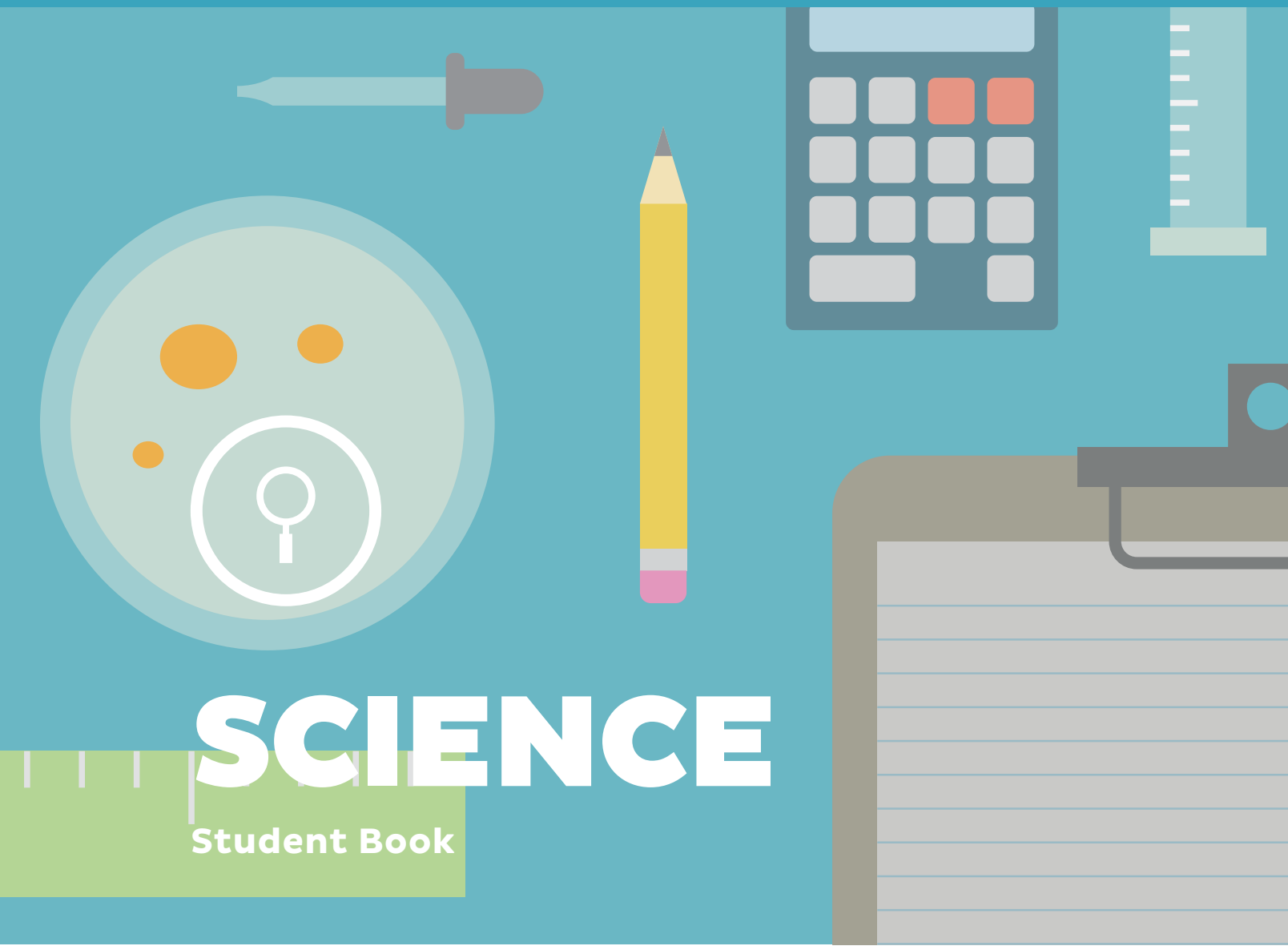
LIFEPAC®



SCIENCE

Student Book

5th Grade | Unit 5

Alpha Omega
PUBLICATIONS

