Lesson: What is Energy?

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Summary

With an introduction to the ideas of energy, students discuss specific types of energy and the practical sources of energy. Hands-on activities help them identify types of energy in their surroundings and enhance their understanding of energy.

Engineering Connection

We use energy in all its forms almost every day. Engineers study these forms of energy to help create things that make our lives easier. Currently, engineers are looking for better ways to produce electricity to keep energy affordable and less destructive to the environment. They are also investigating alternative fuel sources for use in vehicles, such as ethanol from corn and hydrogen from water.

Contents

Grade Level: 4 (3-5)

Lesson #: 1 of 9

Time Required: 15 minutes

Lesson Dependency :None

Keywords: energy, energy sources, renewable energy, types of energy

Related Curriculum

subject areas	Physical Science
	Science and Technology
curricular units	Energy
activities	Energy Detectives at Work
	What Is Energy? Short Demos

Educational Standards

- Colorado: Science
- International Technology and Engineering Educators Association: Technology
- Next Generation Science Standards: Science

Learning Objectives (Return to Contents)

After this lesson, students should be able to:

- Define energy and identify the different types that exist.
- Define potential and kinetic energy.
- Relate specific types of energy to different engineering projects.
- Understand the role of engineering in finding and testing various sources of energy for the production of electricity.

Introduction/Motivation (Return to Contents)

You cannot always see energy, touch it or hold it in your hand, but energy is everywhere.
Energy is the ability to do work, to make things happen, and to cause changes. Energy cannot be made or destroyed; it can only be changed into different forms. Can you name a form of energy? (Examples: Light, heat, electricity, sound) From where do you think we get electricity? (Possible answers: Power plant, the outlet in the wall, food) Can you think of an example in which energy is changed from one form to another? How about a light bulb? We turn it on by plugging it into the wall. What happens when you leave a light bulb on for a while? It gets hot! Well, that is an example of electrical energy changing into heat energy from the vibration of the filament, which also produces light!
Now, let's think about a gas-fueled electricity plant. A power plant produces electricity by changing the *chemical energy* in fuel into *electrical energy*. First, gas is burned within the plant, converting its chemical energy into heat. Next, the heat turns water into steam, which moves a turbine motor or generator. Finally, the generator produces electricity.
This steam-based technology was first discovered in the early 1700s when engineers began to figure out ways to use the energy in steam released by boiling water. They developed engines that converted steam energy into *mechanical energy* for use in farm and factory machinery, and later for trains and cars. Historians often cite the development of the steam engine as the start of a period in modern history called the industrial revolution.
We classify energy in two ways. First is *potential energy*, which is the amount of energy something has stored inside it. Anything can have potential energy. A battery has potential energy stored by a difference in ionic concentration; even you have potential energy, as you sit in your chair. How much potential energy you have depends on a few things, including how high up you are and how big you are. Next is kinetic energy. *Kinetic energy* is the energy of an object in motion. Anything that is moving has kinetic energy. Mechanical objects, such as a clock or a person on a skateboard, have kinetic energy, but so do light, sound, wind and water. Can you see examples of energy around the classroom? Well, today we are going to find some of these examples and learn about how engineers work with different types of energy.
Write the following phrases on the board and discuss with the class.
What is energy?

- The ability to do work or cause change.
- Work is the application of a force through a distance. (Ask the students for examples, such as moving a box across the room, sweeping, etc.)

- Force can put matter into motion or stop it if it is already moving.
- Motion is a change in position of an object with time.

- To do work, energy is needed.

From where does energy come?

- Natural energy sources: food, water, plants, trees, gravity, sun, fossil fuels, uranium, plutonium
- Ways that humans have harnessed or converted natural energy sources: hydroelectric dams, coal/oil power plants, nuclear power plants, wind turbines, solar panels, etc.

What are different types of energy? (See the Vocabulary / Definitions section.)

- Kinetic energy: electrical, light, thermal, solar, sound, wind, hydro
- Potential energy: chemical, mechanical, nuclear, gravitational

How do we use energy?

