ENERGY

Everything that happens in the world requires energy

INTRODUCTION

As described in earlier sections, energy is the ability to do work and make things change, grow, or move. Everything that happens in the world takes energy. This section includes the following energy-related topics:

- energy sources
- sound
- light
- electricity and magnetism
- gravity, friction, and inertia

ENERGY SOURCES

Background Information

Energy is the ability to do work. It is what makes things change, grow, and move. Everything that happens in the world takes energy.

Energy exists in one of two states. **Potential energy** is stored energy. Potential energy is present in a stretched-out elastic band, a rock held above the ground, a **battery** (a source of electricity) that is not in use, and food before it is eaten. **Kinetic energy** is the energy of motion or work. It is present in a rebounding elastic band, a falling rock, a battery that is sending a current to a device, and food that is being used to provide chemical energy to move muscles. In each case, potential energy is turned into kinetic energy.

The potential energy was there in each of these objects — the elastic band, rock, battery, and food — in that the object had the energy within it necessary to do work, but until that energy was released and actually did the work, the energy remained potential energy. When it was released, the potential energy was transformed into kinetic energy.

However, the motion of kinetic energy is not always visible. Sometimes it involves the invisible movement of atoms, molecules, or electrons, such as when heat energy is added to water. The water definitely gains energy, and the motion of the molecules definitely increases, but these changes are visible only as the water's rise in temperature and its expansion.

Scientists classify energy into six types, most of which can exist as kinetic and potential energy:

- **Thermal energy**, also called heat, is the energy carried in the movement of molecules.
- **Radiant energy**, also called sound and light, is the energy carried through the movement of sound waves through air and the movement of light particles/waves through anything, even a **vacuum**, a region without matter.
- **Mechanical energy** is the energy in moving, stretched, or compressed objects, such as a train, an elastic band, and a spring, respectively, and in objects held above the ground.
- **Electrical energy** is the energy of electrons flowing in electric currents.
- **Chemical energy** is the energy in food, fuel, batteries, and other chemicals.
- **Atomic energy** is the energy in the nucleus of an atom.

Energy cannot be created or destroyed, but it can change states or forms. Such a change is called an **energy transformation**. For example, radiant kinetic energy from the sun is stored as chemical potential energy in apples on a tree. This chemical energy remains as potential energy until someone eats the apple. The person's body transforms the apple's chemical potential energy into mechanical energy when it is used by the body to produce movement and heat.

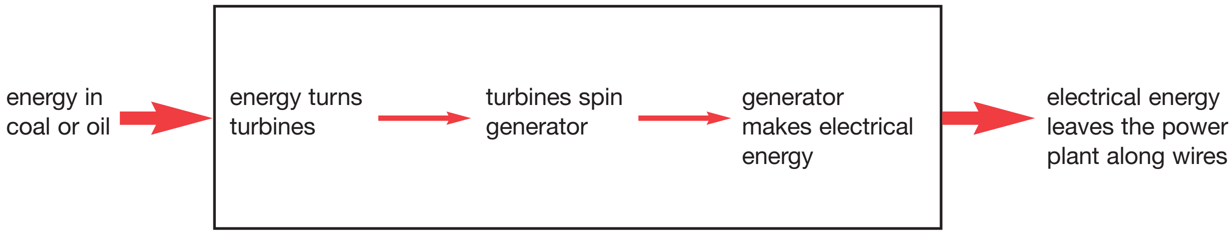
When things grow, change, or move — indeed, when they do anything, it is by means of an energy transformation. The following list gives examples of some common transformations.

Some common energy transformations

- A car uses chemical potential energy stored in fuel to create the mechanical kinetic energy of the motion of the car.
- A telephone transforms radiant kinetic energy of sound waves from a voice into electrical kinetic energy that travels along telephone lines to another telephone, where it is transformed back into sound waves.
- Most power plants turn the potential chemical energy from coal, oil, or nuclear fuel, into the radiant kinetic energy of heat to generate electricity. The exception is a hydroelectric plant that uses the mechanical kinetic energy of falling water to generate the electrical kinetic energy of electricity.
- Hands being rubbed together turn mechanical kinetic energy into the radiant kinetic energy of heat through friction.
- A campfire takes the chemical potential energy contained in wood and turns it into the radiant kinetic energy of heat and light.
- A weightlifter's body turns the chemical potential energy stored in food into the mechanical kinetic energy of moving muscles.
- Plants turn radiant kinetic energy from the sun into the potential chemical energy in fruit and seeds.
- Electrical appliances turn electrical kinetic energy into mechanical kinetic energy for uses such as vacuuming or drilling.

