KIDS DISCOVER

Energy

WHY DRIVE ON THE SUNNY SIDE OF THE STREET ?

SOL BROTHER AND THE SUNSATIONAL CELLS

SEE PAGE 6

HAVE A BLAST WITH CHLORO-PLASTS !

FISSION FUSION FOSSILS AND FUEL

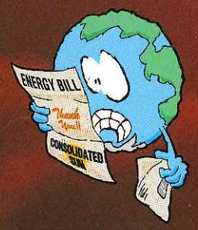
Where Do You Get Your ENERGY?

Brrrrrraaaaa! The alarm clock sounds. Do you leap out of bed already in high gear? Or do you bury your head under the pillow and go back to sleep? No matter what you do, you're using energy.

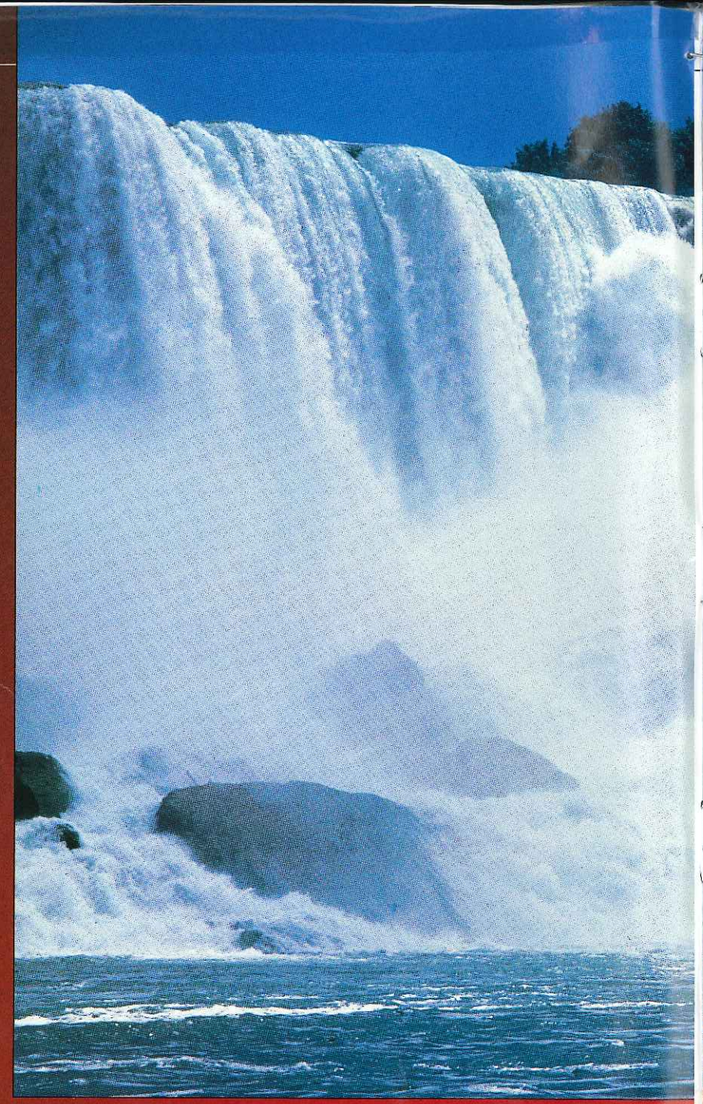
Scientists define energy as the ability to get work done. The work can be anything from breathing to giving a party to building a pyramid—to taking a nap.

But where is energy? Can you touch it? No, but you can see and hear the results of energy. There is energy in the sounds that come out of your CD player. There is energy in the fuel that runs the vehicles that take you where you want to go. There is energy in the electricity that powers the gadgets and machines you use. There is energy in the wind, the waves, the flowing streams. There is energy in you—and in every other living thing. There is even energy in the elastic you stretch to its limit and then let fly.

