Investigate the Possibilities

Elementary Physics

ENERGY

Its Forms, Changes, & Functions

Tom DeRosa
Carolyn Reeves

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About the Authors

Tom DeRosa, as an experienced science educator and a committed creationist, has incorporated both his passions in the founding and the directing of the Creation Studies Institute, a growing national creation organization whose chief focus is education. His wealth of experience in the public school, Christian school, and homeschool markets for over 35 years has given special insights into what really works in engaging young minds. He holds a master's degree in education, with the emphasis of science curriculum. He is an author and sought-out, enthusiastic creation speaker who has a genuine love for the education of our next generation.

Carolyn Reeves is especially skilled at creating ways to help students develop a greater understanding of not just scientific concepts, but also how these are applied within the world around us. Carolyn retired after a 30-year career as a science teacher, finished a doctoral degree in science education, and began a new venture as a writer and an educational consultant. She and her husband make their home in Oxford, Mississippi, where they are active members of North Oxford Baptist Church. The Reeves have three children, three in-law children, and ten grandchildren.

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INTRODUCTION

The world has tremendous energy needs, both essential needs and those for desired lifestyles. Energy makes our cars go and helps us stay warm in the winter and cool in the summer. It gives us cold drinks or hot french fries, lights to see, and tunes to hear.

One of the amazing things about energy is that you can never destroy it and you can never create it. You might think the light in a room disappears at the flick of an electric switch, but the light energy is just changed into heat and mechanical energy.

Scientists define energy as the ability to do work. However, to be useful, energy must be harnessed and directed. For example, electrical energy has little practical value when it is in the form of electricity. There is a huge demand for electricity because it is easy to change electrical energy into other forms of energy, like heat or light or sound. Engineers have developed numerous ways to change energy into forms we can use to make life easier and more entertaining!

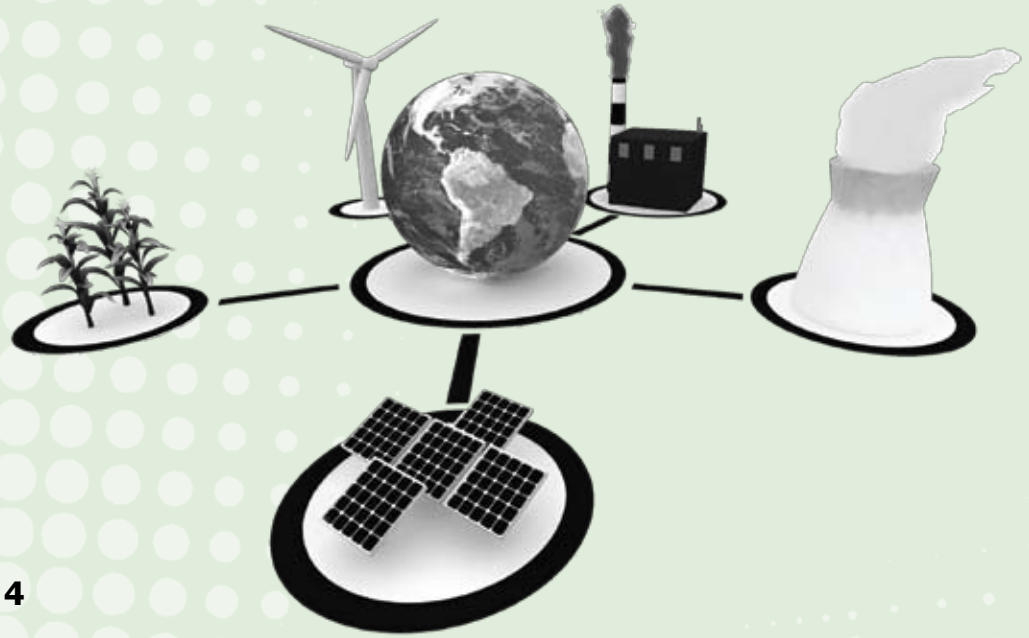
We will be looking at some of the basic forms of energy — light, heat, chemical, electrical, mechanical, and nuclear. We will also be looking at natural fuels and household electricity.