Apart from food, the most important sources of energy for humanity are **fossil fuels**. These are fuels made from the carbon-rich remains of prehistoric plants and animals. The most abundant fossil fuel is **coal**, a dark brown or black rock-like substance that contains at least 50 percent carbon and burns well. Coal has been used as fuel for thousands of years. Today, it is burned mainly to melt iron in steel mills and to generate electrical power.

The other main fossil fuels are **oil** and **natural gas**, two carbon-rich substances formed from processes similar to that which produced coal, so that they also burn easily. Oil, sometimes called petroleum, is a brownish liquid that is pumped from oil wells in the ground. It is used to make many types of fuel, including gasoline, diesel oil, and heating oil. It is also used to make plastic, fertilizer, and pesticides.



A fossil fuel power plant

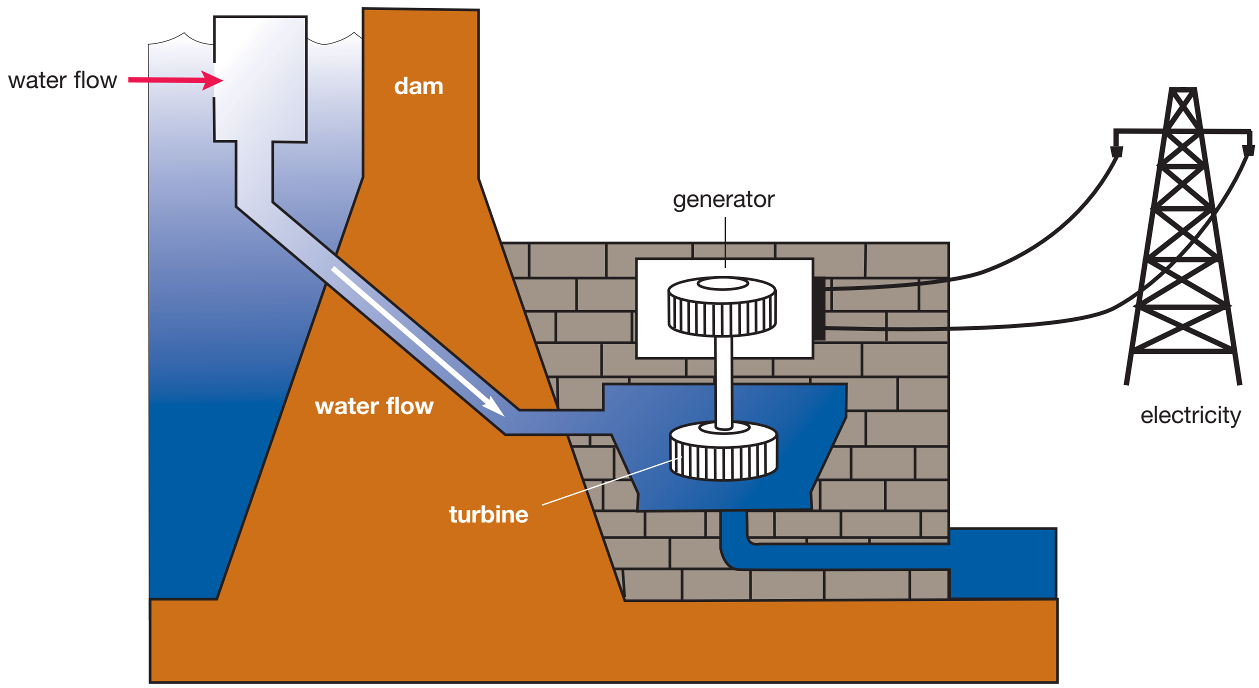
Natural gas is a gas composed mostly of methane, a simple molecule of carbon and hydrogen. Like oil, it is taken from gas wells in the ground, often the same wells that produce oil because the two are often found together. Natural gas is used in homes, businesses, and factories for heating.

One of the main uses of coal, natural gas, and crude oil is to generate electricity. This is done at a set of buildings and structures called a **fossil fuel power plant**. The process of generating electricity from fossil fuel has four main steps:

- In a huge piece of equipment called a **boiler**, coal, gas, or crude oil are burned to heat water until it turns to steam.
- The steam is under tremendous pressure, which allows it to turn a **turbine**, an enormous metal wheel that operates something like a pinwheel. Whereas wind makes a pinwheel go around, steam makes a turbine go around.
- The turbine rotates a shaft connected to a **generator**, a device that creates electrical energy. As the turbine spins, the generator also spins.
- The generator is composed of copper wires coiled up into large bundles surrounded by magnets. As the generator spins, an electric current is created in the copper coils by the magnets. The current is fed into power lines that carry it out to the world.

