



# SCIENCE

STUDENT BOOK

▶ **8th Grade | Unit 5**

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# SCIENCE 805

## Energy

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

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# Energy

## Introduction

Energy exists in many forms: mechanical energy, heat energy, radiant energy, chemical energy, electrical energy, and atomic energy. All of these forms of energy can be changed into the other forms and are closely related in that all energy is the ability to do work. We shall consider the various ways each type of energy is able to do work and ways in which energy can be changed from one type to another.

## Objectives

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

1. Define kinetic and potential energy.
2. Explain the difference between force and work.
3. Define heat in terms of work and friction.
4. Explain conduction and convection.
5. Discuss radiation and distinguish it from regular heat energy.
6. Explain chemical energy.
7. Label a simple atom.
8. Explain fission and fusion.
9. Explain how energy is converted from one form to another.
10. State the steps of energy conversion in a given process.
11. Define and explain entropy.
12. Discuss the implications entropy has for a Christian

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

A large rectangular area with horizontal blue lines, intended for writing questions. The lines are evenly spaced and extend across the width of the box.

# 1. MECHANICAL ENERGY

Mechanical energy is the **energy** of moving objects or objects which have the capacity of moving. If an object is moving, it possesses

**kinetic energy**. If an object has the capacity to move because of its position but is not moving, it has **potential energy**.

## SECTION OBJECTIVES

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

1. Define kinetic and potential energy.
2. Explain the difference between force and work.

## VOCABULARY

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

**energy** (en' ur jē ). The ability to do work.

**force** (fōrs). A push or a pull.

**heat** (hē t). The energy of vibrating molecules.

**kinetic energy** (ki net' ik en' ur jē ). Moving energy.

**mechanical energy** (mu kan' u kol en' ur jē ). Kinetic and potential energy.

**pendulum** (pen' ju lum). A weight hanging from a point and free to swing.

**potential energy** (pu ten' shul en' ur jē ). Stored energy.

**pull** (pül). A force.

**push** (pūsh). A force.

**work** (wèrk). A force moving through a distance.

**Note:** All vocabulary words in this LIFEPAC appear in **boldface** print the first time they are used. If you are not sure of the meaning when you are reading, study the definitions given.

**Pronunciation Key:** hat, āge, cāre, fār; let, ēqual, tērm; it, īce; hot, ōpen, ōrder; oil; out; cup, pūt, rüle; child; long; thin; /ʒh/ for then; /zh/ for measure; /u/ represents /a/ in about, /e/ in taken, /i/ in pencil, /o/ in lemon, and /u/ in circus.

## KINETIC ENERGY

To understand **mechanical energy**, we must first consider some basic facts leading up to a discussion of **energy**. We must understand the relationship between **force** and **work** before mechanical energy will have any meaning.

**Force.** Force is defined as a *push or a pull*. Whenever force is exerted, it is in the form of a **push** or a **pull**. Any force that you can think of can be reduced to a push or a pull. A child blowing out birthday candles is exerting a pushing force. A man digging with a spade first

pushes the spade into the earth and then pulls the spade up. When we open doors, we either push them or pull them. When we walk, we push downward with our feet. The atmosphere exerts a push force of 14.7 lbs. per square inch on the earth. Any object resting on the earth is exerting a push force. A child tugging on a wagon is using a pull force. A cowboy trying to put on his boots is pushing with his foot while pulling with his arms. A man trying to land a fish is exerting a pull force.

In each of these instances, a force is being exerted in an attempt to accomplish a task. Whether the object of the force is accomplished or not does not affect the force. Force is exerted regardless of whether a change is seen.

Every object in the universe is exerting force of one kind or another. For example, the force of gravity is the attraction that exists between every object in the universe and every other object. No object can exist without exerting some kind of force.



### Tell whether the force is a push or a pull.

- 1.1 \_\_\_\_\_ sitting in a chair
- 1.2 \_\_\_\_\_ carrying a suitcase
- 1.3 \_\_\_\_\_ playing a piano
- 1.4 \_\_\_\_\_ working a revolving door
- 1.5 \_\_\_\_\_ opening a washing machine
- 1.6 \_\_\_\_\_ standing
- 1.7 \_\_\_\_\_ kicking a football
- 1.8 \_\_\_\_\_ working a zipper
- 1.9 \_\_\_\_\_ slicing bread
- 1.10 \_\_\_\_\_ removing a page from a spiral notebook

**Work.** Work is closely related to force. Force is being exerted constantly. Only part of the time is work being accomplished. Work is defined as a force moving through a distance. If a force is exerted in a certain direction and movement occurs *in the same direction*, work is accomplished. For example, a person pushes on a pile of bricks. If the bricks topple, work has been done. A force was exerted. The bricks moved in the same direction. Suppose a man shoves a spade into soft earth. He pushes down. The spade moves down. Work has been done.

Look at Figure 1. When the man moves forward, he is exerting two forces. He is pushing his whole body and the suitcase forward. He is pulling up on the suitcase, but the suitcase is not moving upward. The upward force is not doing any work. Work is being done, but not by the upward force on the suitcase.