There are two main categories of fuels: nonrenewable fuels that can't be recreated in a small amount of time and renewable fuels that can be produced in a short period of time as long as we have sun, wind, water, plant life, and heat inside the earth.

People are using massive amounts of the earth's nonrenewable sources of oil, natural gas, and coal, as well as uranium. Our need for energy sometimes conflicts with our responsibility to take care of our environment or to prevent air, water, and soil pollution. There is also a danger that we will squander our energy resources instead of conserving them.

The need for solutions to our energy needs is huge. Maybe some of you will be part of the solution. You may run a wind farm, produce new kinds of fuels from plants or garbage, or discover some brand-new source of energy.

You may also want to become a scientist and help unravel the mysteries of the origins of the nonrenewable energy sources. Some scientists are challenging the popular theory that these energy sources were created millions and millions of years ago by gradual processes. They believe instead that major catastrophes were the primary way in which huge amounts of vegetation and other living things became the world's supply of oil, natural gas, and coal. Could that have something to do with Noah's Flood?



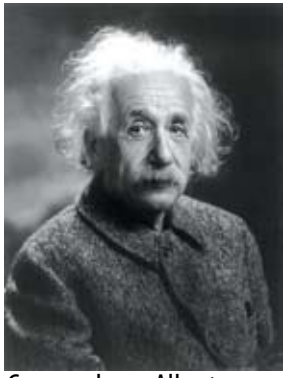
Scientists

Aristotle ..... (384 B.C.–322 B.C.)
Galileo ..... (1564–1642)
Michael Faraday ..... (1791–1867)
Joseph Henry ..... (1797–1878)
Samuel Morse ..... (1791–1872)
Hans Christian Oersted..... (1777–1851)
Lord Kelvin ..... (1824–1907)
Enrica Fermi..... (1901–1954)
Albert Einstein ..... (1879–1955)
Lise Meitner..... (1878–1968)
Niels Bohr ..... (1885–1962)

Where Exactly Does Energy Go?

Think about This

Ella understands that light is a form of energy, but she is having trouble with the idea that light energy cannot be created or destroyed.



German-born Albert Einstein was awarded the 1921 Nobel Prize in physics. His studies of light transformation helped to base his discovery of the photoelectric effect.

"Look," she told her aunt, who is a science teacher. "When I flip the switch and turn off the lights, I cause all the lights in the room to go away." She demonstrated and made the room very dark.

"Now look what happens when I turn the light switch back on. The room fills with light again. Didn't I just create and destroy the light in the room?" she asked.

"No, you certainly did not," her aunt said. "All you did was demonstrate how energy can change from one form into another."

Let's look at some examples of how energy changes from one form to another in this lesson.

The Investigative Problems

What are examples of energy?

Can one form of energy change into another form of energy?

Gather These Things:

- ✔ 1.5-volt dry cell
- ✔ 5-inch piece of electric wire
- ✔ Small wooden boards
- ✔ Assorted rubber bands (different thicknesses but same length)
- ✔ 1.5-volt lightbulb
- ✔ Sandpaper
- ✔ Sturdy shoe box

Procedure & Observations

1. Electric energy to light and heat energy: Take a 1.5-volt dry cell, a five-inch wire, and a light bulb. Test different combinations until you get the light bulb to come on. Show your teacher when you are successful. Make a drawing to show how you connected everything.

   Feel the light bulb. Can you tell if it has gotten any warmer? (Note: This is a small amount of heat and it may not be easy to detect.)

2. Mechanical energy to heat energy: Rub a piece of sandpaper quickly over a board several times. Feel the sandpaper and the board. What kind of energy is produced?

