



Lasers

UNIT 18

BACKGROUND INFORMATION AND ESSENTIAL WORDS AND PHRASES

Complete the sentences using words from the box below. You may change the form of the words.

amplification
photon
laser
digital
stimulate
medium

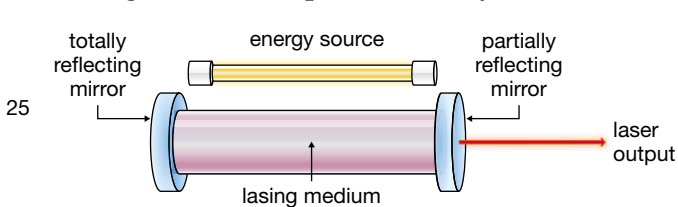
1. A single unit or particle of light is called a _____.
2. The _____ of sound makes it louder.
3. To _____ something is to cause a reaction in it.
4. _____ information is sent and received in the form of numbers.
5. A substance through which waves of energy travel is called a _____.
6. A _____ is a device that produces a narrow, powerful line of light that can be used for many purposes.

Useful Beams of Light

1 Since the first laser was built in 1960, lasers have become essential to our lives. Lasers produce light in a narrow **beam**¹ that can be very precisely controlled. The word *laser* stands for “Light Amplification by Stimulated Emission of Radiation.” “Light amplification” means the generation of more light. “Stimulated emission”
5 of radiation” is best explained at the atomic level.

An atom is said to be **excited**² if it has greater energy than it normally has. If a light particle—a photon—of a particular energy passes by such an excited atom, it can stimulate that atom to emit another photon of the same energy as the one passing by. One of these photons can go on to stimulate another excited
10 atom to give off a third photon of the same energy. In a laser, this process goes on and on: billions of atoms are stimulated to give off photons of the same energy. Because they have the same energy, they all have the same wavelength, and therefore the same color.

Lasers are basically a **cylinder**³ containing a material called the lasing
15 medium. This can be a gas, a liquid or a solid (ruby was the lasing medium in the first laser built). Energy is injected into the lasing medium to excite the atoms. As these atoms then drop down to a lower energy level, they emit photons of a particular wavelength. At each end of the cylinder there is a mirror. The photons
20 **bounce**⁴ back and forth between the two mirrors, stimulating more atoms to emit photons of the same wavelength. One of the mirrors is only a **partial**⁵ mirror. It reflects only some of the light, while allowing the rest of the light to pass through it and escape from the cylinder in a narrow, concentrated beam—a laser



The basic elements of a laser.

beam. Unlike normal white light, with its many different wavelengths and waves that are out of step with each other, laser light contains only one wavelength and is coherent, which means that

30 all its waves **vibrate**⁶ in step with each other. This coherence makes laser light extremely useful.

It is hard to imagine modern life without lasers. DVD and CD players contain a small laser to read information stored in digital form on a disc, which is then translated into pictures or music. In supermarkets, a laser reads
35 the **barcode**⁷ on each item a customer is purchasing. Lasers of different power can be used to generate varying degrees of heat. In eye surgery, lasers are now commonly used to reshape the cornea. The heat of a laser melts parts of the



A laser cutter.

cornea's⁸ surface, changing its shape and improving its ability to focus, thus enabling people to see clearly without eyeglasses. 40 Lasers are used in manufacturing for high-precision cutting and **welding**.⁹ Nuclear scientists are hopeful that lasers will enable them to control the **nuclear fusion**¹⁰ process, which generates enormous amounts of clean 45 energy but requires very high temperatures. The hope is that very powerful lasers will be able to generate those high temperatures.

The use of lasers will continue to expand in all aspects of our modern life: in the home and workplace, and in science, 50 medicine and industry.

glossary text to go here

VOCABULARY STUDY

Match each word or phrase with its definition. Try to guess the meaning from the context without using a dictionary.

- | | |
|--------------------|---|
| 1. beam | a. not total |
| 2. excited | b. the transparent front of the eye |
| 3. cylinder | c. to join metal using very high heat |
| 4. bounce | d. a straight line of light |
| 5. partial | e. with more energy than normal |
| 6. vibrate | f. to make fast, small movements back and forth |
| 7. barcode | g. to move in a different direction after hitting a surface |
| 8. cornea | h. a process in which atoms come together, releasing energy |
| 9. weld | i. a tube-shaped object with circular ends and straight sides |
| 10. nuclear fusion | j. the black and white label on a product from which a computer reads information about its price |

COMPREHENSION QUESTIONS

Circle the best answer, a, b, c or d, to each of these questions.