A fossil fuel power plant thus makes use of four main energy transformations:

- The chemical potential energy in the fuel is turned into the radiant kinetic energy of heat in the boiler.
- The energy of the heat is transformed into the mechanical kinetic energy of the moving pressurized steam.
- The energy of the moving steam is transformed into the mechanical kinetic energy of the spinning turbine and generator.
- The mechanical energy of the generator is transformed into the electrical kinetic energy of electrons moving in power lines.



A hydroelectric power plant

A second type of power plant is a **hydroelectric plant**, a set of buildings and structures in which the kinetic energy of moving water is used to generate electricity. A hydroelectric power plant makes use of four main energy transformations:

- The mechanical potential energy of water held behind a dam at a higher elevation than it would naturally settle at, is turned into the mechanical kinetic energy of falling water when it is allowed to fall through a pipe to a turbine.

- The mechanical energy of the falling water is transformed into the mechanical kinetic energy of the spinning turbine and generator.

- The energy of the generator is transformed into the electrical kinetic energy of electrons moving in power lines.

A third type of large power plant is a **nuclear power plant**. Nuclear power plants are similar to fossil fuel power plants except that they do not burn fuel in a fire to heat water. Instead, they heat water by splitting atoms.

Most nuclear power plants use **uranium**, a naturally occurring metal. In a process called **nuclear fission**, the nucleus of a uranium atom splits apart, giving off two neutrons and creating the two byproducts, cesium and rubidium.

If the uranium atoms are sufficiently concentrated, each of the two neutrons given off by the first fission reaction smashes into another uranium nucleus, causing it to split and give off two neutrons, for a total of four neutrons from the second set of reactions. Those four neutrons then smash four nuclei, giving off eight neutrons, and so on.

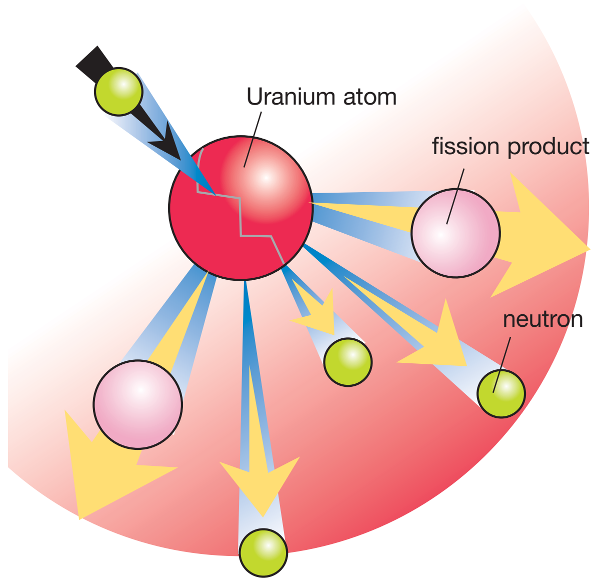
When a uranium nucleus splits into neutrons and byproducts, the total mass of the resulting parts is less than the mass of the original nucleus. That is, the sum of the masses of the neutrons and the cesium and rubidium atoms do not add up to the same mass as the original uranium atom. The missing mass is turned into energy in the form of heat. That heat can be used to heat water just the same way that fossil fuels can, but the amount of heat released for a given mass of fuel is millions of times greater than that from burning fossil fuels.

As may already be obvious, the problem with using nuclear fission as a source of heat is that the reaction tends to run out of control. The number of atoms that are split doubles each time, and so does the amount of energy released. This tendency to grow is the reason why nuclear power generation has to be controlled very carefully and the equipment is contained within large concrete buildings. A nuclear bomb uses a similar reaction, but the tendency to grow is encouraged rather than slowed, so the release of energy is explosive rather than controlled.

Nuclear power generation has advantages and disadvantages. The main advantages are:

- Nuclear power plants do not burn large amounts of coal, crude oil, or natural gas, so they do not produce large amounts of gases that pollute the air.

- Nuclear power generation does not rely on fossil fuels that will eventually run out.