3. Mechanical energy to sound energy: Remove the cover from a sturdy box and cut three grooves on opposite edges of the box. Now choose three rubber bands of equal length, but each with a different thickness. Stretch the rubber bands around the box, fitting each into one of the grooves. Pluck each rubber band. Observe that it is vibrating. Listen for a sound. Repeat for each rubber band. Compare the pitch made by the different rubber bands. Record your observations.

The Science Stuff

Energy is what enables matter to move or to change. Energy is found in many different forms, such as heat, light, electricity, mechanical (the energy in moving things), sound, nuclear, and chemical. One form of energy can be changed into another form of energy. Still, the total amount of energy never changes. This means that energy cannot be created or destroyed. These ideas are expressed in one of the most important laws in all of science — the law of conservation of energy.

These activities illustrate some of the main forms of energy. Each activity shows one form of energy being changed into another form of energy. Electrical energy changed into light and heat, mechanical energy changed into heat, and mechanical energy changed into sound.

In the first activity, when the equipment was wired together correctly, an electric circuit was completed. An electric current then moved through the dry cell, wires, and light bulb. As the electric current moved through the light bulb, electric energy changed into light energy and heat energy.

This activity illustrates another important concept about energy. It shows that energy can be transferred from one place to another. Much of the earth's energy is transferred from the sun to the earth.

Remember the conversation between Ella and her aunt? When Ella flipped the light switch, the electric current began to move through the wires and the light bulb. Inside the light bulb, electric energy changed into light and heat energy, which is the same thing that happened in your activity with electricity. When she turned the lights off, the objects in the room absorbed the heat and light energy. (This is a small amount of energy, and you probably couldn't detect it without some sophisticated equipment.)

When you rubbed a board with sandpaper, your motion produced mechanical energy. This motion produced friction between the sandpaper and the wood, causing the molecules to move faster. As a result, both the sandpaper and the wood became hotter. Thus, the mechanical energy of the moving sandpaper changed into heat energy.

You were also the source of motion when you plucked the tight rubber bands, causing them to vibrate. Sound is produced when a force causes something to vibrate and produce sound waves. Sound energy is carried in waves.

Making Connections

Another way in which mechanical energy can produce sound waves is by tapping on a table. Tapping on the table causes the table to vibrate in the same way plucking on the rubber bands caused them to vibrate. Sound waves actually travel faster through the table than through the air. You can put your ear next to the table and hear the tapping sounds clearly. You can also raise your head and hear the sounds as the sound waves pass through the table and then through the air.

When electrical energy passes through a light bulb, it is changed into light energy and heat energy. Even though the heat energy is unwanted, it is still part of the electric bill. Engineers try to design light bulbs that increase the amount of light and decrease the amount of heat produced. Some progress has been made, but light bulbs continue to produce unwanted heat.

Dig Deeper

Start with the energy being given off from a TV or a radio in your home. Try to figure out where this energy comes from. See how far back you can trace the energy changes. This gets a little complicated, so get a good reference book to help you.

What is the difference between an electric motor and an electric generator? They basically contain the same parts and are built the same way. However, an electric motor changes electric energy into mechanical energy, and an electric generator changes mechanical energy into electric energy.

In 1905, Albert Einstein proposed a theory that altered the law of conservation of energy. He said that matter can be changed into energy, and energy can be changed into matter, but the total amount of matter and energy in the universe remains the same. How was Einstein's theory shown to be true?

What Did You Learn?

1. Give two examples of how one form of energy can change into heat energy. Give another example of an energy change.
2. List two ways in which energy does work for us.
3. The following list contains examples of forces, properties of matter, and forms of energy. Underline all the examples of forms of energy: inertia, light, heat, density, buoyancy, electricity, lift, weight, chemical, push, and nuclear.
4. Define mechanical energy and give an example.
5. What kind of energy can be quickly provided by a battery?
6. What is the law of conservation of energy?
7. Give an example of when an unwanted form of energy is produced in a device.
8. What happens to a roomful of light on a dark night when the lights are turned off?
9. Was energy transferred from the battery to the light bulb when an electric circuit was completed?