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Earth In Space: Part 2

LIFEPAC Test is located in the center of the booklet. Please remove before starting the unit.

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Earth In Space: Part 2

Introduction

Our solar system consists of the sun and the family of heavenly bodies held by its gravitational force. Our solar system consists of eight planets of varying sizes, more than 169 moons, several dwarf planets, thousands of asteroids, and millions of meteoroids. The sun is a medium-sized star, moving through space at a speed of 226 kilometers per second.

The eight planets revolve around the sun and travel with it through space. They are illuminated and heated by the sun. Many of the planets shine with a steady radiance and, although they shine by reflected light, are brighter than stars. They owe their relative brightness to their closer location to the sun and earth.

Planets revolve around the sun counterclockwise in elliptical orbits. The sun pulls on the planets and keeps them in orbit like a boy swinging a yo-yo around in circles.

In this LIFEPAC®, you will be learning about the sun's energy supply. You will learn about the sun's family. You will learn about eclipses and Earth's moon. You will compare our earth with the other planets.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAC. When you have finished this LIFEPAC, you should be able to:

1. List the benefits of the sun's energy.
2. Name and describe theories of the sun's energy source.
3. Diagram and explain eclipses.
4. Construct a scale model of the solar system.
5. List and describe members of the sun's family.
6. Describe the moon's path around the sun.
7. Diagram phases of the moon showing the relationship between the sun, earth, and moon.
8. Describe the effect of the moon on the ocean tides.

Survey the LIFEPAC. Ask yourself some questions about this study and write your questions here.

1. THE SUN'S ENERGY

The sun is a huge glowing ball of gases at the center of our solar system. It is only one of billions of stars in the universe. As a star it is not unusual, but the sun is more important to life on earth than any other star. Without heat and light from the sun, no life could exist on earth. The sun is the source of **energy** that supports life.

> *And God said, Let there be light: and there was light. And God saw the light, that it was good: and God divided the light from the darkness. And God called the light Day, and the darkness he called Night. And the evening and the morning were the first day.... And God said, Let there be lights in the firmament of the heaven to divide the day from the night; and let them be for signs, and for seasons, and for days, and years: And let them be for lights in the firmament of the heaven to give light upon the earth: and it was so. And God made two great lights; the greater light to rule the day, and the lesser light to rule the night: he made the stars also. And God set them in the firmament of the heaven to give light upon the earth, And to rule over the day and over the night, and to divide the light from the darkness: and God saw that it was good. And the evening and the morning were the fourth day. (Genesis 1:3-5, 14-19)*

In this section of the LIFEPAC, you will learn about the sun that God created. You will learn how the sun's energy is generated. You will learn about the benefits we receive from the sun.

SECTION OBJECTIVES

Review these objectives. When you have completed this section, you should be able to:

1. List the benefits of the sun's energy.
2. Name and describe theories of the sun's energy source.

VOCABULARY

Study these words to enhance your learning success in this section.

combustion (kum bus' chun). The act or process of burning; chemical combination attended by heat and light.

energy (en' ur jē). Capacity for doing work, such as lifting or moving an object. Light, heat, and electricity are different forms of energy.

fission (fish' un). The splitting of atoms that releases tremendous amounts of energy and is used to start the chain reaction of an atomic explosion; nuclear fission.

fusion (fyü' zhun). The combining of two atomic nuclei to produce a nucleus of greater mass. The fusion of atomic nuclei with low atomic numbers requires a very high temperature, and releases tremendous amounts of energy.

nucleus (nü' klē us). A proton, or a group of protons and neutrons, and other nuclear particles, forming the center of an atom. The nucleus forms the core around which the electrons orbit. It contains most of the mass of the atom.

photosynthesis (fō' tu sin' thu sis). The process by which plant cells make carbohydrates from carbon dioxide and water in the presence of chlorophyll and light, and release oxygen as a by-product.

solar energy (so' lur en' ur jē). Coming from the sun. Solar energy is given off by atomic reactions taking place inside the sun.

Note: *All vocabulary words in this LIFEPAC appear in* **boldface** *print the first time they are used. If you are unsure of the meaning when you are reading, study the definitions given.*

Pronunciation Key: h**a**t, **ā**ge, c**ă**re, f**ä**r; l**e**t, **ē**qual, t**ė**rm; **i**t, **ī**ce; h**o**t, **ō**pen, **ô**rder; **oi**l; **ou**t; c**u**p, p**u**t, r**ü**le; **ch**ild; lo**ng**; **th**in; /*Ŧ*H/ for **th**en; /zh/ for mea**s**ure; /u/ represents /a/ in **a**bout, /e/ in tak**e**n, /i/ in penc**i**l, /o/ in lem**o**n, and /u/ in circ**u**s.

