



Forms of Energy

Maraline Ashley and Jordan Bookman

INTRODUCTION

This is a five-part series of lessons that will serve as an introduction for students about the nature of energy and electricity. Students will realize that energy exists all around us and we are constantly witnessing the transformation from one form to another. They will become aware of our sources of energy and recognize the primary sources for electricity in the form of renewable and non-renewable resources. Students will be able explain the formation of fossil fuels and explore alternative technologies we have available to us as a primary source of energy.

These lessons can be used in sequential order as a five day unit or split up into five separate lessons.

LESSON OVERVIEW

Grade Level & Subject: 9-12, Environmental Science, Earth Science, Physical Science, and Physics.

Length: One Week (Five 45-min periods)

Objectives:

After completing this lesson, students will be able to:

- Define potential and kinetic energy.
- Identify real life examples of potential and kinetic energy.
- Describe various forms of energy.
- Define and Explain the Law of Conservation of Energy.
- Identify the sources of the United States' electricity.
- Label and illustrate the parts of a turbine generator.
- Describe the process that occurs in formation of fossil fuels.
- Identify renewable sources of energy.
- Explore alternative technologies as renewable resources of electricity and energy.

National Standards Addressed:

This lesson addresses the following National Education Standards¹

- Content Standard: [NS.9-12.2 Physical Science](#)
As a result of their activities in grades 9-12, all students should develop an understanding of:
 - Structure of atoms

¹ <http://www.education-world.com/standards/>

- Structure and properties of matter
- Chemical reactions
- Motions and forces
- Conservation of energy and increase in disorder
- Interactions of energy and matter
- Content Standard: [NS.9-12.4 Earth and Space Science](#)
As a result of their activities in grades 9-12, all students should develop an understanding of:
 - Energy in the earth system
 - Geochemical cycles
- Content Standard: [NS.9-12.5 Science and Technology](#)
As a result of their activities in grades 9-12, all students should develop an understanding of:
 - Abilities of technological design
 - Understandings about science and technology
- Content Standard: [NS.9-12.6 Personal and Social Perspectives](#)
As a result of their activities in grades 9-12, all students should develop an understanding of:
 - Personal and community health
 - Population growth
 - Natural resources
 - Environmental quality
 - Natural and human-induced hazards
 - Science and technology in local, national, and global challenges

Materials Needed:

- Reproducible #1- **Forms of Energy**
- Reproducible #2- **Your Forms of Energy**
- Reproducible #3- **Your Forms of Energy - Questions**
- Reproducible #4- **Law of Conservation of Energy**
- Reproducible #5- **Energy Efficiency**
- Reproducible #6- **Magnets and Electricity**
- Reproducible #7- **How Electricity is Generated**
- Reproducible #8- **Magnets and the Generation of Electricity**
- Reproducible #9- **US Energy Consumption By Source, 2007**
- Reproducible #10- **How Fossil Fuels Were Formed**
- Reproducible #11- **Renewable Energy Source**

Assessment: Students will be assessed through the following activities:

- Participation in class discussion.
- Written answers to presented questions on reproducibles.
- Creation and illustration of turbine generator.
- Energy source posters.