- To break down and digest food (in our bodies)
- To heat houses and other buildings
- To illuminate lights
- To power televisions, radios, games, cars
- To run computers and appliances

Lesson Background & Concepts for Teachers

Energy takes many forms. *Thermal energy* (or heat) boils water, keeps us warm and drives engines. Chemical energy fuels automobiles and airplanes. Electrical energy drives many small machines and keeps lights glowing. Almost every form of energy can be converted into other forms. But whatever form it is in, energy is essentially the capacity for making something happen or, as engineers and scientists say, "doing work."

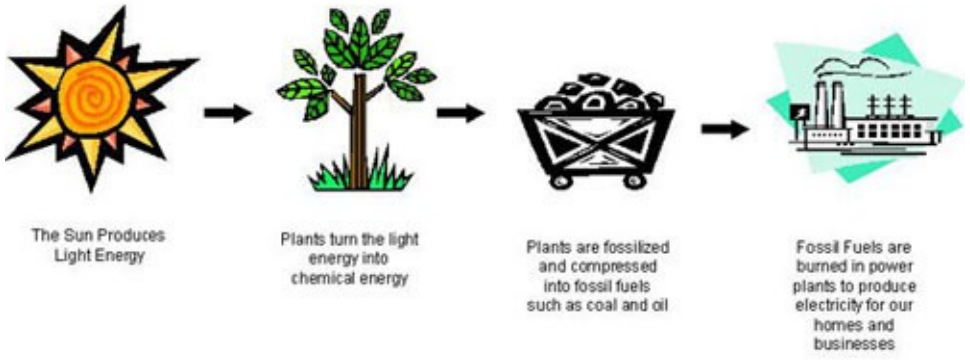

Figure 1. The energy cycle from the sun to our homes.

Nearly all our energy comes to us ultimately from the sun (see Figure 1). We get some energy directly via passive solar lighting and heating, or solar power cells. However, most energy comes indirectly via burning fossil fuels (coal, oil and gas), which received their energy from fossilized plants and other organisms. The plants and organisms originally obtained their energy directly from the sun by a process called photosynthesis. Some of these sources of energy are *renewable* and others *nonrenewable* or limited in their available quantity.

Vocabulary/Definitions (Return to Contents)

Biomass energy:	An energy resource derived from organic matter. Many people use biomass energy to heat their homes; they burn wood. Many agricultural crops are also biomass. For instance, corn can be fermented to produce ethanol that is burned as a liquid fuel. Wood is a renewable energy source as long as cut trees are replaced immediately.

Chemical energy:	The energy stored on the chemical bonds of molecules that it released during a chemical reaction. Chemical energy holds molecules together and keeps them from moving apart. For example, a car engine uses chemical energy stored in gasoline, and moving people use chemical energy from food.
Electrical energy:	Electrical energy exists when charged particles attract or repel each other. Television sets, computers and refrigerators use electrical energy.
Energy:	The ability to do work.
Kinetic energy:	The energy of motion. For example, a spinning top, a falling object and a rolling ball all have kinetic energy. The motion, if resisted by a force, does work. Wind and water both have kinetic energy.
Light energy:	Visible light energy, such as from a light bulb or fireflies or stars, is just one form of electromagnetic energy. Others forms include infrared and ultraviolet light.
Mechanical energy:	Mechanical energy is energy that can be used to do work. It is the sum of an object's kinetic and potential energy.
Nonrenewable energy:	Energy from sources that are used faster than they can be created. Sources include oil (petroleum), natural gas, coal and uranium (nuclear).
Nuclear energy:	Nuclear energy is the energy found inside the nucleus of atoms and can only be released when atoms are split. Some power companies that supply homes, schools and buildings with electricity use nuclear energy to generate electricity.
Potential energy:	Potential energy is the energy stored by an object as a result of its position. A roller coaster at the top of a hill has potential energy.
Renewable energy:	Energy that is made from sources that can be regenerated. Sources include solar, wind, geothermal, biomass, ocean and hydro (water).
Sound energy:	Audible energy that is released when you talk, play musical instruments or slam a door.
Thermal energy:	Heat energy produced when the molecules of a substance vibrate. The more heat a substance has, the more rapid the vibration of its molecules. Heat energy flows from places of higher temperature to places of lower temperature.