1. In a laser, excited atoms emit:
 - a. photons.
 - b. new atoms.
 - c. gas.
 - d. protons.
2. What was the lasing medium in the first laser ever built?
 - a. Water
 - b. Ruby
 - c. A gas
 - d. Plastic
3. How many mirrors are there in a laser?
 - a. One
 - b. Two
 - c. Three
 - d. Four
4. In a laser beam, the light is:
 - a. medium.
 - b. varying.
 - c. partial.
 - d. coherent.
5. In eye surgery, the heat of a laser _____ parts of the cornea's surface.
 - a. damages
 - b. cuts
 - c. melts
 - d. welds
6. Which use for lasers is not mentioned in the reading passage?
 - a. In CD players
 - b. In weapons
 - c. In high-precision welding
 - d. To read barcodes in supermarkets

SUMMARY AND LISTENING PRACTICE

Read the paragraph and fill in as many blanks as you can. Then listen to the recording and fill in the rest of the blanks.

Lasers are essential in many parts of life. They produce a _____ of coherent _____ that can be very precisely controlled. Lasers work by stimulating excited _____ to give off photons of a particular wavelength. Inside a laser, the photons bounce back and forth between two _____, one of which allows light to escape in a narrow, concentrated beam. Lasers are used in a wide variety of applications, including in CD and DVD players, in supermarkets for reading _____ and in eye _____. The use of lasers will continue to expand in all aspects of modern life.

STRUCTURE AND WRITTEN EXPRESSION

Complete the sentences using the most appropriate words or phrases. You may refer to the main text to choose the best option.

1. Since 1960, lasers _____ essential in many parts of life.
a. became b. become c. have become d. becoming
2. "Light amplification" means the generation _____ more light.
a. by b. of c. from d. on
3. Lasers are a cylinder _____ a material called the lasing medium.
a. contain b. contains c. containing d. for containing
4. One of the mirrors in a laser is a _____ mirror.
a. medium b. concentrated c. powerful d. partial
5. A laser can be used to read digital information stored _____ a disc.
a. from b. at c. on d. with
6. Scientists hope lasers will _____ them to control the nuclear fusion process.
a. enable b. let c. stimulate d. use



Renewable Energy

UNIT 19

BACKGROUND INFORMATION AND ESSENTIAL WORDS AND PHRASES

Complete the sentences using words or phrases from the box below. You may change the form of the words or phrases.

hydroelectricity
windmill
photovoltaic
global warming
geothermal
biofuel

1. A _____ has blades that turn when pushed by the wind.
2. _____ is generated from the energy of moving water.
3. A _____ is made from plant material.
4. A _____ device changes light into electricity.
5. _____ energy is derived from the heat below the Earth's surface.
6. Scientists know that temperatures on the Earth have been rising and are working on ways to fight _____.

Beyond Fossil Fuels

Renewable energy is energy produced from a resource that constantly replaces itself. Before the use of coal became **widespread**¹ in the 19th century, almost all of the energy used by humans was renewable, and much was based on the muscle power of humans and of animals like horses. Now much of our energy comes from the burning of fossil fuels such as coal and oil. These sources are called non-renewable. They cannot be replaced—once used, they are gone forever—and eventually they will run out. Burning fossil fuels to produce energy also creates greenhouse gases, which are harming the atmosphere and causing global warming. These factors have led to the increased worldwide use of renewable energy.

Flowing water has long been used to produce energy. Once it was used to turn large wheels to grind **grain**² in **mills**³ built beside rivers. Hydroelectricity now provides nearly one quarter of the world's electricity. Water is stored in dams and released in pipes. The falling water drives turbines—devices that convert movement energy into electricity. As hydroelectricity plants do not use fossil fuels, they produce no greenhouse gases. Once established, they are cheap to operate. What is more, they have a long life—perhaps 50 to 100 years. Potential disadvantages of hydroelectricity are that the dams may take up a lot of land and may harm the life in the rivers that supply the water.

Wind was used in the past to power windmills for **pumping**⁴ water and to operate sailing boats, the main means of sea travel until the introduction of steamships. Wind is now widely used to generate electricity. In many countries, wind farms containing hundreds of turbines supply electricity to the power **network**.⁵ Wind power produces no greenhouse gases, is **plentiful**⁶ and widely distributed and uses little land. However, it can harm bird life and many people think the farms are **visually**⁷ polluting and too noisy.