LESSON BACKGROUND

Relevant Vocabulary:²

- **Energy:** the capacity to do work.
- **Potential Energy:** the energy of a body or a system with respect to the *position* of the body or the arrangement of the particles of the system.
- **Kinetic Energy:** the energy of a body or a system with respect to the *motion* of the body or of the particles in the system.
- **Electricity:** one of the basic properties of the elementary particles of matter giving rise to all electric and magnetic forces and interactions.
- **Turbine:** any of various machines having a rotor, usually with vanes or blades, driven by the pressure, momentum, or reactive thrust of a moving fluid, as steam, water, hot gases, or air, either occurring in the form of free jets or as a fluid passing through and entirely filling a housing around the rotor.
- **Generator:** a machine that converts one form of energy into another.
- **Electromagnetic:** pertaining to or exhibiting magnetism produced by electric charge in motion; "electromagnetic energy."
- **Engine:** a machine for converting thermal energy into mechanical energy or power to produce force and motion.
- **Waterwheel:** a wheel or turbine turned by the weight or momentum of water and used to operate machinery.
- **Fossil Fuel:** any combustible organic material, as oil, coal, or natural gas, derived from the remains of former life.
- **Law of Conservation of Energy:** the fundamental principle of physics that the total energy of an isolated system is constant despite internal changes.
- **Efficiency:** the ratio of the effective or useful output to the total input in any system.
- **Primary:** constituting or belonging to the first stage in any process.
- **Secondary:** derived from what is primary or original.
- **Renewable:** relating to a natural resource, such as solar energy, water, or wood, that is never used up or that can be replaced by new growth.
- **Non-renewable:** of or relating to an energy source, such as oil or natural gas, or a natural resource, such as a metallic ore, that is not replaceable after it has been used.
- **Decomposed:** to become broken down into components; disintegrate.
- **Biomass:** organic matter, esp. plant matter, that can be converted to fuel and is therefore regarded as a potential energy source.
- **Hydroelectric power:** a form of energy generated by the conversion of free-falling water to electricity.
- **Geothermal:** of or pertaining to the internal heat of the earth.

Information:

² <http://www.dictionary.com>

Energy gives us the ability to “make change” or “do work.” You require energy to eat breakfast, walk or take the bus to school, do your homework, and play outside. How many different situations can you think of where you use energy? The electricity we use to power our TVs, computers, air conditioners and refrigerators is only one of the ways in which we use energy - energy is also used to run planes, buses, and cars. We use different energy sources every day in our homes, schools, businesses, and factories. Energy can be made in a variety of ways, but currently over 85 percent of the energy consumed around the world comes from oil, natural gas, or coal. These nonrenewable fuel sources are called fossil fuels because they are found deep inside the earth and formed from the remains of dead plants and animals from hundreds of millions of years ago. The United States consumes more energy than any other country. In fact, the United States consumes 25% of the world’s energy, but only makes up 4.6% of the world’s population.³ The rate at which we consume energy today limits the lifespan of our oil and gas reserves to an estimated 40 – 70 years.⁴ It is important for us to find other sources of energy to replace this nonrenewable supply. Additionally, using these nonrenewable sources of energy significantly pollute our planet, harm our environment and contaminate our air.

According to the Energy Information Administration, the United States ranks first in consumption of petroleum and natural gas and second in the world for coal consumption.⁵ When we use fossil fuels for energy, they release ‘greenhouse gases,’ such as carbon dioxide, methane and nitrous oxide. These gases act together like a greenhouse – trapping heat in the atmosphere – keeping the planet warm. At normal levels, these greenhouse gases have helped keep our earth at the right temperature for millions of years. However, burning fossil fuels has increased the amount of greenhouse gases in our atmosphere, thus gradually warming our planet.

Every action you perform has an effect on the planet. For example, with every gallon of gas burned by the average car, about 19.4 lbs of CO₂ is placed into the atmosphere.³ An excess of greenhouse gases in the earth’s atmosphere creates changes in temperature, weather patterns, and sea level. The more we drive our cars, throw out trash that could be recycled, cut down trees, and use incandescent light bulbs, we are unnecessarily emitting gases like carbon dioxide and methane that harm the planet and ultimately ourselves.

Excessive use of nonrenewable energy sources is bad for our planet, but there are ways to provide energy that does not use nonrenewable energy sources. By using alternative renewable energy sources, we can lower the level of greenhouse gas emissions and make our planet a healthier place!

- See *Renewable Energy* Background, Earth Day Network, 2009
 - Green Power Network-
http://apps3.eere.energy.gov/greenpower/buying/buying_power.shtml Energy

³ "Population and Energy Consumption,," World Population Balance.
<http://www.worldpopulationbalance.org/pop/energy/>.

⁴ "Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel." U.S. Environmental Protection Agency. <http://www.epa.gov/oms/climate/420f05001.htm#carbon>.

⁵ "Official Energy Statistics from the U.S. Government," Energy Information Administration (EIA).
<http://www.eia.doe.gov/>.