SCIENCE 505
TRANSFORMATION OF ENERGY

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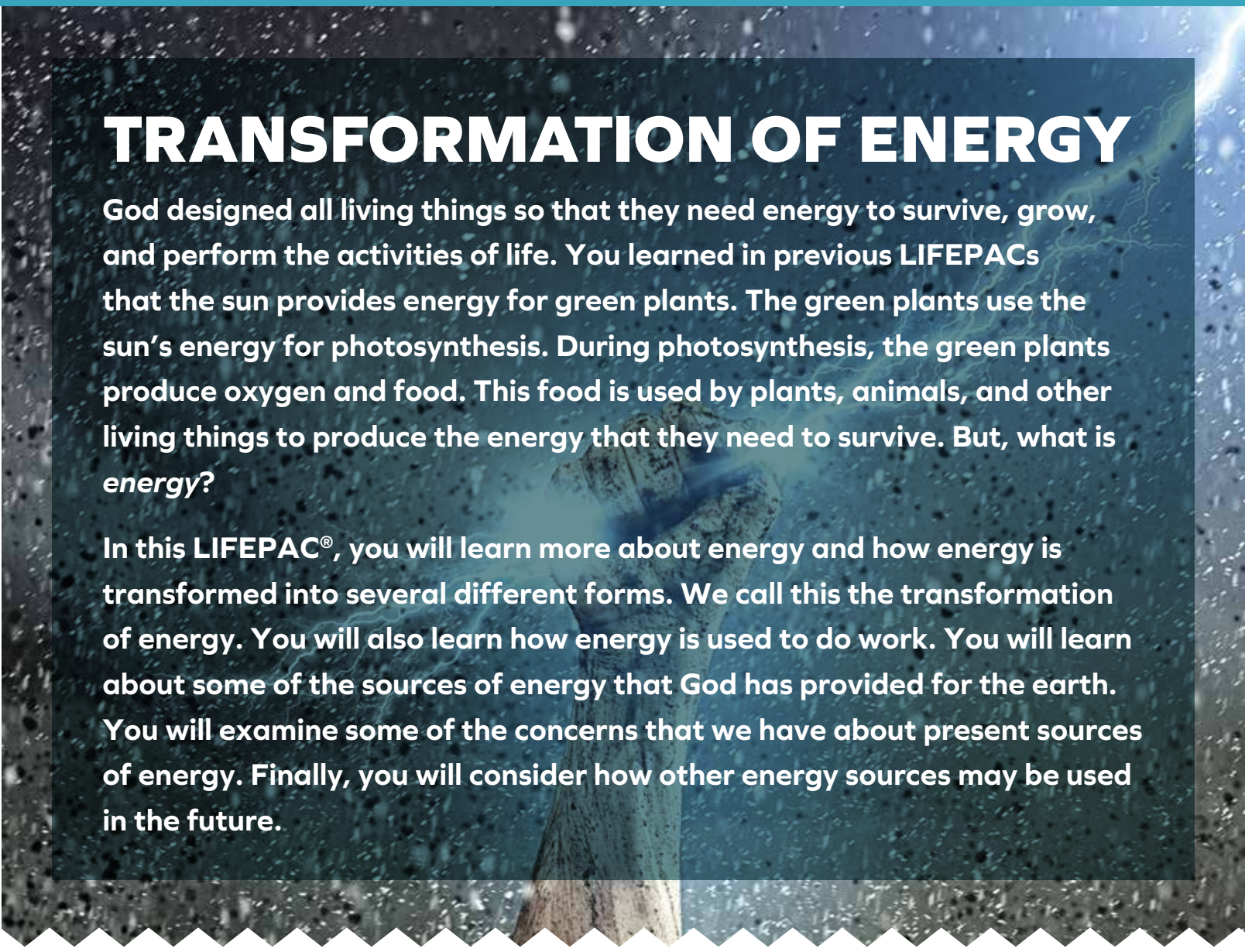