Photovoltaic cells convert sunlight directly into heat and electricity. This solar power has probably the most potential of all renewable energies and is the fastest-growing source of renewable energy. Some people predict that by 2050 most of the world's electricity will be produced by solar power. With both solar and wind power, one major challenge is storing the produced energy for when it is needed.



A solar farm.

Another important renewable energy source is biofuels. These are produced by the **fermentation**⁸ of sugars from plants, but have the disadvantage that these plants can no longer be used for food.

40



45

A hydroelectric plant.

Brazil is the world's largest user of biofuels. The gasoline sold there contains 25 percent ethanol, produced from sugar cane.

Ultimately, most sources of renewable energy come from the sun, since its energy drives the Earth's climate, which provides rain and wind and makes plants grow. One of the few types of energy that does not come directly or indirectly

from the sun is geothermal energy. This is produced by harnessing the very high temperatures produced by radioactive decay deep under the Earth's surface. The world's largest geothermal **plant**⁹ is in California.

In the long term, renewable energy is normally cheaper than energy from fossil fuels. Also, it has less of an effect on the environment. Many countries are now **investing**¹⁰ in renewable sources for their energy needs.

glossary text to go here

VOCABULARY STUDY

Match each word with its definition. Try to guess the meaning from the context without using a dictionary.

- | | |
|-----------------|---|
| 1. widespread | a. plant seeds used as food |
| 2. grain | b. to do with the way something looks |
| 3. mill | c. happening in many places |
| 4. pump | d. present in large amounts |
| 5. network | e. a kind of factory where power is produced |
| 6. plentiful | f. a system of things that are all connected |
| 7. visually | g. to make water move from one place to another |
| 8. fermentation | h. to spend money to get something in the future |
| 9. plant | i. a kind of factory where material is crushed or ground |
| 10. invest | j. a chemical change that produces alcohol from sugar in plants |

COMPREHENSION QUESTIONS

Circle the best answer, a, b, c or d, to each of these questions.

1. Burning fossil fuels creates:
 - a. greenhouse gases.
 - b. muscle power.
 - c. hydroelectricity.
 - d. biofuels.

2. Which of the following energy sources is not renewable?
 - a. Coal
 - b. Hydroelectricity
 - c. Wind
 - d. Biofuels

3. Which of the following is not mentioned as a disadvantage of wind power?
 - a. The harm that can be caused to bird life
 - b. The noise that wind farms create
 - c. The way wind farms look
 - d. The amount of land that wind farms take up

4. Photovoltaic cells produce heat and electricity from:
 - a. water.
 - b. wind.
 - c. sunlight.
 - d. plants.

5. The world's largest user of biofuels is:
 - a. Europe.
 - b. Brazil.
 - c. California.
 - d. Japan.

6. Geothermal energy comes from:
 - a. the sun.
 - b. wind.
 - c. plants.
 - d. radioactive decay inside the Earth.

SUMMARY AND LISTENING PRACTICE

Read the paragraph and fill in as many blanks as you can. Then listen to the recording and fill in the rest of the blanks.

Renewable energy is energy produced from a resource that constantly replaces itself. Today much of our energy comes from burning _____ fuels, which will eventually run out. But worldwide use of renewable energy is increasing. Hydroelectricity is produced when water stored in _____ is released, driving _____ that convert the movement energy into electricity. Windmills are also widely used to generate electricity. _____ power is produced by photovoltaic _____ converting sunlight directly into heat and electricity. Two other important forms of renewable energy are biofuels—produced by the _____ of sugars from plants—and geothermal energy, which harnesses the high temperatures below the Earth's _____.

STRUCTURE AND WRITTEN EXPRESSION

Complete the sentences using the most appropriate words or phrases. You may refer to the main text to choose the best option.

1. Eventually, fossil fuels will run _____.
a. off b. on c. out d. in
2. Hydroelectric plants are cheap to _____.
a. build b. operate c. replace d. enlarge
3. One challenge with solar power is _____ energy for when it is needed.
a. store b. storage c. storing d. stored
4. The gasoline in Brazil contains ethanol _____ sugar cane.
a. produced from b. stored in c. invested in d. driven by
5. California has the world's largest geothermal _____.
a. mill b. plant c. source d. farm
6. Countries around the world are investing _____ renewable energy.
a. in b. at c. to d. with