Fission of a uranium atom

The main disadvantages of nuclear power generation are:

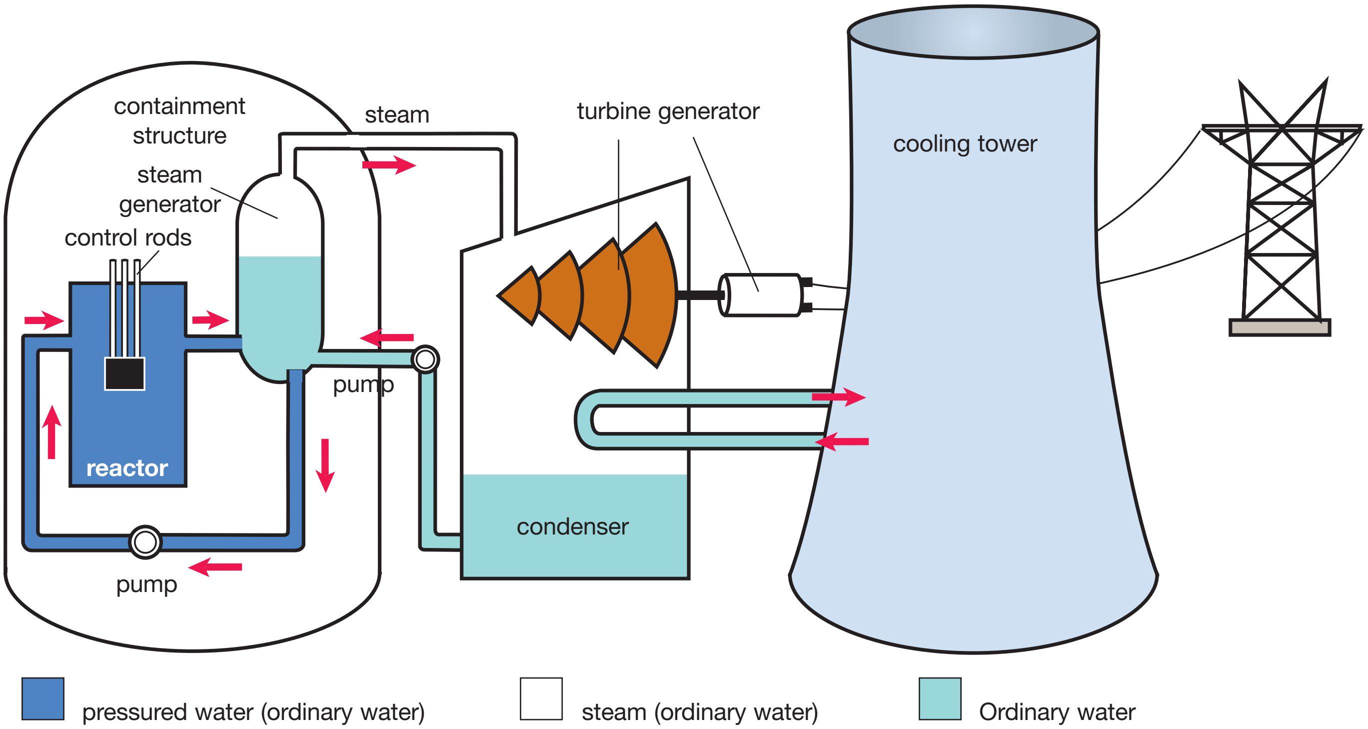
- Nuclear power plants are expensive to build and to shut down.

- Nuclear power plants need very high safety standards to avoid accidents.

- Fission produces **radioactive waste**, leftover uranium that gives off radiant energy that can make people sick if not handled properly.

Many people fear nuclear power plants because of these disadvantages. Other people prefer nuclear power because it creates less air pollution than burning fossil fuels.

Fossil fuels are an important **natural resource**, something that occurs in nature and that people use in large amounts. For example, forests are a natural resource because people use them to make paper and lumber. Fossil fuels are a natural resource because people use them to make things like fertilizer and plastic, and to do



A nuclear power plant

things like heat houses and generate electricity.

Conserving natural resources means not wasting them. Conserving fossil fuels will make them last longer and create less pollution. The concept of "the three Rs: Reduce, Re-use, and Recycle," provides a handy memory device for simple conservation methods.

Did you know?

Burning coal produces approximately 0.7 kilowatt-hours of energy per pound (1.6 kilowatt-hours of energy per kilogram). Nuclear fission of uranium produces approximately 8.5 million kilowatt-hours of energy per pound (18.7 million kilowatt-hours of energy per kilogram).