What exactly is this thing called energy, and where does all this energy come from? Sit back, relax, and save your energy as *Kids Discover* answers these questions—and more—about the fascinating world of energy.

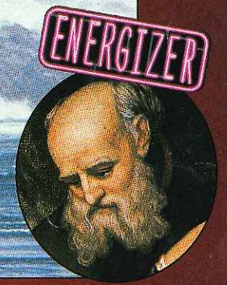


➤ **The amount of** energy the earth receives from the sun in a two-week period equals all the energy stored in the world's supply of coal, oil, and gas.



➤ **Most of the** energy we use on earth comes from one source—the sun. Without the sun's energy, no people, animals, or plants could exist on earth.

➤ **You can think of** energy as something that can be stored (potential energy) or something that flows from place to place (kinetic energy). A slingshot stretched to its limit has *potential energy.* That is, it has the capability of doing work in the future. Once the elastic is released, the stone has *kinetic energy,* the energy of something in motion.



Galileo Galilei (1564–1642) proved that objects move because of potential energy, not because it is "in their nature to do so," as was the belief at the time.

▲ **The energy in** moving water comes from the sun! Sunshine causes water to evaporate from the oceans. This water vapor forms clouds. Eventually, the water vapor falls to earth as snow or rain. Rain forms rivers. When the water in a river falls, energy is converted into kinetic energy.

Energy Yesterday and Today

Have you ever sat around a campfire toasting marshmallows and telling stories? Fun, right? But would it be quite so much fun if that campfire was the only way you had to keep warm, to cook your food, and to light the darkness, as it was for cave dwellers thousands of years ago?

Fire, fed by wood, was one of the earliest forms of energy harnessed by humans. But people are a clever bunch. And as the centuries rolled by, they discovered more and more ways of getting their work done. Let's take a look at some of them.

For thousands of years people have used the energy of the wind to move them from place to place. The clipper ship, developed in the United States in the early 1800s, was the fastest sailing vessel ever designed. It was soon overshadowed, however, by ships using the newly developed power of steam, which is heated water.

Flowing water can be used to get work done. Waterwheels have been used to grind grain, cut lumber, and irrigate fields.

Although the ancient Greeks and Romans burned coal as fuel, it wasn't until the early 1700s that the use of coal became widespread. At a time when wood was becoming scarce in England, coal fueled the new steam engines that were revolutionizing transportation as well as the way work got done.

Much of the fuel that we use today—coal, oil, and natural gas—is fossil fuel, the remains of plants and animals that lived millions of years ago.

The first commercial oil well began operating in 1859 in Titusville, Pennsylvania. The oil was mainly used to light lamps. However, since the invention of the internal combustion engine in 1876, which runs on oil, oil has been in great demand to get us where we want to go. It's also used to heat buildings.

Using the power of the wind to get work done on land began more than a thousand years ago in ancient Persia. In a windmill, the wind pushes against sails connected to a vertical pole, and the pole turns a stone that grinds grain into flour. Windmills can also be used to bring water to crops and to drain wet lands. By 1800, 12,000 windmills were helping keep Holland dry. Modern windmills, called wind turbines, are made of metal. They convert wind energy into electricity rather than grind grain. Though most are powered by natural wind, wind produced by speeding cars powers others.

Check It Out!

How does the sun's energy create wind power?
(answer on back cover)

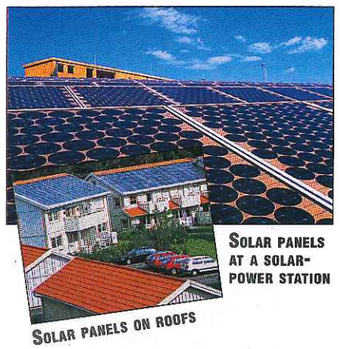
Energy for Today and Tomorrow

Suppose you wake up one morning and there is no heat or electricity in your house. When your parents go to fill up the car with gas, all of the gas stations are closed—permanently. Sound like a nightmare? It could happen. There is a limited supply of fossil fuels (coal, oil, natural gas). Scientists estimate that we may run out of oil by the year 2050. Natural gas and coal will last a little longer, but not forever. That's one reason why it's important to develop other sources of energy. Another reason is that burning fossil fuels releases harmful pollutants into the atmosphere.