Quest Room -

http://www.energyquest.ca.gov/ask_quester/answers_fossil_fuels.html

- "Population and Energy Consumption." World Population Balance - <http://www.worldpopulationbalance.org/pop/energy/>
- "Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel." U.S. Environmental Protection Agency - <http://www.epa.gov/oms/climate/420f05001.htm#carbon>
- Energy Information Administration - EIA – Official Energy Statistics from the U.S. Government. - <http://www.eia.doe.gov/>

Other Resources:

- Energy Information Administration- <http://www.eia.doe.gov/kids/energyfacts/sources/electricity.html> (March 2009)
- U.S. Department of Energy- http://fossil.energy.gov/education/energylessons/coal.gen_howformed.html (March 2009)
- US Department of Energy - Energy Efficiency and Renewable Energy: www.eere.energy.gov
- US DOE and EPA's EnergySTAR – www.energystar.gov

LESSON STEPS

Warm-up: *Forms of Energy*

1. Write "What is Energy?" on the board. Have students raise their hands and give personal definitions to the word "energy." Accept all answers and write key words mentioned on the board. Examples of words you might want to highlight on the board are: change, moving or movement, electricity, work, heat, sound, and light.
2. Give the students a documented definition of energy such as "the ability to make change" or "the capacity to do work." Discuss how this definition compares to the ideas presented by the class.

Activity One: *Forms of Energy Field Trip*

1. Hand out Reproducible #1- **Forms of Energy** and/or project an overhead image. As a class, go over the definition and examples. Try to come up with examples not already provided.
2. Hand out Reproducible #2- **Your Forms of Energy**. Take a 20 minute "mini-field trip" - tour your school, library, computer lab or walk outside your building. Spend these 20 minutes making silent observations of energy. Students should list examples of energy on their handout and categorize them as Potential or Kinetic energy. Encourage them to give detailed descriptions of what they are observing and how it relates to energy.
3. Hand out Reproducible #3- **Your Forms of Energy- Questions** and ask students to use their observations from the mini-field trip to answer the given questions.

4. Homework suggestion: Write examples of potential and kinetic energy from your walk home, ride home, house or apartment.

Warm-up: Journal Topic- Law of Conservation of Energy

Write the Law of Conservation of Energy on the board (*the fundamental principle of physics that the total energy of an isolated system is constant despite internal changes; energy cannot be created or destroyed but can only change form*). This means the total amount of energy that is found in the universe always stays the same. In student journals, have them hypothesize if this were not true. What would this mean for us and the planet? What if they found a way to create energy? Students should write a paragraph explaining what they would do with this new-found knowledge.

Activity Two:

1. Hand out Reproducible #4- **Law of Conservation of Energy**. You can also create an overhead of this Reproducible. Explain how energy is never destroyed or created. It always changes from one form to another. Use this as an opportunity to reinforce the types of energy learned in Activity One.
2. Go over the examples provided in the handout and think of others. This can be done as a class, individually, or in small groups. Answer question on handout - What is the one source that all energy can be traced back to? (The Sun) Explain and discuss why this is true. Challenge students to think of examples that would prove this to be wrong. (It always does go back to the Sun!!)
3. Take another mini-field trip around the school building (outside or inside), computer lab, library or cafeteria. Have students find and explain examples of energy transformations that they observe.
4. Homework suggestion: Have students complete Reproducible #5- **Energy Efficiency**.

Warm-up: One Minute Brainstorm

Time students in a one minute drill. They should list all the ways they use electricity, and at the end of one minute, put pencils down. As a class, share answers and have students cross off the ones they have in common. Give prizes to students with the greatest number of original answers (ie: ones that haven't been crossed off). Prizes could be a CFL light bulb, low-flow faucet, batteries, recycled notepad, extra credit, etc....

Activity Three: How is Electricity Made?

1. Discuss the following questions as a class:
 - a. What is electricity? (the flow or movement of electrons).
 - b. Examples of this flow of electrons are Lightning - electrons going from one cloud to another and Static - electrons going from one object to another.
 - c. How do you get electricity to flow? (you need to apply a force to get electrons to be pushed from their orbits. This force has to get electrons to jump from atom to atom).
2. Hand out Reproducible #6- **Magnets and Electricity** and Reproducible #7- **How**

Electricity is Generated. You can go over these as a class, divide the class into small groups or have students read the handouts individually.

