scientific **data indicate** that generating electricity by using water, wind, and solar energy will benefit the world. However, at a local level, many people do not like these projects. They complain that wave farms destroy beautiful beaches. They also worry that a wave farm might **affect** whales and fish that swim in the water. Likewise, people complain that wind machine propellers are killing birds that fly too close to the blades. Others complain that rows of solar panels are ugly. They also say that the solar panels take up space that could be used for farming or recreation.

The choice is a difficult one. We need to consider both present and future needs when we decide how to **obtain** energy and how we **consume** it. ■



A wind farm



A field of solar panels

READING COMPREHENSION

Mark each statement *T* (True) or *F* (False) according to Reading 2.

- 1. The concept of using wave power to create electricity is possible mainly on sea coasts.
- 2. A wind farm could affect people as well as whales and fish.
- 3. Consumers near wind farms could obtain electrical power generated by the wind.
- 4. Data obtained by scientists indicate that using renewable sources of energy to generate electricity will benefit the world.
- 5. Engineers will use the potential energy of ocean waves to bring water to nearby consumers.
- 6. Building wind farms is one approach that will use natural forces to create electricity.
- 7. Solar panels reflect heat that is derived from the sun.

READING SKILL

Identifying Signals of Comparison

APPLY Identifying Signals of Comparison

Look back in Reading 2 to find signals of comparison. Write the ones you find in these paragraphs.

1. Paragraph 1 _____
2. Paragraph 4 _____
3. Paragraph 5 _____
4. Paragraph 6 _____

REVIEW A SKILL Identifying Contrast Signals (See p. 132)

1. Work with a partner. What two ideas are contrasted in Paragraph 1? Have one partner read the first idea and the second partner read the other idea. What words tell you that one idea is old and another one is new?
2. What two ideas are contrasted in Paragraph 5? Have one partner read the first idea and the second partner read the other idea. What word signals the contrast?

Vocabulary Activities STEP I: Word Level

To *obtain* something means “to get something.” It is a formal word. People use *get* in conversations.

You can **obtain** directions to the stores on their web sites.

The factory **obtained** machine parts from several sources.

(See Oxford American Dictionary for learners of English, p. 484)



- A.** Work with a partner. Imagine that one of you has just moved to a new city. Ask where to *obtain* things you need. Your partner will answer the questions.

Q: I lost the book I was reading. Where can I obtain a new copy?

A: You can obtain a new copy at the bookstore.

- | | | |
|---|--------------------|------------------------------|
| 1. I will be traveling overseas soon. | a passport | at the embassy office. |
| 2. I don't know how to use my cell phone. | help | at the electronics store. |
| 3. I would like to work at your company. | a job application | at the employment office. |
| 4. I'll be buying a car next week. | a driver's license | at the Motor Vehicle office. |
| 5. I want to move in this building. | rental information | at the manager's office |

The *source* of something is where it comes from.

My car was making an odd noise, but I couldn't find the source of the noise.

The Internet is an important source of information.

(See Oxford American Dictionary for learners of English, p. 693)



- B.** Work with a partner. Write **L** by the items that are *sources* of light. Write **S** by the items that are *sources* of sound. Write **H** by the items that are *sources* of heat. Some items may be *sources* of more than one thing. Take turns making sentences with the information.

A drum is a source of sound.

- | | | | |
|-----------------|-----------|-----------|------------|
| — a ship's horn | — a radio | — an oven | — a candle |
| — piano | — the sun | — thunder | — a bell |
| — a lamp | — a voice | — a fire | — a stove |

Vocabulary Activities STEP II: Sentence Level

To *affect* someone or something means “to change or influence someone or something in some way.”

The climate in an area can affect what crops will grow.

Everyone in the school was affected by the new rules.

The noun form of *affect* is *effect*.

The new rules had an effect on everyone.