Figure 1 | Exerting Two Forces



**Tell whether work is being done (work or no work).**

- 1.11 \_\_\_\_\_ Samson pushing on the pillars (Judges 16:26-30)  
 1.12 \_\_\_\_\_ A mother pushing a child on a swing  
 1.13 \_\_\_\_\_ A student raising her hand  
 1.14 \_\_\_\_\_ A bellringer pulling a rope  
 1.15 \_\_\_\_\_ A wind pushing a sailboat  
 1.16 \_\_\_\_\_ A baby pulling at his father's 100-pound barbells  
 1.17 \_\_\_\_\_ A secretary typing a letter  
 1.18 \_\_\_\_\_ A baseball player swinging his bat  
 1.19 \_\_\_\_\_ A lady pushing on a locked door  
 1.20 \_\_\_\_\_ A leaf falling from a tree

**Circle the arrow of the force accomplishing work.**

1.21



**Give an example of a force accomplishing work.** Use complete sentences.

1.22

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**Energy in motion.** We have discussed both force and work. To do work or even to exert a force, energy is required. Energy is defined as the *ability to do work*. Work is accomplished when energy is used to exert a force through a distance.

Energy that is actually accomplishing work (moving a force through a distance) is moving energy—energy in motion. Moving energy is called **kinetic energy**. To accomplish work, energy must be kinetic energy. Other types of energy must be changed into kinetic energy to do work.



### Answer true or false.

- 1.23 \_\_\_\_\_ Energy is the ability to think.
- 1.24 \_\_\_\_\_ Moving energy is called kinetic energy.
- 1.25 \_\_\_\_\_ Objects that are standing still possess kinetic energy.

### Complete these sentences.

- 1.26 Heat is a form of \_\_\_\_\_ energy.
- 1.27 Energy is the ability to do \_\_\_\_\_ .

## POTENTIAL ENERGY

Not all energy is moving energy. Some energy is waiting to be used. It is stored energy. We call stored energy **potential energy**. It is potentially able to do work.

Some objects have potential energy by reasons of their position. These objects have the potential or possibility of changing their positions by moving. When these objects move, their energy becomes kinetic. When they stop moving, the kinetic energy is stored once again as potential energy.

The classic example of potential energy is a **pendulum** at the top of its arc. A pendulum is like a child's swing. It moves in a curve. At the top of the swing, the pendulum possesses

Kinetic energy is the energy possessed by any moving object. Kinetic energy is the energy possessed by the object by virtue of the fact that the object is moving. Kinetic energy can come from several different sources—the other types of energy. We will discuss these other types of energy in the next section.

Kinetic energy is often found in the form of **heat**. Heat energy is the energy possessed by moving molecules. In a later section of this LIFE-PAC, we shall study heat energy in detail.



| The Pendulum

total potential energy. As it moves downward the potential energy gradually becomes kinetic energy. At the bottom of the swing, the pendulum has only kinetic energy. As the pendulum moves upward on the other side, the total kinetic energy is changed back into potential energy.

A baby seems to know without being told that objects perched on the edge of a table have potential energy. A tiny shove and the object suddenly is changing its potential energy to kinetic energy.

A child on a sled at the top of a snowy hill has potential energy. As the sled starts down the hill the potential energy becomes kinetic energy.

A skydiver poised in the door of an airplane has potential energy. As he jumps the potential energy becomes kinetic energy.

Water at the top of a dam has potential energy. As the water falls over the edge of the dam, the potential energy is released and becomes kinetic energy.

In each of these examples, we can see that the object had potential energy because of a high position from which a fall was possible. In this section we have discussed two kinds of mechanical energy: kinetic and potential. In the next section we shall consider other kinds of energy.



**Complete these statements.**

- 1.28** Stored energy is \_\_\_\_\_ energy.
- 1.29** The two kinds of mechanical energy are a. \_\_\_\_\_ and  
b. \_\_\_\_\_.
- 1.30** To do work energy must be \_\_\_\_\_.

**Label this pendulum.**



**TEACHER CHECK**

\_\_\_\_\_ initials

\_\_\_\_\_ date



**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

Write true or false (each answer, 1 point).

- 1.01 \_\_\_\_\_ A force is the ability to do work.  
 1.02 \_\_\_\_\_ A push or a pull is a force.  
 1.03 \_\_\_\_\_ The air exerts a force on people.  
 1.04 \_\_\_\_\_ All objects attract all other objects.  
 1.05 \_\_\_\_\_ Work is a force through a distance.  
 1.06 \_\_\_\_\_ Moving energy is potential energy.  
 1.07 \_\_\_\_\_ Potential energy is stored energy.  
 1.08 \_\_\_\_\_ A pendulum has both kinetic and potential energy.  
 1.09 \_\_\_\_\_ A car on top of a hill has potential energy.  
 1.010 \_\_\_\_\_ All objects have kinetic energy.

Put *W* if work is being done and *N* if work is not being done (each answer, 2 points).

- 1.011 \_\_\_\_\_ A boy lifts a box up.  
 1.012 \_\_\_\_\_ A girl pushes a locked door.  
 1.013 \_\_\_\_\_ A mother pulls a book from the shelf.  
 1.014 \_\_\_\_\_ A father pulls green beans from a vine.  
 1.015 \_\_\_\_\_ A baby pulls on a table leg.

Put a *P* if it has potential energy and *K* if it has kinetic energy (each answer, 2 points).

- 1.016 \_\_\_\_\_ A pendulum at the top of its swing.  
 1.017 \_\_\_\_\_ A moving car.  
 1.018 \_\_\_\_\_ A ball on the edge of a table.  
 1.019 \_\_\_\_\_ A girl roller skating.  
 1.020 \_\_\_\_\_ Moving molecules.

24

30

SCORE \_\_\_\_\_

TEACHER \_\_\_\_\_

initials

date



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