3. Hand out Reproducible #8- **Magnets and the Generation of Electricity-Questions**
Students should be able to answer the questions using the information provided in the passages. Answers may vary but should be similar to:
 1. Magnetic field
 2. Electrons
 3. Device converting mechanical energy into electric energy
 4. A small electric current is induced.
 5. Steam turbines, internal combustion engines, gas combustion engines, water turbines, and wind turbines.
 6. 350 units
 7. Fossil fuels
 8. 49%

4. Homework suggestion- Students should create an illustration of a turbine generator labeled with the magnets, turbine, wire coil, North Pole, South Pole and direction of electric current.

Warm-up: *U.S Energy Consumption*

1. Create an overhead of Reproducible #9- **U.S Energy Consumption by Source, 2007.**
2. Give students the definition of Fossil Fuels - An energy source that comes from remains of decayed animals, plants and organisms. Ex: Coal, Oil, and Natural Gas.
3. What percent of U.S energy comes from fossil fuels? 83.3% (Petroleum 37.5% + Natural Gas 23.3% + Coal 22.5%)

Activity Four: How Fossil Fuels Were Formed

1. Hand out Reproducible #10- **How Fossil Fuels Were Formed.** Have students read handout individually, in small groups or as a class.
2. After reading, students should choose one of the following activities to begin in class and finish at home.
 - a. Create a poster that illustrates the process of coal formation.
 - b. Create a 10 question quiz with answer key, using the information found in the handout.
 - c. Write a short story describing life without fossil fuels.
 - d. Conserving electricity is an immediate and direct way to reduce the use of fossil fuels and pollution associated with it. Create a poster that encourages conservation of electricity.
 - e. Research and write a list of pros and cons for use of fossil fuels for energy.

Warm-up: *U.S Energy Consumption- Part Two*

Refer back to the overhead image of Reproducible #9- **U.S. Energy Consumption by Source, 2007**. Give students the definition of Renewable Energy- relating to a natural resource, such as solar energy, water, or wood, that is never used up or that can be replaced or re-grown. What percent of energy consumption came from a renewable source in 2007? 6.7% (Biomass, 3.6% + Hydropower, 2.4% + Geothermal, 0.3% + Wind, 0.3% + Solar, 0.1%)

Activity Five: Renewable Research

1. Divide class into 5 groups. Each group is assigned a renewable energy resource. Examples might include: Biomass, Hydropower, Geothermal, Wind and Solar. Using the internet, books and various resources available, begin research on their renewable energy source. Use the questions on Reproducible #11- **Renewable Energy Source** as a guide and assessment tool.
2. Final assessment on their renewable energy source can include a poster promoting their source. The poster should include a slogan, facts, figures and images.

Wrap Up: As a class discuss what was learned. What did you find out that was new to you? Students can present their information gathered from the renewable energy source research. This will reinforce the information and teach the class about all of the renewable energy sources available to them. Students can also hang their posters (turbine engines, conservation of electricity and renewable energy source) around the school building for all to see.

Extension:

1. Have students research the following technologies, write a report and/or present to the class:
 - Clean Coal
 - Underwater Generators
 - Solar Cells
 - Methane Hydrate
 - Hydrogen
 - Carbon Sequestration
 - Hydropower
 - Wind
 - Nuclear
 - Geothermal
2. Conduct an energy audit to investigate the energy costs for your school building (electricity, heat, cooling, etc.) and the fuels your school uses for electricity. Also, determine the efficiency of your building. Information for do-it-yourself audits may be found at these and other websites:
 - a. US Department of Energy - Energy Efficiency and Renewable Energy: www.eere.energy.gov
 - b. US DOE and EPA's EnergySTAR – www.energystar.gov
3. After making observations and gathering data on your school's energy use, brainstorm ways to save energy and costs at school. Are there lights left on after school? Do computers stay

on all day? Are there areas with leaks or no insulation? Raise awareness about these issues and present solutions to other students, teachers and administration.