(See Oxford American Dictionary for learners of English, pp. 12–13)



C. Rewrite these sentences in your notebook with a form of *affect*. Share your sentences with a partner.

1. Wave farms could harm the environment of whales and fish.
2. Using renewable energy sources will change the production of electricity.
3. A changing climate could influence the way humans live.
4. Our many machines have caused changes in how humans do work.
5. The growing world population has influenced our need for energy.

The adjective *potential* is used to describe something that is possible in the future. *Potential* can only be used in front of a noun. The adverb form is *potentially*.

Wind farms are a potential danger to birds.

Wind farms are potentially dangerous to birds.

I've heard that our mayor is a potential candidate for president.

Our mayor is potentially a candidate for president.

The noun *potential* refers to the abilities that a person or thing has, but that may not be fully developed. It is often used with the verb *have*.

Wind farms have the potential to be dangerous to birds.

Our mayor has the potential to be a great president.

(See Oxford American Dictionary for learners of English, pp. 543–544)



D. Rewrite these sentences on a separate sheet of paper to include the given form of *potential*. Share your sentences with a partner.

1. Wave farms could cause harm to whales. (potentially)
2. Wave farms are a possible source for generating electricity. (potential – adjective)
3. Renewable energy could increase our supply of electricity. (potential – noun)
4. Cloudy weather can reduce the amount of energy a solar panel absorbs. (potential – noun)
5. A growing population will cause a possible increase in energy needs. (potential – adjective)

To consume something means “to use something in such a way that there is less of it.”

*My car **consumes** a lot of gasoline.*

*Homework **consumes** about four hours of my time each day.*

To consume something also means “to eat something.”

*Many Americans **are consuming** more fruits and vegetables.*

*They **are consuming** less meat.*

A *consumer* is a person who buys products or pays for services.

***Consumers** expect good service when they shop.*

(See Oxford American Dictionary for learners of English, p. 156)



E. Read the paragraph below. Then rewrite each of the six underlined sentences to include a form of *consume*. Take turns reading all the sentences with a partner. The first one has been done for you.

(1) Automobiles use a lot of fuel. (2) People who purchase things are demanding cheaper fuel. (3) One approach is to make a fuel from plants that people eat, such as corn. (4) However, using corn to make fuel means less corn for people to eat. Another approach is to use paper, wood pieces, and even olive seeds to make fuel. This approach uses special bacteria. (5) The bacteria eat these materials, and their bodies release oil. (6) This process is one way to give customers a cheaper fuel.

1. *Automobiles **consume** a lot of fuel.*

F. Use the following words to complete this paragraph.

affect	concept	data	indication	potential
approach	consumers	derive	obtained	sources

Advertisements for automobiles used to stress how fast a car could go or how beautiful it was. (1) _____ buyers were expected to (2) _____ a feeling of need from the ads. Now advertisements for automobiles stress that their automobiles do not (3) _____ the environment in a bad way. Advertisements often include (4) _____ that was (5) _____ from scientific (6) _____ to show how “clean” a car is. The (7) _____ of a “clean car” is new. This new (8) _____ to selling automobiles is an (9) _____ of how (10) _____ today are concerned about the potential harm that automobiles and other machines could cause to the environment.

Writing and Discussion Topics

Discuss the following topic in small groups.

How would your life be affected if you and your family could not obtain the amount of electric power that you now use? What changes would you have to make in your daily lives? How would your city or community be different with less electricity?

Choose one of the following topics. Write six to eight sentences about the topic. Use some of the target vocabulary words.

1. Many people believe that the climate of the Earth is changing. What are some ways that life on Earth might change if the climate becomes warmer?
2. Vertical farming (Unit 9) is a way to grow food plants within a city environment. Would it be possible to have solar farms or wind farms in a big city? Why would this be a good approach to providing electricity? What are some potential problems?
3. Another way to deal with the energy shortage is to use less of it. Describe some steps that you have already taken to use less energy. What other steps could you take?