TRANSFORMATION OF ENERGY

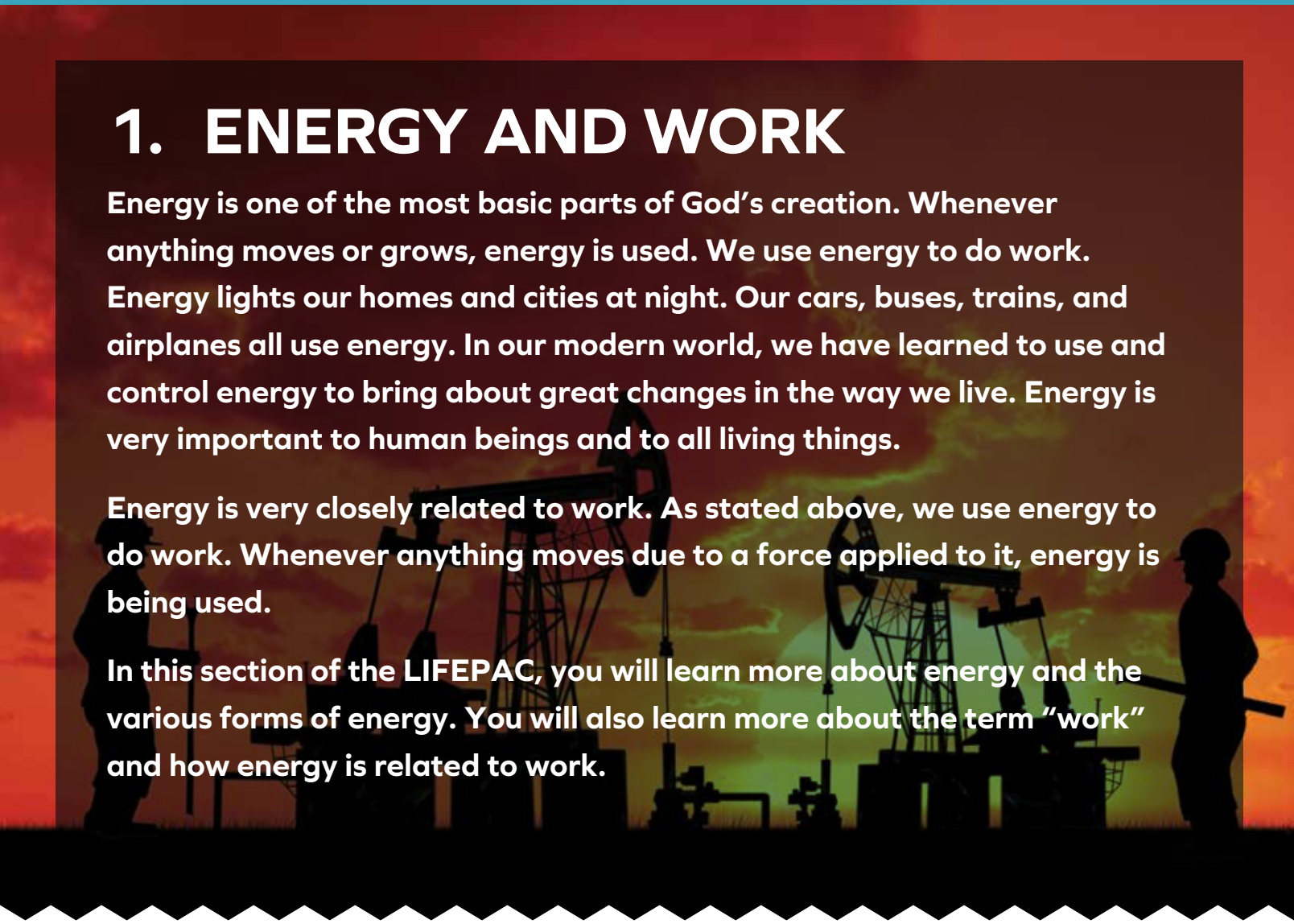
God designed all living things so that they need energy to survive, grow, and perform the activities of life. You learned in previous LIFEPACs that the sun provides energy for green plants. The green plants use the sun's energy for photosynthesis. During photosynthesis, the green plants produce oxygen and food. This food is used by plants, animals, and other living things to produce the energy that they need to survive. But, what is *energy*?

In this LIFEPAC®, you will learn more about energy and how energy is transformed into several different forms. We call this the transformation of energy. You will also learn how energy is used to do work. You will learn about some of the sources of energy that God has provided for the earth. You will examine some of the concerns that we have about present sources of energy. Finally, you will consider how other energy sources may be used in the future.

Objectives

Read these objectives. These objectives tell what you should be able to do when you have completed this LIFEPAC. Each section will list according to the numbers below what objectives will be met in that section. When you have finished this LIFEPAC, you should be able to:

1. Describe energy.
2. Identify forms of energy.
3. Describe work.
4. Explain the relationship between work and energy.
5. Identify energy concerns of today that may be problems of the future.
6. Describe several possible energy sources of the future.