That's the bad news. The good news is that for several years people have been experimenting with energy sources other than fossil fuels. Some of them are as old as the sun; others are as young as the twentieth century. Here's just a sampling.

A DROP OF OIL

SOLAR-POWERED TELEPHONE

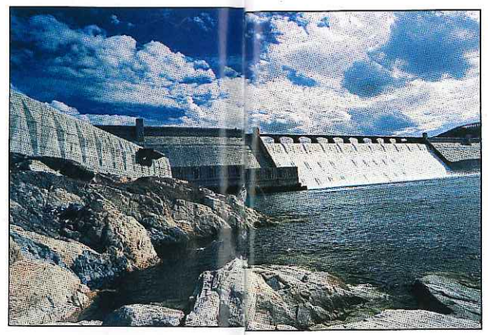


SOLAR PANELS AT A SOLAR-POWER STATION

SOLAR PANELS ON ROOFS

◀ **People have used** the sun's energy for thousands of years. Cave dwellers found warmer living space by choosing caves that faced the sun. However, only recently have people begun to use technology to harness the sun's energy. Solar cells, which make up solar panels, use the sun's radiation to produce electricity. The solar-power station pictured at left, located on an island off Italy, is used to run a desalination plant, a plant that removes salt from water.

▼ **Today's hydro-**electric power plants are a far cry from the watermills of yesteryear. Still, they do use water to produce energy—in the form of electricity. A dam holds back a river's water, releasing it in a steady flow. The force of the water turns a turbine (a kind of modern waterwheel), which drives an electric generator. Below is the world's largest concrete dam, Grand Coulee, in Washington state.



A These residents of Japan are relaxing in a bath of warm sand, heated by geothermal energy. Geothermal (land heat) energy comes from naturally occurring, harmless radioactive elements in the earth. It's one of our few sources of energy that doesn't come from the sun. While geothermal energy could never serve all our energy needs, it can reduce our dependence on fossil fuels. Erupting volcanoes are visible evidence of the heat trapped deep inside our planet.

A Bioenergy is a fancy name for using plants as fuel. Wood is the oldest form of bioenergy. Today, people also burn charcoal, coconut shells, straw, rice husks, sugarcane, and tumbleweed. Some plants with a high sugar content can be made into liquid fuel. In Brazil, sugarcane is grown as a fuel crop. The bad news is making it is an expensive process. The good news? Unlike fossil fuels, it's a renewable source of energy. A new crop comes along every year.

RIDDLE

When will water stop running downhill?
(answer on back cover)

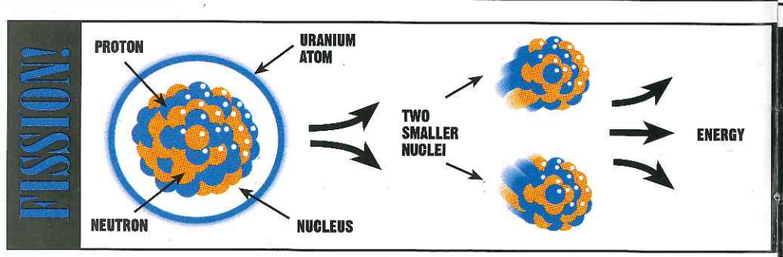
Think Piece!

Almost every source of energy that people have tapped has some drawbacks. Sun and wind are unreliable. Nuclear fission is dangerous. Fossil fuels pollute. How do you think people should meet their energy needs?