CONCLUSION

These lessons should be used as an introduction to the forms of energy we experience all around us. Students can observe sources of energy as well as the transformation from one form to another. They will become aware of our sources of energy and recognize renewable and non-renewable resources. Students will be able to explain the formation of fossil fuels and explore alternative technologies available to us as a primary source of energy. At the end of these lessons students will have working knowledge of how electricity is generated and where it originates. They also will be able to educate others on the importance of expanding our knowledge and use of renewable energy sources as well as the conservation of electricity in order to limit our use of fossil fuels.

Forms of Energy⁶

Potential (energy due to position)	Kinetic (energy of motion)
Chemical- The bonds of atoms and molecules store this type of energy. Can be found in food, gas, propane, wood and petroleum.	Electrical- The flow or movement of electrons.
Elastic- The stored energy in an object because of compression (spring) or stretching (bow and arrow, rubber band, and bungee cord)	Radiant- Electromagnetic energy traveling in waves. Ex: light, solar energy, radio, x-rays..
Gravitational- The stored energy in an object due to its height. A skier at the top of a hill has more gravitational potential energy than a skier at the bottom of the hill.	Thermal- Another name for “heat”. It is caused by the movement of atoms. More movement=More heat
Nuclear- The nucleus of an atom stores this type of energy. When the nucleus of an atom splits (fission), energy is released.	Motion- Explained by Newton’s Law of Motion, a force causes an object to move. The movement of an object from one place to another is an example of Kinetic energy.
	Sound- Energy that travels in waves.

⁶ <http://www.eia.doe.gov/kids/energyfacts/science/formsofenergy.html> (March 2009)

Your Forms of Energy

Potential (energy due to position)	Kinetic (energy of motion)

Your Forms of Energy - Questions:

1. Increasing the height or mass of an object can increase its gravitational potential energy. Do you have any examples of potential energy that you could increase? List them here and explain how you would increase the energy.

2. The more mass and speed of an object, the more kinetic energy. Pick four of your examples of kinetic energy and rank them in order of *most* to *least* amount of kinetic energy. Explain your reasons.

Law of Conservation of Energy:
**energy cannot be created or destroyed, it can only
change form.**

Examples:

Chemical Energy → Kinetic Energy
(food) (running to class)

Radiant Energy → Chemical Energy → Kinetic Energy
(Sun) (plants as food) (running to class)

Chemical Energy → Thermal Energy → Radiant Energy
(wood) (heat from fire) (light from fire)

Chemical Energy → Electrical Energy → Thermal Energy
(fossil fuels) (electricity) (heat from stove)

Come up with your own example:

→ →

What is the one source that all energy can be traced back to?

Energy Efficiency

Energy efficiency describes how much energy is being changed into useful work. For example, a light bulb changes electrical energy into light. The problem is, the electric energy is also converted into heat. Since you aren't using a light bulb to heat your house, the efficiency of a standard light bulb is pretty low. The new CFLs (compact fluorescent light bulbs) convert that electricity to light without as much energy being lost to heat, making them more efficient.

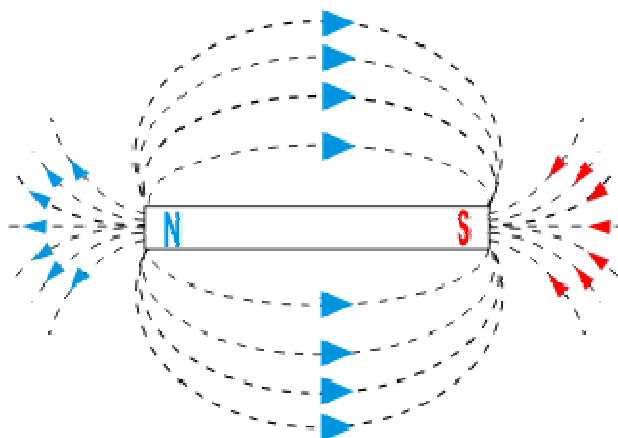
Pick three of the following examples and explain how you could increase its efficiency (limit the amount of energy lost).