1. ENERGY AND WORK

Energy is one of the most basic parts of God's creation. Whenever anything moves or grows, energy is used. We use energy to do work. Energy lights our homes and cities at night. Our cars, buses, trains, and airplanes all use energy. In our modern world, we have learned to use and control energy to bring about great changes in the way we live. Energy is very important to human beings and to all living things.

Energy is very closely related to work. As stated above, we use energy to do work. Whenever anything moves due to a force applied to it, energy is being used.

In this section of the LIFEPAC, you will learn more about energy and the various forms of energy. You will also learn more about the term "work" and how energy is related to work.

Objectives

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

1. Describe energy.
2. Identify forms of energy.
3. Describe work.

Vocabulary

Study these new words. Learning the meanings of these words is a good study habit and will improve your understanding of this LIFEPAC.

explosion (ek splō' zhən). A blowing up with a loud noise.

fuel (fyü' əl). Something that can be burned to get fire and energy.

kinetic (kin et' ik). Of or relating to the motion of objects.

matter (mat'ər). The material that makes up things.

mechanical (mə kan'ə kə). Of machines. A form of energy that is of motion or movement.

nuclear (nü' klē ər). Having to do with the center of atoms.

particles (pär' tə kəlz). Tiny parts of a material or substance.

potential (pə ten' shəl). Something possible. The ability to go into action or to produce movement.

radiates (rā' dē ātz). Gives out rays.

solar (sō' lər). Having to do with the sun.

transformation (tran' sfər mā' shən). Change in form or condition.

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**ã**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**ů**t, r**ü**le; **ch**ild; lo**ng**; **th**in; /ŦH/ for **th**en; /zh/ for mea**s**ure; /u/ or /ə/ 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.

Energy

Energy makes things happen. If you look around you right now, you can probably see energy being used. If it is daytime, the sun is giving off heat energy and light energy. If it is night, the light bulbs are using electrical energy to give off light energy.

Definition. Energy is commonly defined as *the ability to do work*. Notice carefully this definition. Energy and work are very closely related. When energy is used, work is done. For example, when you run or play, your body uses energy to help you move. When energy is stored, work *can be* done. For example, when you are at rest, the energy stored in your body's fat and muscle tissues will allow you to start running when you are ready. So, the *ability* to do work, either actually being done or ready to be done, is called energy.

Types of energy. This leads us to the two basic types of energy. Energy that is stored is called **potential** energy. In this case, no work is being done. However, the energy is ready and available to do work. Therefore, it is called *potential energy*. The other basic type of energy occurs when a body or material thing is moving or in motion. Energy that is moving is called **kinetic** energy. Any **matter** that is moving has *kinetic energy*.

Let's consider an example. Do you have a pencil (or pen) on your desk or table? If it is at rest, it has *potential* energy. If you shove the pencil over the side of your desk or table, it will fall to the floor. When this happens, the pencil is moving as it falls to the floor.

As it is falling it has kinetic energy.

Now consider what happens as you pick the pencil off the floor and put it back on your desk. You use your own energy to lift and move the pencil. Moving the pencil to a higher position from the floor *adds energy* to the pencil. If you place the pencil on the table, it again has potential energy. Placing the pencil at a higher position, such as a door frame, *adds potential energy* to the pencil. If it falls to the floor again, it would have a greater distance to fall, creating more energy.

If the pencil drops from the door frame, the kinetic energy created would be *greater* than the kinetic energy created when it fell from the table.

| The pencil at rest has *potential* energy.

| The falling pencil has *kinetic* energy.

Remember:
resting at greater height = more potential energy
resting at less height = less potential energy
falling from greater height = more kinetic energy
falling from lesser height = less kinetic energy

Write the correct words in the blank spaces.