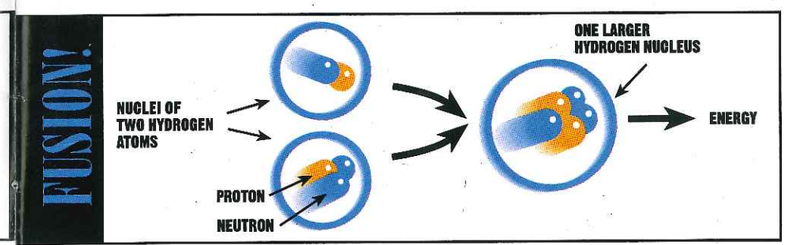
ENERGIZER

Hans Bethe (born 1906) was awarded the Nobel Prize for Physics in 1967 for his deduction that nuclear fusion provides the energy of stars.

THE POWER IN AN ATOM



It doesn't take big things to make big energy. The greatest release of energy ever achieved by human beings came from splitting the atom. Atoms are the smallest particles of a chemical element. But in the early 1900s, scientists discovered that atoms consist of smaller particles. Further research revealed that splitting the core, or nucleus, of an atom (nuclear fission) could release huge amounts of energy. During World War II, scientists used this information to build an atom bomb. When the United States dropped atom bombs on the Japanese cities of Hiroshima and Nagasaki, over 150,000 people were killed and thousands more were disabled.



After the war, scientists found a way to use nuclear fission to produce useful energy. There are now nuclear power plants all over the world. However, the nuclear waste produced by these plants is a great hazard, and an accident at a nuclear plant could be disastrous. In 1986, such an accident occurred at the Chernobyl nuclear plant in the Ukraine. The area is still unsafe for human habitation.

Some scientists think that the answer to the problems caused by nuclear fission is nuclear fusion—the forcing together of atoms of hydrogen, which produces helium along with enormous amounts of energy. This is the same process that creates the energy of the sun and other stars. Nuclear fusion produces even more energy than fission and it is safer and cleaner. However, so far, producing a controlled nuclear fusion reaction in a laboratory requires more energy than it creates, so it's not practical.

