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Welcome to God's Design® for the Physical World

You are about to start an exciting series of lessons on physical science. *God's Design® for the Physical World* consists of three books: *Heat and Energy*, *Machines and Motion*, and *Inventions and Technology*. Each of these books will give you insight into how God designed and created our world and the universe in which we live.

No matter what grade you are in, third through eighth grade, you can use this book.

3rd–5th grade

Read the lesson and then do the activity in the box (the worksheets will be provided by your teacher). After you complete the activity, test your understanding by answering the questions in the box. Be sure to read the special features and do the final project.

6th–8th grade

Read the lesson and then do the activity in the box. After you complete the activity, test your understanding by answering the questions in the box. Also do the "Challenge" section in the box. This part of the lesson will challenge you to do more advanced activities and learn additional interesting information. Be sure to read the special features and do the final project.

There are also unit quizzes and a final test to take.

Throughout this book you will see special icons like the one to the right. These icons tell you how the information in the lessons fit into the Seven C's of History: Creation, Corruption, Catastrophe, Confusion, Christ, Cross, Consummation. Your teacher will explain these to you.

When you truly understand how God has designed everything in our universe to work together, then you will enjoy the world around you even more. So let's get started!

UNIT 1

FORMS OF ENERGY

KEY CONCEPTS

- **Identify**, with examples, the different forms of energy.
- **Distinguish** between kinetic and potential energy.
- **Distinguish** between chemical energy and nuclear energy.

UNIT LESSONS

Forms of Energy

It works!

LESSON 1

What is energy and what types of energy are there?

Words to know:

- energy
- mechanical energy
- chemical energy
- nuclear energy
- thermal energy
- electrical energy
- magnetism
- sound energy
- light energy

Challenge words:

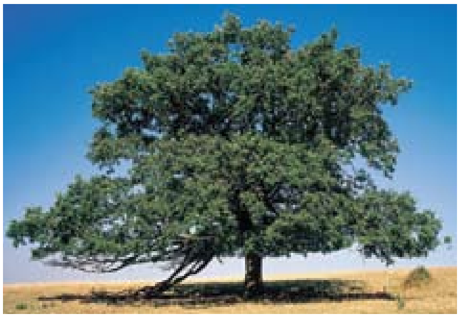
- first law of thermodynamics

What do you think of when you hear the word *energy*? Do you think of running around the block or playing football? It certainly takes energy to perform physical activities. Maybe you think of the amount of gasoline it takes to drive a car. Your car needs energy to transport you from one place to another. Or maybe you thought of the energy needed to heat your home in the winter. All of these are examples of energy, but what is energy from a scientific point of view? The scientific definition of **energy** is the ability to perform work.

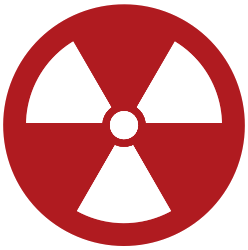
As you have already seen in the previous examples, there are many different types of energy. Energy is found in different forms, such as light, heat, sound, and motion. Although there are many forms of energy, they can all be put into two categories: kinetic and potential. Energy that is being used is called kinetic energy. Energy that is being stored is called potential energy. Forms of kinetic energy include mechanical, thermal, electrical, sound, and light energy. Forms of potential energy include chemical, nuclear, and gravitational energy. Each form of energy was designed by God to supply the energy needs of our world.

Mechanical energy is the energy of movement. When an object moves or has the potential to move, it is said to have mechanical energy. Movement of objects is quite often what we associate with work. Our car uses mechanical energy to move us from one place to another. A crane uses mechanical energy to pick up a giant iron beam. Most mechanical energy is produced when a different form of energy is converted into mechanical energy.

Chemical energy is energy that is stored or released during chemical reactions.



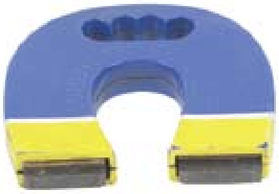
Chemical energy is associated with the energy levels of the electrons in atoms. As the electrons are forced into a higher energy level, they store energy. When they return to a lower energy level, they release energy. Photosynthesis and digestion are two of the most common chemical reactions that store and/or release chemical energy. Burning and combustion are also examples of the release of chemical energy.



Nuclear energy is also associated with the energy of atoms. However, **nuclear energy** is stored in the nucleus of the atom instead of the electrons. Nuclear energy can be released either by fission, which is the splitting of a nucleus into smaller particles, or by fusion, which is the combining of smaller particles to form a new nucleus. Tremendous amounts of energy are stored in the nuclei of atoms.