1.1 Whenever anything moves or grows, _____ is used.

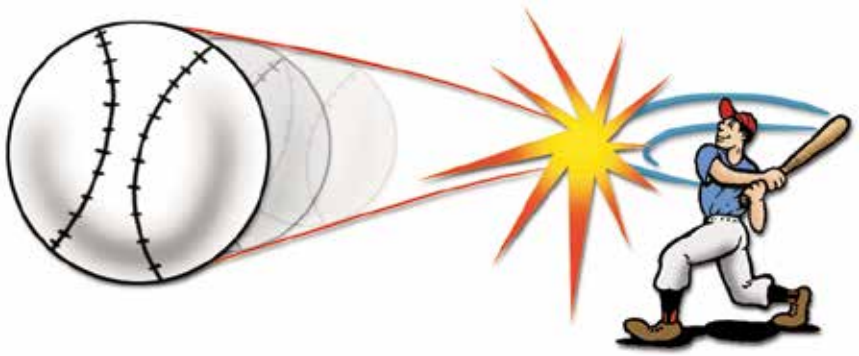
1.2 Energy is the a. _____ to do b. _____ .

1.3 Energy that is stored is called _____ energy.

1.4 Energy that is moving is called _____ energy.

Label these pictures. Use the words *potential energy* and *kinetic energy* to label the pictures.

1.5 _____



1.6 _____

| Energy from the sun is stored in food.

| Animals benefit from this stored energy.

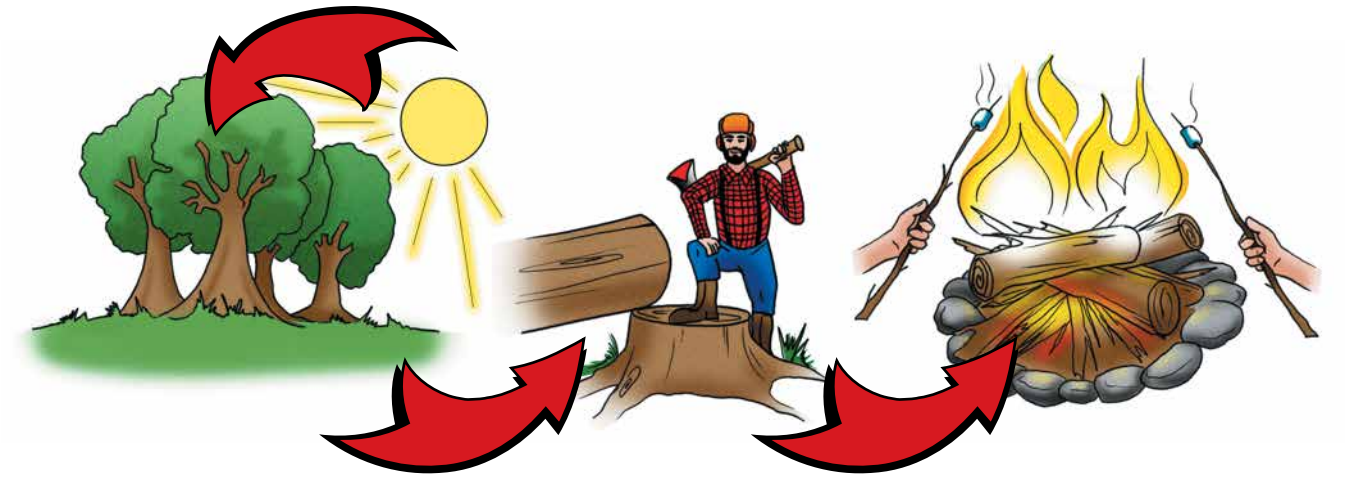
| The stored energy in food also gives us energy.

Sources of energy. God has provided us with many sources of energy. Our main source of energy is the sun. Each day, a great amount of energy is released from the sun. The sun's energy comes to us in the forms of heat energy and light energy. Only a small portion of the sun's energy falls on the earth. However, this small amount of the sun's energy is more than enough to support life on our planet.

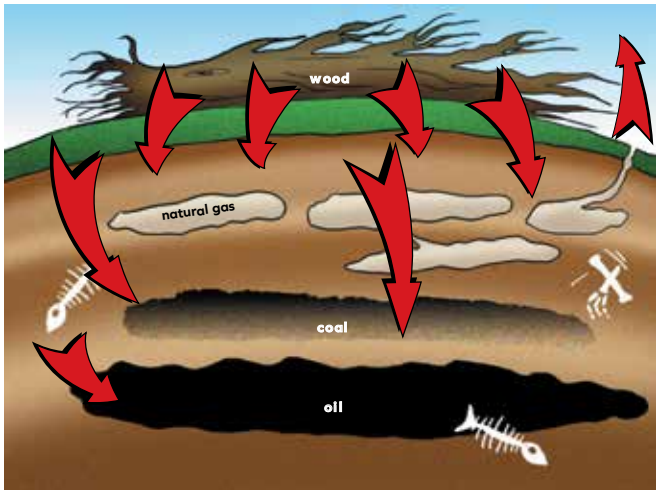
Energy from the sun provides for most of the other energy sources that we have on earth. It does this because the sun's energy can be stored in matter. This energy in matter can be used as other sources of energy for us. For example, you have already learned that part of the sun's energy is stored in green plants as food. This food can be used as an energy source for other living things. The food is eaten and the cells of living things *burn* it for energy. The cells in your body burn food and provide the energy you need to move, grow, and do all of your activities.