Air Conditioner
Refrigerator
Lifting something heavy
Driving your car
Hot water heater
Heating your home
Riding your bike
Cooking on your stove
Raking leaves

Magnets and Electricity⁷

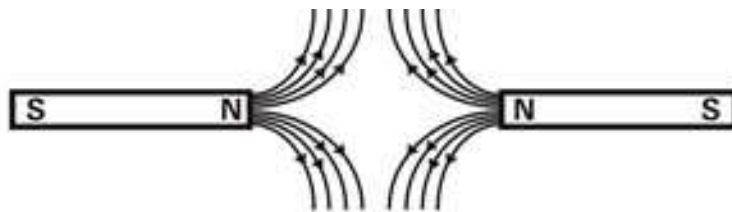
The spinning of the electrons around the nucleus of an atom creates a tiny magnetic field. Most objects are not magnetic because the atoms are arranged so that the electrons spin in different, random directions, and cancel out each other.

Magnets are different; the molecules in magnets are arranged so that the electrons spin in the same direction. This arrangement of atoms creates two poles in a magnet, a North-seeking pole and a South-seeking pole.



Bar Magnet

A magnet is labeled with North (N) and South (S) poles. The magnetic force in a magnet flows from the North Pole to the South Pole. This creates a **magnetic field** around a magnet.



Like poles of magnets (N-N or S-S) repel each other.

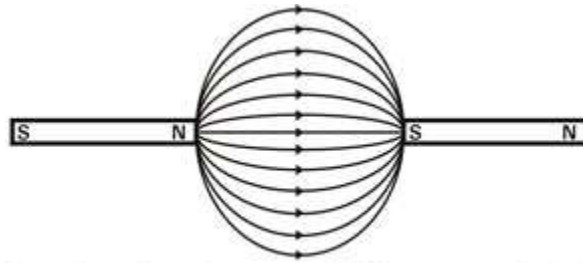
Have you ever held two magnets close to each other? They don't act like most objects. If you try to push the South poles together, they repel each other. Two North poles also repel each other.

⁷ [What is Electricity?](http://eia/doe.gov/kids/energyfacts/sources/electricity.html) –<http://eia/doe.gov/kids/energyfacts/sources/electricity.html>

Magnets and Electricity⁸

(Page 2)

Turn one magnet around and the North (N) and the South (S) poles are attracted to each other. The magnets come together with a strong force. Just like protons and electrons, opposites attract.



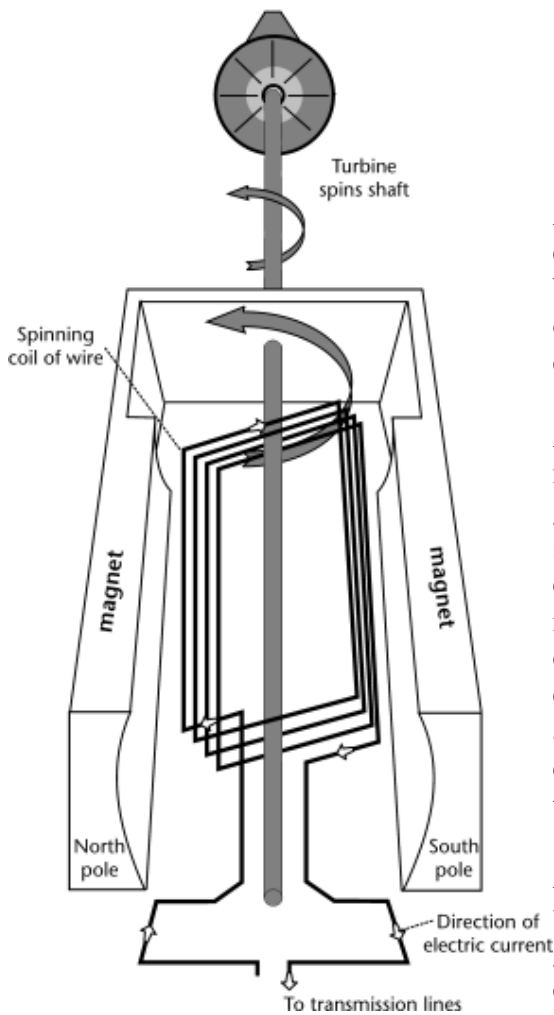
Opposite poles of magnets (N-S) attract each other.