Thermal energy is also known as heat. It is the energy of moving atoms and molecules. Thermal energy is mechanical energy on an atomic or molecular scale. The more thermal energy an object's atoms contain, the higher its temperature will be. As the temperature goes up, the molecules or atoms move faster. As the molecules slow down, the temperature also goes down.

Electrical energy is the flow of electrons. Electrons can easily move through conductors such as copper and aluminum. This is the form of energy we use most often in our homes and buildings. When the electricity is shut off for some unexpected reason, it becomes very difficult to do many of the normal everyday activities because our society is very dependent on electricity.



Magnetism is a force you are probably familiar with. It is very closely related to electricity. **Magnetism** is basically a force between electric currents—two parallel currents in the same direction attract, and in opposite directions they repel. The earth itself has magnetic fields, most likely due to the flow of electrical ions in the planet's liquid outer core.

The forms of energy mentioned so far are easily seen as energy. We often see how electricity is used to make the various appliances in our homes work for us. We also know that if we put gas in our car, the chemicals in the gas are converted into mechanical energy. But, you may not associate sound and light with energy, because we do not see them producing work as readily as other forms of energy. Nevertheless, they are definitely forms of energy.

Sound energy is energy that travels in waves through matter such as air, water, or wood. The speed of the sound waves depends on the type of matter through which they are traveling. In general, most humans can detect sound waves that vibrate at frequencies between 20 and 20,000 vibrations per second (called Hertz). Many animals can hear sound waves at higher frequencies than humans can.

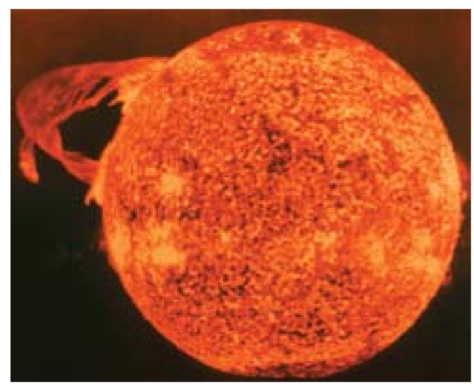
And finally, **light energy** is energy that also travels in

Conversion of energy

Energy is easily converted from one form to another. We need different kinds of energy for different functions. We need heat energy to warm our homes and cook our food. We need mechanical energy to wash our clothes and vacuum our carpets. We need light energy to light up our homes when the sun goes down. Many of these functions begin with electricity that enters our home and is then converted to the form in which we want to use it. To understand the many conversions that energy experiences, complete the "Energy Conversion" worksheet.

waves but does not need to move through a medium. Light is one form of electromagnetic radiation that can travel through empty space. Other forms of electromagnetic radiation include radio waves, infrared, ultraviolet, X-rays, and gamma rays. Light waves can travel through the vacuum of space at speeds up to 186,000 miles per second or about 300 million meters per second.

Probably the most important source of energy for the earth is the sun. The sun converts approximately 657 million tons of hydrogen into 653 million tons of helium every second! The remaining 4 million tons of matter are converted into energy including heat, light, nuclear, and electrical energy. A portion of this energy travels across the vacuum of space to earth and heats and lights our world, providing the energy needed for photosynthesis and life. God has provided our world with many important sources of energy to more than adequately meet our needs. ■



WHAT DID WE LEARN?

- What is the scientific definition of energy?
- What are some of the types of energy recognized by scientists?
- Which types of energy can be converted into other types of energy?

TAKING IT FURTHER

- Which types of energy are defined by the energy in the atoms or parts of atoms?
- Which types of energy can travel through space?
- If the sound of a solar flair was loud enough, could we hear it on earth?
- What is the final form of almost all energy?
- If most energy ends up lost, how do we keep everything working on earth?

Energy chains

The **first law of thermodynamics** states that mass and energy cannot be created or destroyed; they can only change form. This is considered a scientific law because this is what has been observed time after time in scientific experiments. Energy is converted from one form to another, but no new energy is created in any known process. Since this is true, what is the ultimate source of all energy on earth?

Energy can easily change forms, so it is easy to trace the chain of energy in most processes. For example, let's look at the energy chain for a flashlight. At creation, God placed certain materials in the crust of the earth. Man extracts these materials and manufactures batteries. The batteries provide chemical energy that is converted into electrical energy. The electrical energy is converted inside the flashlight into light and heat.

Earth's crust => Mining of raw material => Manufacturing of batteries => Chemical energy => Electrical energy => Light and heat

This is a fairly simple energy chain. Other energy chains are more complex. On a copy of the "Energy Chains" worksheet, draw the energy chain for a coal-powered power plant. Include where the energy came from that is in the coal, and how the energy is used after it leaves the power plant.