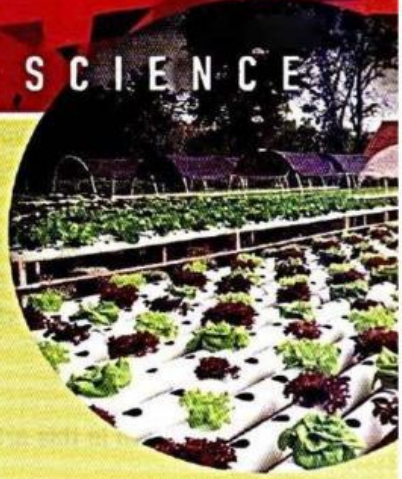
EARTH SCIENCE

UNIT 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						
AWL benefit						
maintain						
AWL principle						
regulation						
AWL require						
strategy						
AWL 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

LIVEWORKSHEETS

Before You Read

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

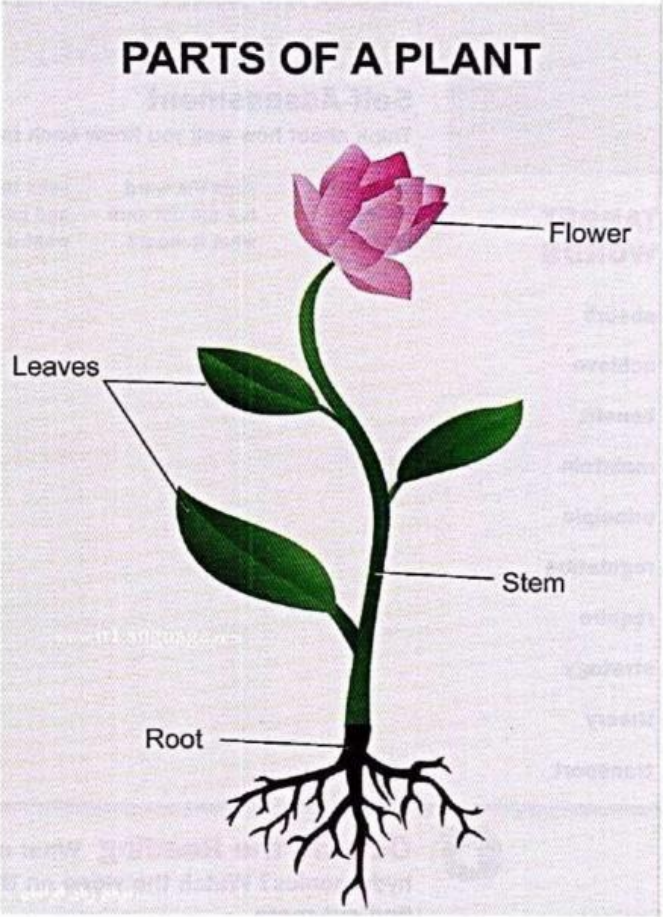
1. Have you ever visited a farm? What was growing? What kinds of equipment were used?
2. Have you ever tried to grow something at home? What did you grow? Were you successful?
3. What do plants need in order to grow?

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

LIVEWORKSHEETS

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.

A commercial hydroponic farm

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.

Inside a greenhouse

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. ■

LIVEWORKSHEETS

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?

   _____ _____

LIVEWORKSHEETS

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)

CORPUS

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.

LIVEWORKSHEETS

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)

CORPUS

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.

LIVEWORKSHEETS

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)

CORPUS

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)

CORPUS

LIVEWORKSHEETS

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)

CORPUS

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

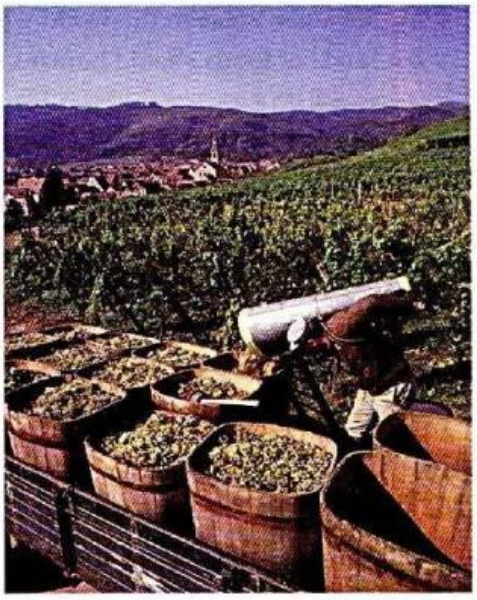
1. Write a sentence that describes a rule that your family believes in.
2. Write a sentence that describes something you will or will not do because of your personal beliefs.
3. Write a sentence about a rule of English grammar or punctuation.

LIVEWORKSHEETS

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 (4) _____ 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.

LIVEWORKSHEETS

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 to 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.

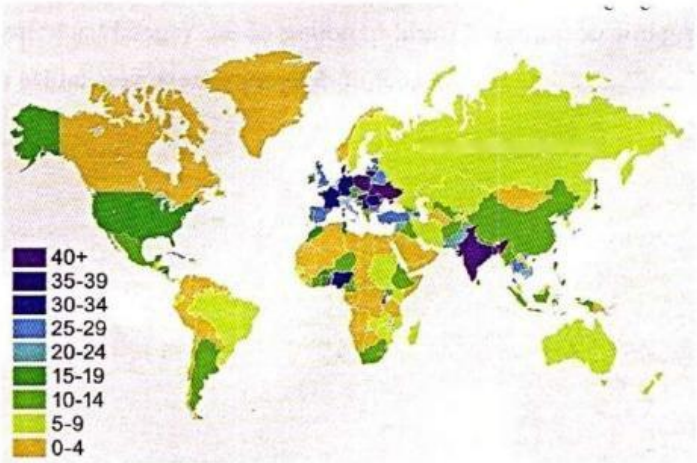
مرجع زبان ایرانیان www.irLanguage.com

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.

LIVEWORKSHEETS

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.

A hydroponic farm

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.

Vertically farmed vegetables have many advantages.

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. ■

LIVEWORKSHEETS

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

LIVEWORKSHEETS

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)

CORPUS

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)

CORPUS

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	

LIVEWORKSHEETS

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)

CORPUS

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

LIVEWORKSHEETS

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)

CORPUS

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)

CORPUS

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?

LIVEWORKSHEETS