One of the first sources of energy that human beings used was wood from trees. The wood can be burned in fire. When wood burns, the energy stored in the wood is given off as heat energy and light energy.

When living things die, there is still energy stored in the matter of the dead bodies. Over time, this dead matter can be turned into other substances like coal, oil, and natural gas. These materials contain great amounts of stored energy. We call these materials "fossil **fuels**." These materials can be burned and give off heat and light energy. Thus, coal, oil, and natural gas are important sources of energy for human beings today.



As you learned in a previous LIFEPAC, the sun causes water in the oceans and lakes to evaporate. This water vapor eventually forms rain upon the earth, producing rivers and streams. Eventually, human beings learned to use the energy of the flowing rivers and streams to turn waterwheels. Waterwheels, in turn, provided energy to turn large millstones to crush wheat and other grains for food. Thus, water became an important source of energy for people. Flowing water is still used today in many dams to produce electrical energy to supply our energy needs.



| Wood, coal, oil, and natural gas are sources of energy.

The wind was also used by human beings many years ago to turn windmills and move sailing ships. The sun's energy, combined with temperature differences on the earth and in the atmosphere, helps the wind to move. This energy in the wind is also a source of energy that can still be used today.

God has provided many other sources of energy. For example, **nuclear** energy, chemical energy, and solar energy are also sources of energy being used today. You will learn more about some of these sources of energy later in this LIFEPAC.

Complete this activity.

1.7 Do a word search for *sources of energy* in the puzzle below. There are eleven sources of energy that have been mentioned so far in this LIFEPAC. All eleven words are in the puzzle. The words are either listed across or down. None of the words are listed backwards or diagonally. When you find the words, circle them and write them in the spaces below.

Word Search

C	N	O	P	W	O	O	D	C
L	A	E	D	I	X	I	F	H
M	Z	C	N	N	P	L	Q	E
R	F	O	O	D	S	W	L	M
B	W	A	T	C	G	A	S	I
S	O	L	A	R	Z	T	N	C
U	F	M	A	L	M	E	P	A
N	U	C	L	E	A	R	A	L

Across

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

Down

g. _____

h. _____

i. _____

j. _____

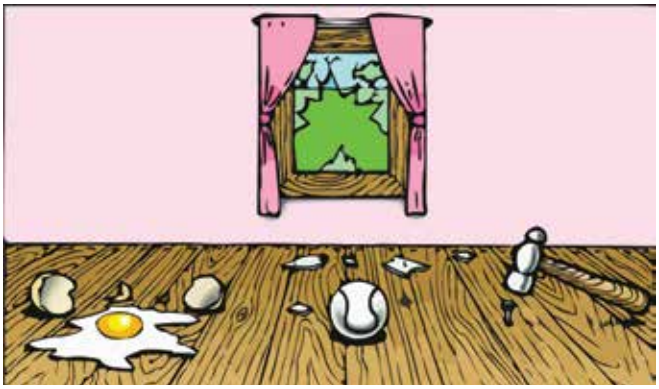
k. _____

Forms of energy. Energy can take many forms. It is constantly changing from one form to another. We call this changing from one form of energy to another the **transformation** of energy. When energy is transformed from one form to another, no energy is lost. The total sum of energy always remains the same.

You learned that energy comes to us from the sun in two forms: *light* energy and *heat* energy. These are two of the forms of energy. When energy from the sun is stored in matter such as wood, coal, oil, and gas, the energy becomes *chemical* energy. Chemical energy is another form of energy.

When matter is burned, the chemical energy in the matter is changed into heat energy. There is a transformation of energy from chemical energy to heat energy. Heat energy, in turn, can cause other matter to get warmer. Heat energy warms things by causing the smallest **particles** in matter to move faster.