BENEFITS OF SOLAR ENERGY

The sun provides four benefits to us on Earth due to its position in space. These benefits are: (1) heat energy, (2) light energy, (3) photosynthesis in plants, and (4) a distance just right for us to live comfortably.

Heat energy. The temperature of any place on the earth depends on the position of the sun in the sky. The temperature is one of several factors that control regional weather. Tropical regions near the equator have a hot climate because the sun shines almost directly overhead at noontime. Polar regions have a cold climate because the sun never rises far above the horizon, and its rays are not as direct.

Other forms of energy used by man depend ultimately upon the sun's energy. Hydroelectric plants use the force of running water to generate electricity. The sun's heat evaporates water from the soil, lakes, and oceans. Water vapor condenses in clouds and later falls as rain and snow or other forms of precipitation. Part of the precipitation makes its way to streams and rivers. Moving waters turn the blades of turbines. Turbines are connected to dynamos that generate electricity.

Even the energy that turns the blades of windmills is derived from **solar energy**. Wind results from the uneven heating of the earth's surface.

Light energy. The sun's light energy is essential to the process of **photosynthesis**. In this process, water from the soil is split by light energy into hydrogen and oxygen. The oxygen is released into the atmosphere. The hydrogen combines with carbon dioxide derived from the atmosphere to form a simple sugar. Sugar is a basic material from which the plant manufactures various essential foods. These foods are as necessary to humans and animals as they are to plants. Humans and animals obtain them by eating either plants or the animals that eat plants. Photosynthesis also provides much of the oxygen required for animal respiration and for **combustion**.

Coal provides us with solar energy that has been stored. Coal is the final stage in the transformation of vegetation that has been buried and compressed. It is the remains of vegetation that absorbed sunlight.

Petroleum is another form of stored solar energy. It is derived from marine animal and vegetable life.

Solar energy has been used directly, although to a limited extent, to supply heat and power. Our homes are partially heated by sunlight entering through windows. Some houses are especially designed so that heat is derived from coils behind special windows that collect sunlight.

Solar ovens are used by high-altitude climbers. Solar engines use the sun's rays to heat water and make steam which performs work.

Make a list.

1.1 List four benefits derived from the position of the earth with respect to the sun.

a. _____

b. _____

c. _____

d. _____

Complete the following projects.

1.2 Research and write a report that explains photosynthesis. Include diagrams and/or drawings. You may wish to devise an experiment to show some phase of photosynthesis. Submit your report.

TEACHER CHECK _____ initials _____ date

1.3 Research an industry in your area that manufactures or markets an energy-saving product. Report on it to the class

TEACHER CHECK _____ initials _____ date

Write true or false.

1.4 _____ The temperature of any place on earth depends on its distance from the sun.

1.5 _____ Wind results from ocean waves.

1.6 _____ Photosynthesis involves the combining of hydrogen with carbon dioxide.

1.7 _____ A by-product of photosynthesis is oxygen.

1.8 _____ Coal is derived from marine animal and vegetable life.

SOURCE OF SOLAR ENERGY

The sun's energy results from reactions between the nuclei of atoms. This type of reaction is different from chemical reactions in two ways. *First*, nuclear reactions involve changes in the **nucleus** that convert one element to another. *Second,* a small amount of matter is converted to a large amount of energy.

Scientists and philosophers for thousands of years have wondered about the sun. Several theories have come down to us concerning the cause of the sun's heat and light.

Combustion theory. When fuel burns, it combines with oxygen. Early scientists thought that the sun was a great furnace. The sun is more than 80 percent hydrogen, which is combustible. The sun also has enough oxygen to bring about combustion at a rapid rate. When hydrogen and oxygen combine chemically to form water, energy is released. However, the intense heat of the sun makes the reaction of hydrogen and oxygen impossible. Even if the reaction were possible, the energy released would not be enough to maintain the brilliance of the sun for even a fraction of the time that it has been a star.

Contraction theory. In the nineteenth century, the celebrated German scientist, Hermann von Helmholtz, proposed a theory for solar energy which was widely accepted for many years. According to his theory, solar energy is generated by gravitation compressing the gases in the sun. This compression would cause the sun to shrink. Helmholtz calculated that a decrease in diameter of only 280 feet per year would be enough to maintain the sun's energy production rate. This small amount of contraction would be too small to see even over the span of recorded history. The amount of energy liberated by contraction would support its radiation for about two million years.