RADIATION TESTERS AT CHERNOBYL

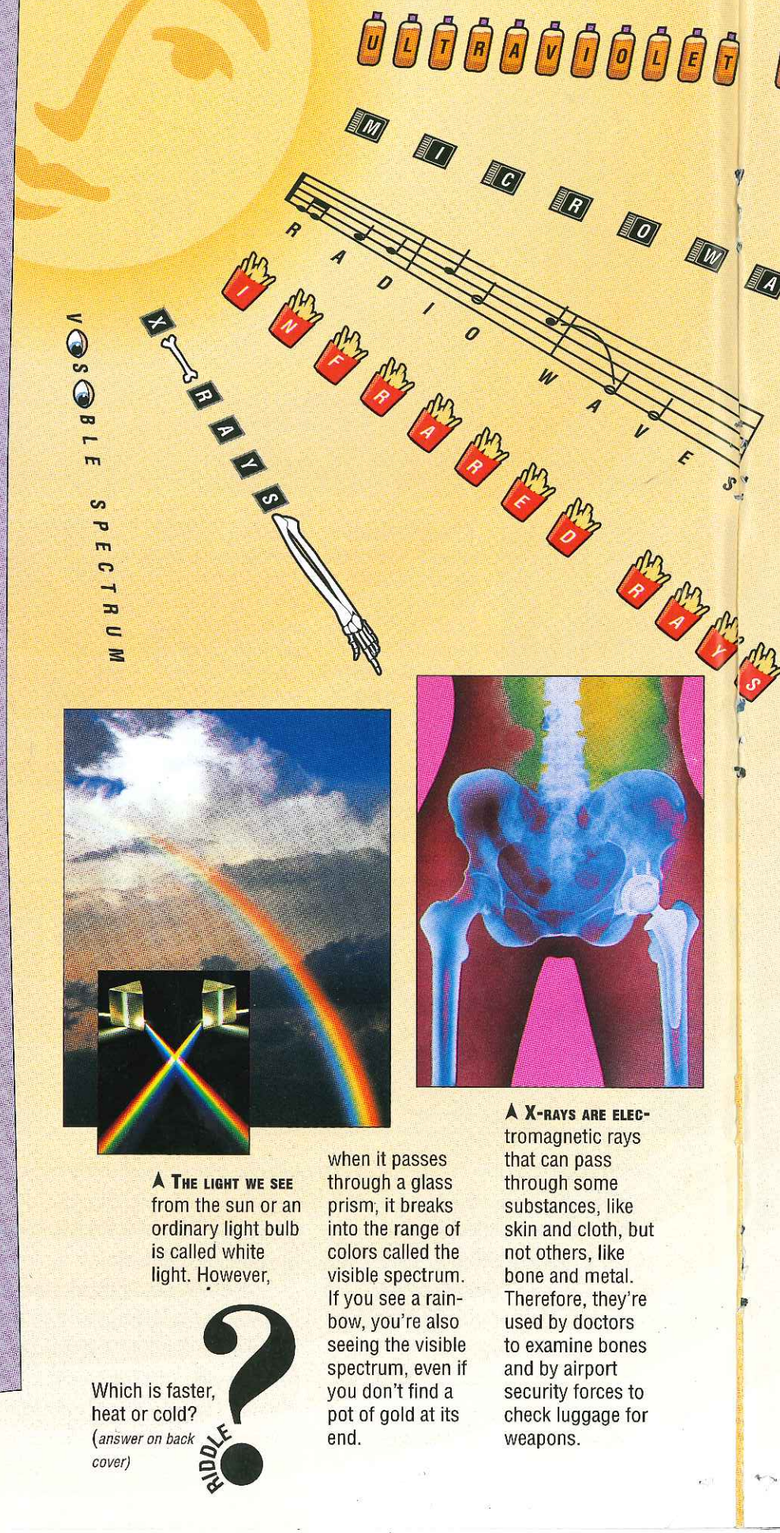
LIGHT AND HEAT

A ball of gas 93 million miles away—the sun—sends energy to us in the form of light and heat. Without it, we'd be nowhere. But what exactly is light? What exactly is heat? What can they do?

Light comes at us as waves —waves of electric and magnetic fields. That's why the scientific term for light waves is electromagnetic radiation. Radiation is a way of transferring energy from one place to another. In addition to the light we see, electromagnetic radiation includes infrared, ultraviolet, microwaves, radio waves, and X-rays. These forms of electromagnetic radiation help us get many jobs done.

Heat is closely related to the energy of moving molecules and atoms, the basic building blocks of matter. The hotter something is, the faster its atoms and molecules are moving. You can actually see this movement in boiling water. Like electromagnetic radiation, heat is also a way of transferring energy from one place to another. This is easy to see when you watch a log burn. The potential (chemical) energy in the wood is converted into heat energy in the flames.

Let's look at some of the other properties of light and heat.

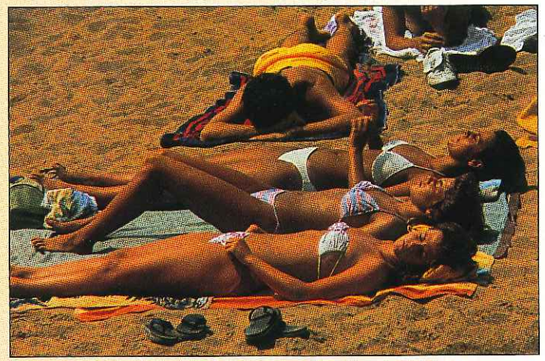


THE LIGHT WE SEE from the sun or an ordinary light bulb is called white light. However, when it passes through a glass prism, it breaks into the range of colors called the visible spectrum. If you see a rainbow, you're also seeing the visible spectrum, even if you don't find a pot of gold at its end.