Heat energy can also be generated by another form of energy—**mechanical** energy. Mechanical energy is the energy of moving things. It is one form of kinetic energy. Mechanical energy can be transformed into heat energy.



| Results of mechanical energy

You can observe this happening. Rub your hands together. Do they feel warmer when you rub them? The rubbing of your hands together is mechanical action. It is mechanical energy. Heat is generated on the surface of your hands by the rubbing action. The heat is from the heat energy produced by the mechanical action. This is another example of the transformation of energy. In this case, some of the mechanical energy is transformed into heat energy. That is why your hands feel warmer when you rub them together.

Mechanical energy can produce other results besides heat. For example, if you dropped an egg on the floor, the shell might break. The mechanical energy of the falling egg would be enough to break open the eggshell. Another example of mechanical energy is represented by a baseball moving through the air. If the baseball hit a window, the mechanical energy in the baseball could cause the window to break.

Of course, mechanical energy is not always a problem. Mechanical energy can be useful, too. For example, a nail can be driven into wood as a result of the mechanical energy contained in a moving hammer head. Therefore, mechanical energy was probably used to build your home.

Heat energy can be changed into light energy as it **radiates** off matter that is hot. For example, a piece of metal that is heated to a high temperature will glow as it gives off light energy. In the same way, the heat from the high temperatures on the sun gives off light energy. **Solar** energy is a common term for the light energy received from the sun.

Whenever you turn on a light, use a flashlight, or hear a radio, you are using *electrical* energy. Electrical energy is one of the most important forms of energy in our modern world. The source of the electrical energy might be a battery, or it might come into your home through power lines from an electrical power company. Lightning in the sky is another type of electrical energy.

Another form of energy is *sound*. The sound of an **explosion** can shake a house or break its windows. Some dentists use drills that use high-pitched sound to drill teeth. Such use of sound energy is one of the more recent developments in our use of energy.

Match these energy forms.

1.8 _____ solar energy

1.9 _____ a falling apple

1.10 _____ burning causes it

1.11 _____ batteries are sources

1.12 _____ an explosion may rock a house

1.13 _____ energy of movement

1.14 _____ burning changes this form to heat

1.15 _____ oil stores it

a. chemical energy
b. heat energy
c. mechanical energy
d. light energy
e. electrical energy
f. sound energy

Work

| Example of work.

We have defined energy as the ability to do work. But what is *work*? The word *work* has several different meanings as people commonly use it. For example, you may have to *work* on some math problems for school. Or, you might discover that your clock does not *work*. Sometimes, your relatives may go to *work*, meaning that they are going to the place where they are employed. However, when we use the word work as we talk about energy, work has a special meaning.

Definition. Work is done when a force moves an object by a distance. Energy supplies the force needed to move objects through a distance. If you move your chair to another place, you do work. Anytime an object is moved by a force, work is done. If the object does not move, no work is done, even though a force may be applied to it. For example, if you push on your chair, but it does not move, no work is done.

Work is also done when matter changes shape or form. For example, if you change the shape of a glass by breaking it, then work is done. Energy is also used in this process. The same would be true when a lump of clay is molded by a potter into the form of a bowl. The clay changes its shape and form. Work is done by the potter on the clay.

Try these activities. Using the special definition of work as it applies to energy, complete these exercises.

1.16 Blink your eyes.

a. Was work done? Yes No (circle one)

b. Explain your answer. _____

_____

1.17 Pick up your book.

a. Was work done? Yes No

b. Explain your answer. _____

_____

1.18 Hold your book steady in the air without moving it for 3 seconds.

a. Was work done? Yes No

b. Explain your answer. _____

_____

1.19 Write your name here. _____

a. Was work done? Yes No

b. Explain your answer. _____

_____

1.20 Crumple a piece of paper.

a. Was work done? Yes No

b. Explain your answer. _____

_____

Can play really be work? Often when you play, work is being done at the same time. Beside each picture is a space. Explain what work is being done in each of these pictures.

1.21 _____

_____

_____

_____

_____

1.22

1.23

Measurement of work. When something moves, the work that is done can be measured. The amount of work that is done is equal to the force applied to an object multiplied by the distance that the object moves. The amount of work can be shown this way:

WORK = FORCE X DISTANCE

Scientists and engineers measure work in units that represent both force and distance. In the United States, the *foot-pound* is the most commonly used unit of work. One foot-pound equals the work done when a force of 1 pound moves something a distance of 1 foot. Therefore, if a 50 pound weight is lifted 3 feet off the ground, the amount of work done is:
50 pounds X 3 feet = 150 foot-pounds.