Meteor-impact theory. According to this theory, the heat of the sun is derived from the impact of meteors falling into the sun. No one takes this theory seriously nowadays. Even if meteors plunged into the sun at a fantastic rate, the energy generated upon impact could not account for the sun's heat.

Radioactive-substance theory. Radio-active decay has been suggested as the source of the sun's energy. This explanation could be true only if the sun were composed almost entirely of radioactive elements such as uranium. However, from spectroscopic evidence we know that if these elements are present in the sun, they exist in such minute concentrations that they could account for only a tiny fraction of the sun's total energy release.

Nuclear-fusion theory. The theory that matter could be converted into energy was introduced by Albert Einstein in 1905. Einstein developed a formula ($E = mc^2$) which predicted that energy released by nuclear reactions was much greater than energy released by ordinary chemical reactions. In the early 1940s, Einstein's theory was proved true when the heavy uranium atom was split (by nuclear **fission**) to yield two lighter atoms and great amounts of energy.

Some years later, the hydrogen bomb was developed. It works on the same principle as the sun: matter is converted into energy by the **fusion** of hydrogen nuclei to form helium nuclei. The energy released can be illustrated in the following manner: four atoms of hydrogen (atomic mass of 4.030 units) form one atom of helium (atomic mass of 4.003 units). The small amount of mass that is "lost" (.027 units) is converted into energy.

Two explanations have been offered for the way the hydrogen nuclei fuse to form helium. In one process, the *proton-proton reaction,* helium nuclei are built from hydrogen nuclei (protons). Four hydrogen atoms fuse to form a helium nucleus.

The other generally accepted process is called the *carbon-cycle reaction.* The German-born American physicist, Hans A. Bethe, worked

out a detailed theory to explain how solar energy could be derived from transformations of atomic nuclei. In the carbon-cycle theory, solar energy is generated by a six-step reaction in which four hydrogen nuclei fuse to form a helium nucleus. (The carbon atom is involved as a catalyst and is not changed. It can go through the same cycle again.) Vast energy is released in the carbon cycle. The fusion of a hundred tons of hydrogen into helium would release more energy than all mankind could use in a year. The present brilliance of the sun could be maintained for thirty billion years if its hydrogen continued to be transformed into helium at the present rate.

The earth receives only about one two-millionth of the energy released from the sun. About 30 percent of this fraction is absorbed or scattered by the atmosphere, yet the minute amount that strikes the earth's surface is equivalent to 4,690,000 horse-power per square mile.

Write the letter for the correct choice on each line.

1.9 The sun's energy results from _____ .
a. nuclear reactions b. meteoric impacts c. burning d. solar shrinking

1.10 The combining of oxygen and fuel is _____ .
a. combustion b. compaction c. contraction d. impaction

1.11 The radioactive-substance theory would require the sun to contain large amounts of _____ .
a. coal b. hydrogen c. uranium d. helium

Make a list.

1.12 List five theories developed to explain the source of the sun's tremendous supply of energy. Write a summary sentence that explains each of the five theories.

a. _____

_____

b. _____

_____

c. _____

_____

d. _____

_____

e. _____

_____

Answer these questions.

1.13 How did experimental scientists prove the truth of Einstein's equation, $E = mc^2$?

_____

_____

1.14 By what process does the sun create energy? _____

_____

1.15 How much of the sun's energy reaches the earth's upper limit? _____

1.16 Of the energy that reaches the top of the earth's atmosphere, part is scattered or absorbed. What percent reaches the earth's surface? _____

Review the material in this section in preparation for the Self Test. The Self Test will check your mastery of this particular section. The items missed on this Self Test will indicate specific areas where restudy is needed for mastery.

SELF TEST 1

Match each vocabulary word with its definition (each answer, 2 points).

1.01 _____ combustion
1.02 _____ atom
1.03 _____ fission
1.04 _____ nucleus
1.05 _____ catalyst
1.06 _____ energy
1.07 _____ photosynthesis
1.08 _____ solar energy

a. splitting the atom
b. combining nuclei
c. capacity for doing work
d. burning
e. energy from the sun
f. nucleus surrounded by electrons
g. plants producing sugar
h. causes change without being changed
i. central part of an atom

Complete these statements (each answer, 3 points).

1.09 The temperature of a place greatly affects the _____ of that region.

1.010 The remains of vegetation of long ago is _____ .

1.011 The process by which plants manufacture a simple sugar is _____

_____ .

1.012 Photosynthesis provides the _____ needed for human respiration.

1.013 The sun's energy is the result of a _____ reaction.

1.014 Splitting the atom proved the equation $E = mc^2$, which was formulated by _____

_____

_____

Match the following theories with their description (each answer, 2 points).