These special properties of magnets can be used to make electricity. Moving magnetic fields can pull and push electrons. Some metals, like copper have electrons that are loosely held. They can be pushed from their shells by moving magnets. Magnets and wire are used together in electric generators.

⁸ [What is Electricity?](http://www.eia.doe.gov/kids/energyfacts/sources/electricity.html) – <http://www.eia.doe.gov/kids/energyfacts/sources/electricity.html> (March 2009)

TURBINE GENERATOR

How Electricity is Generated⁹



A generator is a device that converts mechanical energy into electrical energy. The process is based on the relationship between magnetism and electricity. In 1831, Faraday discovered that when a magnet is moved inside a coil of wire, electrical current flows in the wire.

A typical generator at a power plant uses an electromagnet—a magnet produced by electricity—not a traditional magnet. The generator has a series of insulated coils of wire that form a stationary cylinder. This cylinder surrounds a rotary electromagnetic shaft. When the electromagnetic shaft rotates, it induces a small electric current in each section of the wire coil. Each section of the wire becomes a small, separate electric conductor. The small currents of individual sections are added together to form one large current. This current is the electric power that is transmitted from the power company to the consumer.

An electric utility power station uses either a turbine, engine, water wheel, or other similar machine to drive an electric generator or a device that converts mechanical or chemical energy to generate electricity. Steam turbines, internal-combustion engines, gas combustion turbines, water turbines,

and wind turbines are the most common methods to generate electricity. Most power plants are about 35 percent efficient. That means that for every 100 units of energy that go into a plant, only 35 units are converted to usable electrical energy.

Most of the electricity in the United States is produced in steam turbines. A turbine converts the kinetic energy of a moving fluid (liquid or gas) to mechanical energy. Steam turbines have a series of blades mounted on a shaft against which steam is forced, thus rotating the shaft connected to the generator. In a fossil-fueled steam turbine, the fuel is burned in a furnace to heat water in a boiler to produce steam. *Coal, petroleum (oil), and natural gas* are burned in large furnaces to heat water to make steam that in turn pushes on the blades of a turbine.

Did you know that most electricity generated in the United State comes from burning coal? In 2006, nearly half (49%) of the country's 4.1 trillion kilowatthours of electricity used coal as its source of energy.

⁹ <http://www.eia.doe.gov/kids/energyfacts/sources/electricity.html> (March 2009)

Magnets and the Generation of Electricity- Questions

1. What is created when electrons spin around the nucleus of an atom?
2. A moving magnetic field can pull or push_____.
3. What is a generator?
4. When an electromagnetic shaft rotates, what happens?
5. What are the most common methods used to generate electricity in the United States?
6. If 1,000 units of energy are generated, how many units are converted into electric energy?
7. What is used to heat the water and create steam in order to turn a turbine?
8. What percent of our country's electricity is generated from coal?

U.S. ENERGY CONSUMPTION BY SOURCE, 2007



BIOMASS 3.6%
renewable
 Heating, electricity, transportation



PETROLEUM 37.5%
nonrenewable
 Transportation, manufacturing



HYDROPOWER 2.4%
renewable
 Electricity



NATURAL GAS 23.3%
nonrenewable
 Heating, manufacturing, electricity



GEOTHERMAL 0.3%
renewable
 Heating, electricity



COAL 22.5%
nonrenewable
 Electricity, manufacturing



WIND 0.3%
renewable
 Electricity



URANIUM 8.3%
nonrenewable
 Electricity



SOLAR & OTHER 0.1%
renewable
 Light, heating, electricity



PROPANE 1.7%
nonrenewable
 Manufacturing, heating

Sources: Energy Information Administration, Annual Energy Review 2007, June 2008.
 The National Energy Education Development Project, Intermediate Energy Infobook, 2007
<http://www.eia.doe.gov/kids/energyfacts/science/formsofenergy/html> (March 2009)

Fossil Fuel - An energy source that comes from remains of decayed animals, plants and organisms. Ex: coal, oil and natural gas.