Resources

There are many excellent books and websites about energy sources. Here are some examples:

- Graham, Ian. *Fossil Fuels.* Austin, TX: Steck-Vaughn, 1999.
- Taylor, Charles and Stephen Pople. *The Oxford Children's Book of Science.* New York, NY: Oxford University Press, 1995.
- Energy Story. <http://www.energyquest.ca.gov/story/>

There are many ways to conserve fossil fuels. Here are a few:

HOME AND DAILY LIFE

- Use public transportation instead of driving a car.
- Insulate houses properly so less energy is used to heat and cool them.
- Keep the house cool in winter and wear a sweater indoors.
- Wash clothes in cold water.
- Run the dishwasher and washing machine only when they are full.
- Use light bulbs specially designed to use less energy.
- Keep the refrigerator and freezer closed as much as possible.
- Turn off lights where they are not needed.

BUSINESS AND INDUSTRY

- Rotting waste in landfill sites produces methane gas that can be trapped and used for fuel.
- Fossil fuel power plants create heat as well as electricity, heat that can be used to heat nearby buildings.
- Recycle materials that take a large amount of energy to produce, such as copper, aluminum, cans, and cars.

ACTIVITY 1

Transforming Energy

Purpose

To learn how energy can be transformed from one state or form to another.

Material

Chart, Some common energy transformations.

Photo such as the illustration, Everything that happens in the world requires energy.

Two beanbags, or similar heavy but soft objects.

A small board with a roller or block, set up like a teeter-totter (seesaw).

Electric toaster, Year 6.

Slice of bread, Year 6.

Plate, Year 6.

Dinner knife, Year 6.

Electrical outlet, Year 6.

Whiteboard and marker, Year 6.

Matter and Energy journals and pencils.

Presentation

- Most Montessori teachers present this concept in Year 4 and explore it in more detail in Year 6.

- Announce to the students that they will have an opportunity to investigate how to transform energy.

YEAR 4: EXPLORING ENERGY TRANSFORMATIONS

- Present the illustration and chart and invite the students to examine them. Discuss how energy is used in each instance to do work. Clarify that work is anything that makes things different, whether moving an arm, turning the wheels of a car, lighting a room, or making a sound.

- Invite the students to look around the classroom and name different ways that energy changes things through work. (Examples: students are moving their bodies, which requires food, water, and air energy and produces muscle energy; the lights are glowing, which requires electrical energy and produces light and heat energy; music is playing, which requires electrical energy and produces sound energy; a plant is growing, which requires food, water, and air energy and produces plant growth and movement; the heating system is keeping the room warm, which requires electrical, oil, gas,

or coal energy and produces heat energy.)

- Explain that energy comes in two main forms, potential and kinetic. Explain that potential energy is the energy available to do work if the situation changes.

- Place the teeter-totter on the floor. Place a beanbag on one end of the teeter-totter.

- Invite a student to hold the beanbag above the empty end of the teeter-totter. Explain that the beanbag held in the air has potential energy, also called stored energy, because if the beanbag falls, then the beanbag's movement allows it to do work, such as bouncing the other beanbag on the teeter-totter into the air. But because the beanbag is held in the air, it cannot do any work yet, and only has the potential to do work.

- Explain that the second form of energy is kinetic energy, the energy used in actually doing work, such as the beanbag falling, moving the teeter-totter, and lifting the other beanbag into the air.

- Invite the student to drop the beanbag onto the empty end of the teeter-totter. The beanbag will lift the other beanbag into the air.

- Explain that the potential energy of the beanbag held in the air changes into the kinetic energy of movement, first of the beanbag falling, then of the teeter-totter moving, then of the other beanbag moving.

- Ask the students to use their journals to draw a picture showing the beanbag above the ground, falling toward the teeter-totter, and lifting the other beanbag into the air, with labels that say "potential energy" and "kinetic energy" as appropriate.

YEAR 6: USING ENERGY TRANSFORMATIONS

- Review the concepts of energy and energy transformations.

- Using the whiteboard, present the six main types of energy: thermal, radiant, mechanical, electrical, chemical, and atomic.

- Present the illustration and chart of different energy uses, and work with the students to classify the energy uses shown. (Not all of the six types have to be discussed; those not discussed can be dealt with in the extensions.)

- Explain to the students that today they will find out about the types of energy involved in making and eating a slice of toast.

- Invite a student to put a slice of bread in the toaster. Encourage the student to say what kind of energy she/he just used to pick up the bread. (Mechanical energy.) Invite the student to say where that mechanical energy came from. (Chemical energy.)