1.015 _____ combustion

1.016 _____ contraction

1.017 _____ radioactive-substance

1.018 _____ carbon-cycle

1.019 _____ proton-proton

1.020 _____ meteor

a. gravitation compresses gases of the sun

b. sun would have to be composed of radioactive matter

c. great coal-burning furnace

d. energy released by meteors

e. hydrogen nuclei fuse to form helium

f. hydrogen nuclei fuse to form helium in presence of a catalyst

Complete this item (each answer, 3 points).

1.021 List five parts of God's perfect plan for providing us with the energy we need for life by way of the sun.

a. _____

b. _____

c. _____

d. _____

e. _____

49/61 **SCORE** _____ **TEACHER** _____ _____
initials date

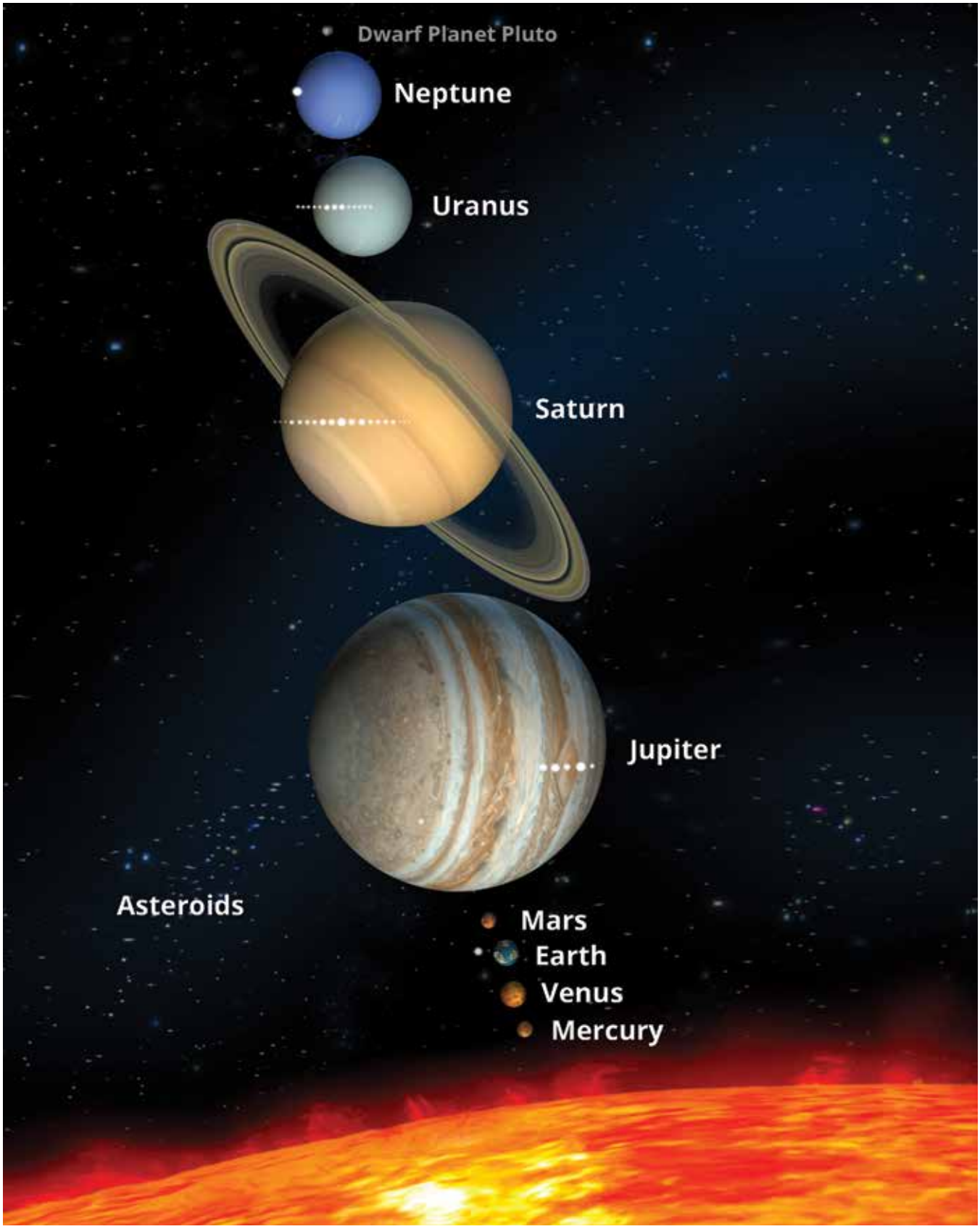

Figure 1 | Our Solar System

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