How Fossil Fuels Were Formed¹⁰ **(U.S. Department of Energy)**

Contrary to what many people believe, fossil fuels are not the remains of dead dinosaurs. In fact, most of the fossil fuels we find today were formed millions of years before the first dinosaurs.

Fossil fuels, however, were once alive!

They were formed from prehistoric plants and animals that lived hundreds of millions of years ago.

Think about what the Earth must have looked like 300 million years or so ago. The land masses we live on today were just forming. There were swamps and bogs everywhere. The climate was warmer. Ancient trees and plants grew everywhere. Strange looking animals walked on the land, and just as weird looking fish swam in the rivers and seas. Tiny one-celled organisms called protoplankton floated in the ocean.

When these ancient living things died, they decomposed and became buried under layers and layers of mud, rock, and sand. Eventually, hundreds and sometimes thousands of feet of earth covered them. In some areas, the decomposing materials were covered by ancient seas, then the seas dried up and receded.

During the millions of years that passed, the dead plants and animals slowly decomposed into organic materials and formed fossil fuels. Different types of fossil fuels were formed depending on what combination of animal and plant debris was present, how long the material was buried, and what conditions of temperature and pressure existed when they were decomposing.

For example, oil and natural gas were created from organisms that lived in the water and were buried under ocean or river sediments. Long after the great prehistoric seas and rivers vanished, heat, pressure and bacteria combined to compress and "cook" the organic material under layers of silt. In most areas, a thick liquid called oil formed first, but in deeper, hot regions underground, the cooking process continued until natural gas was formed. Over time, some of this oil and natural gas began working its way upward through the earth's crust until they ran into rock formations called "caprocks" that are dense enough to prevent them from seeping to the surface. It is from under these caprocks that most oil and natural gas is produced today.

¹⁰ U.S Dept. of Energy-
http://fossil.energy.gov/education/energylessons/coal/gen_howformed.html (March 2009)

How Fossil Fuels Were Formed¹¹ (U.S. Department of Energy)

The same types of forces also created coal, but there are a few differences. Coal formed from the dead remains of trees, ferns and other plants that lived 300 to 400 million years ago. In some areas, such as portions of what-is-now the eastern United States, coal was formed from swamps covered by sea water. The sea water contained a large amount of sulfur, and as the seas dried up, the sulfur was left behind in the coal. Today, scientists are working on ways to take the sulfur out of coal because when coal burns, the sulfur can become an air pollutant.

Some coal deposits, however, were formed from freshwater swamps which had very little sulfur in them. These coal deposits, located largely in the western part of the United States, have much less sulfur in them.

All of these fossil fuels have played important roles in providing the energy that every man, woman, and child in the United States uses. With better technology for finding and using fossil fuels, each can play an equally important role in the future.



Fossil fuels were formed from plants and animals that lived 300 million years ago in primordial swamps and oceans (first). Over time the plants and animals died and decomposed under tons of rock and ancient seas (middle). Eventually, many of the seas receded and left dry land with fossil fuels like coal buried underneath it (last). Ten feet of prehistoric plant debris was needed to make one foot of coal.

¹¹ U.S Dept. of Energy-
http://fossil.energy.gov/education/energylessons/coal/gen_howformed.html (March 2009)

Renewable Energy Source

Use the questions below to explain how electricity is created using your renewable source. Be sure to include a diagram illustrating the transformation of energy.

Ex.

Potential → Kinetic → Kinetic → Kinetic → Kinetic
(dam used to increase ptnl. energy) (movement of water) (turbine) (spin generator) (movement of electrons)

Why do you think the U.S does not rely more heavily on renewable energy sources?

Is pollution a concern with your energy source? Explain

What are the benefits to using this source of energy?

Are there problems associated with this source of energy?

Are there any U.S. companies that provide this type of energy source? Is so, list them.

Go to the Green Power Network Site:

http://apps3.eere.energy.gov/greenpower/buying/buying_power.shtml (March 2009)

Are there any organizations in your state that provide your renewable energy source? If so, what is the company name and resource mix?

Come up with a poster promoting your renewable energy source. You have to “sell” your product so include facts, images and a catchy slogan. Have fun with it!!