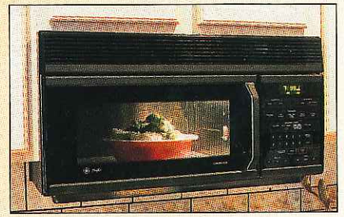
X-RAYS ARE ELECTROMAGNETIC rays that can pass through some substances, like skin and cloth, but not others, like bone and metal. Therefore, they're used by doctors to examine bones and by airport security forces to check luggage for weapons.

RIDDLE

Which is faster, heat or cold? *(answer on back cover)*



YOU CAN'T SEE the sun's ultraviolet rays, but you can certainly see their effect. When your skin absorbs too much infrared or ultraviolet radiation, you get a sunburn or a suntan. Too much of this radiation can cause skin cancer. When ultraviolet rays hit a fluorescent substance, the substance glows. This is one of the kinds of energy that lights up big cities at night.

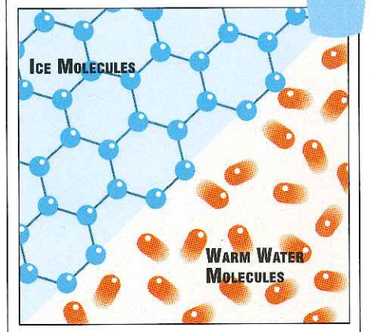


RADIO WAVES ARE electromagnetic radiation. They bring television and radio signals into your home.

CLOSELY RELATED to radio waves are microwaves, which can be concentrated into a thin beam. Microwaves cook food real fast. They're also used in radar to discover the location of a distant object, such as a plane.

INFRARED RAYS from the sun help to keep earth at a temperature that supports life. Very hot things give off a lot of infrared radiation, but even cold things give off some. Some tropical snakes are led to their prey by the warm-blooded prey's infrared radiation. One place you're likely to have seen infrared in action is from heaters keeping food warm at fast-food restaurants.

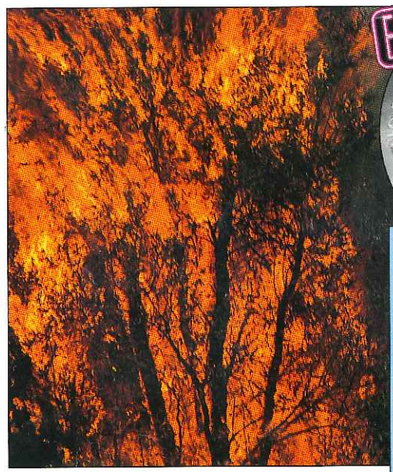
MOVING HEAT



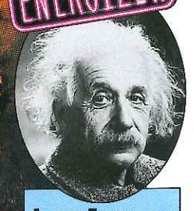
Heat is always transferred from a warmer spot to a cooler one. Put freezing ice cubes into a warm drink and eventually they melt. Why? Water is made up of molecules. Warm molecules move around faster than cold ones because they have more kinetic energy. As they move, they transfer kinetic energy to the ice. This process continues until all the kinetic energy is shared equally and the temperature is evened out.

THERMODYNAMICS

WATCH A FIRE BURN. It looks like the energy that was stored in the wood disappears. But is it destroyed? No. It is just changed into another form—heat. This demonstrates the first law of thermodynamics (the study of heat and work). The law states that the total amount of energy in the universe will always remain the same. Energy cannot be created or destroyed but only changed from one form into another. For a long time this was also called the law of conservation of energy. Then in the early years of the 20th century, Albert Einstein concluded that energy is really matter in a different form. His famous equation is $E=mc^2$. [Energy released is equal to the amount of matter (mass) converted times the speed of light squared. The value of "c" is 186,000 miles per second.] So now the law is called the law of the conservation of energy and mass.



ENERGIZER



ALBERT EINSTEIN (1879-1955) did not do very well in school, but he is considered a genius by people throughout the world for his work in science. He was awarded a Nobel Prize in physics in 1921.

THE ENERGY

released by this geyser in Yellowstone National Park comes from boiling water and steam. Deep within the earth are chambers of water heated to the boiling point by very hot rocks. Resulting steam forces the water to gush out of the earth.