Associated Activities

- What is Energy? Short Demos - In three short demonstrations, students learn about some of the forms of energy commonly found around us.
- Energy Detectives at Work - Students become engineering detectives and find examples of energy all around the classroom or school.

Lesson Closure

Today we started learning about energy and engineering. Can you define and describe the word "energy?" What types of energy can you see, feel or hear? (Possible answers: Heat, light, sound, movement.) Why would an engineer care about energy? (Answer: Engineers develop products that use energy. Engineers help develop ways to store energy for our use.)
Assign students the attached Energy Vocabulary Quiz to gauge their mastery in understanding the uses of energy in their surroundings and the fundamental types of energy.
Attachments (Return to Contents)

- Energy Vocabulary Quiz (doc)
- Energy Vocabulary Quiz (pdf)
- Energy Vocabulary Quiz Answers (doc)
- Energy Vocabulary Quiz Answers (pdf)
- Extension Activity: Energy Vocabulary Worksheet (doc)
- Extension Activity: Energy Vocabulary Worksheet (pdf)
- Extension Activity: Energy Vocabulary Worksheet Answers (doc)
- Extension Activity: Energy Vocabulary Worksheet Answers (pdf)

Assessment (Return to Contents)

Pre-Lesson Assessment

Discussion: Ask the students the following questions:

- What is energy? (Possible answers: The ability to do work or cause change and the capacity for vigorous activity. Work is the application of a force through a distance [ask for examples]. Force can put matter into motion or stop it if it is already moving. Motion is a change in position of an object with time. To do work, energy is needed.)
- Where does energy come from? (Answers: Power plants, people, food, light, windmills, turbines, fires, etc.)
- What are different types of energy? (Answers: Chemical, thermal, mechanical, potential, kinetic, solar, sound, nuclear, etc. [see the Vocabulary / Definitions section].)
- How do we use energy? (Possible answers: Our bodies use energy to break down and digest food. We use energy to heat houses and buildings, to turn on lights, to power televisions, radios, cars, computers, appliances, etc. Sound energy is used in communication and to find fish in the ocean!)

Post-Introduction Assessment

Take-Home Definitions: Ask students to ask several members of their families for definitions of a specific energy form, and then look up the definition in the dictionary. Have them write down comparisons of these definitions and a reason why each might be different. Share these explanations with the class.

Lesson Summary Assessment

Energy Identifier: Bring to class examples or images of the following objects. Have students identify the type of energy that is related to each item. You could set up stations around the room or turn it into a game in which the students earn points for each type of energy correctly identified.

- Fan (Answer: Uses electrical energy; produces kinetic energy.)
- Battery (Answer: Stores chemical energy.)
- Banana (Answer: A source of chemical energy.)
- Flashlight (Answer: Uses chemical energy; produces light energy.)
- Radio (Answer: Uses electrical energy; produces sound energy.)
- Guitar (Answer: Uses chemical energy from a person [energy from the food they eat]; produces sound energy.)
- Candle (Answer: Uses chemical energy; produces light and thermal energy.)
- Waterfall (Answer: The water has potential energy at the top of the falls and kinetic energy at the bottom of the falls.)

Vocabulary Review: Assign students the attached Energy Vocabulary Quiz to gauge their understanding of the ways energy is used in their surroundings and the fundamental types of energy.

Lesson Extension Activities (Return to Contents)

Have students research the source of your local utility company's electricity. Is it coal, natural gas, hydro, nuclear, wind or some combination? Many local utility companies provide detailed websites and extensive K-12 outreach programs for schools. A representative may even come to your classroom or lead a field trip.

For students with a high reading comprehension, use the attached Energy Vocabulary Worksheet to reinforce their understanding of the material.

References (Return to Contents)

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