In the metric system of measurement, the unit of work is the *joule*. One joule is the amount of work done when a force of 1 *newton* moves something a distance of 1 meter. Therefore, 1 joule equals 1 *newton-meter*. For example, if a 2 newton force moves an object a distance of 5 meters, then the amount of work done is 2 newtons X 5 meters = 10 newton-meters = 10 joules.

Calculate the measurement of some work.

1.24 If a 100 pound weight is lifted 5 feet off the ground, how much work is done?

_____

1.25 A force of 10 newtons moves a box 5 meters. How much work is done?

_____

1.26 Jim pushes hard on a rock that weighs 500 pounds. He pushes with a force of 50 pounds, but the rock doesn't move. How much work did Jim do?_____

Explain. _____

_____

_____

Use your Bible. The definition that we used for work in this LIFEPAC differs from the meaning of the word in most of the Bible. For example, an important use of the word *work* was used by Jesus in John 6:26-35. Read this passage from the Bible and answer the following questions.

1.27 How does Jesus explain work in John 6:29? _____

_____

_____

1.28 Why do you think that God's work is important? _____

_____

_____

1.29 How is Jesus' meaning of work different from the definition that we have been using in this LIFEPAC? _____

_____

_____

_____

Review the material in this section to prepare for the Self Test. The Self Test will check your understanding of this section. Any items you miss on this test will show you what areas you will need to restudy in order to prepare for the unit test.

SELF TEST 1

Answer *true* or *false* (each answer, 2 points).

1.01 _____ The sun is the main source of energy on earth.

1.02 _____ Energy is never lost.

1.03 _____ Play cannot be work.

1.04 _____ Whenever anything moves or grows, energy is used.

1.05 _____ Energy is very closely related to work.

1.06 _____ A pencil at rest on a table has potential energy.

1.07 _____ Any matter that is moving has kinetic energy.

1.08 _____ Food is used as an energy source for living things.

1.09 _____ Wood is one of the newest sources of energy that people have used.

1.010 _____ Wind and water cannot provide energy.

1.011 _____ Energy cannot change from one form to another.

1.012 _____ Mechanical energy is the energy of moving things.

1.013 _____ Chemical energy is stored in coal, oil, and natural gas.

1.014 _____ An explosion is an example of sound energy.

1.015 _____ Work has the same meaning in all common uses of the word.

Match these items (each answer, 3 points).

1.016 _____ energy

1.017 _____ work

1.018 _____ fossil fuels

1.019 _____ heat energy

1.020 _____ electrical energy

1.021 _____ chemical energy

a. coal, gas, and oil

b. causes particles in matter to move faster

c. stored energy in matter

d. ability to do work

e. force times distance

f. supplied by a battery

g. energy of moving things

h. explosion is a form

Write the letter of the correct answer in the blank (each answer, 3 points).

1.022 The mechanical action of rubbing causes _____ energy.
a. chemical b. heat c. potential

1.023 When a 5 pound weight is lifted 10 feet, _____ of work is done.
a. 15 foot-pounds b. 50 foot-pounds c. 50 newton-meters

1.024 Wood burning gives off _____ energy.
a. heat b. mechanical c. potential

1.025 A falling pencil has _____ energy.
a. electrical b. chemical c. kinetic

1.026 Energy changing into different forms is called _____ of energy.
a. multiplication b. reduction c. transformation

1.027 Jesus described work in John, chapter 6 as _____ .
a. hard b. force moving an object c. having faith in Him

Complete these sentences (each answer, 4 points).

1.028 When energy is used, _____ is done.

1.029 Energy that is stored is called _____ energy.

1.030 Energy that is moving is called _____ energy.

1.031 _____ has provided us with many sources of energy.

1.032 A common term for the light energy received from the sun is _____ energy.

1.033 The energy stored in oil is called _____ energy.

Define and explain these words (each answer, 5 points).

1.034 energy: _____

_____

_____

_____

_____

1.035 work: _____

_____

_____

_____

_____

Teacher check: Initials _____

Score _____ Date _____

80/100

SCI_Gr3-5

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