- Invite another student to turn the toaster on. Invite the student to say what kind of energy he/she used to turn on the toaster (mechanical), and what kind of energy the toaster is using. (Electrical.)

- With the students, discuss how the toaster cooks the bread. (It transforms electrical energy into heat energy. The intense heat toasts the bread by producing a chemical change in the toast.)

- With the students, watch the toast pop up, then describe what has happened in terms of energy. (The mechanical energy used to push the toast down into the toaster was stored as potential energy in the spring, which turned into mechanical energy to push the toast up.)

- Invite a student to put the toast on a plate and cut it into enough pieces for everyone to have a taste. Invite the student to describe what is happening in terms of energy. (This takes mechanical energy from the student.)

- Encourage each of the students to eat a small piece of the toast. Invite the student to describe what is happening in terms of energy. (Chewing takes mechanical energy produced from the chemical energy of food. The toast contains stored chemical energy.)

- Discuss with the students the different things their bodies may do with the toast's stored chemical energy. Invite the students to describe what is happening in terms of energy (e.g., transforms the toast's stored chemical energy into mechanical energy for walking; transforms the toast's stored chemical energy into heat energy to keep their bodies warm; transforms the toast's stored chemical energy into stored energy (fat) if a student has eaten more than she/he needs at that moment).

- Ask the students to use their journals to draw and label a picture about cooking and eating a slice of toast, and to write a paragraph describing the types of energy involved.

Extensions

- Bake a batch of cookies, the write a summary of the energy transformations involved. Examples of questions that could be answered: What is the heat energy in the oven used for? Does it end up in the cookies as extra chemical energy? (No, but the energy is used in changing the chemical structure of the cookie ingredients from a mix of materials into finished cookies.)

- Create and perform a play, poem, or song about energy. Different types of energy could be different characters.
- At home, make a list of ten ways that energy is used in the house and in a family's ordinary life.

ACTIVITY 2

Investigating How Fossil Fuels Form

Purpose

To learn about the main types of fossil fuels, how they formed, and how they are used.

Material

Clear glass or plastic jar, or other container.

Plant matter such as leaves, twigs, and grass.

Two colors of soil or sand.

Lump of coal.

Vial or bottle of crude oil (dark motor oil can be substituted if a sample of crude oil is unavailable). Caution: Make sure that the lid of the vial or bottle is tight. Do not let the students open the vial or bottle, as oil contains toxic chemicals.

Photos or illustrations showing the main uses of coal (e.g., coal-fired power plants, steel mills).

Photos or illustrations showing the main uses of oil (e.g., gasoline, diesel, heating oil, plastic, fertilizer, pesticides).

Photos or illustrations showing the main uses of natural gas (e.g., heating, cooking).

Matter and Energy journals and pencils.

Presentation

- Most Montessori teachers present this concept in Year 6.
- Announce to the students that they will have an opportunity to investigate how fossil fuels form in the earth.
- Briefly discuss fossil fuels and how they form.
- Invite each student to place a layer of soil or sand in the bottom of a container.
- Ask the students to add a second layer of soil or sand in a different color.
- Explain that just as soil is layered in the containers, so soil is layered in nature.
- Invite the students to place a layer of plant matter on top of the soil. With the students, discuss how in nature, when leaves fall or plants die, they fall to the ground. If the leaves and plants do not rot quickly, a thick pile of plant material builds up.

- Encourage the students to place two or three layers of soil or sand on top of the plant matter. Explain that millions of years ago, many plants grew and died in lush forests, which were then buried under thick layers of soil and sand.
- Invite the students to press the layers down, so that the layers are squeezed together. Explain that over millions of years, layers of soil and sand turned to rock. Chemical changes and the pressure of the rock turned the dead plants into hard coal.
- Pass around the sample of coal for the students to examine.
- Pass around the samples of oil for the students, and invite the students to observe the sample closely. Explain that depending on what was trapped in the earth, rotting material sometimes forms oil like what is in the vial.
- Explain that natural gas is the same type of gas that students have seen heating barbecues or camp stoves, often coming out of metal bottles. State that oil and gas formed in a similar way to coal, but from billions of microscopic sea plants and animals instead of from land plants. As the plants and animals died, they fell to the bottom of the sea and formed layers there.
- Present the photos or illustrations of fossil fuel uses, addressing each type of fossil fuel individually. With the students, discuss the uses of each type of fossil fuel.

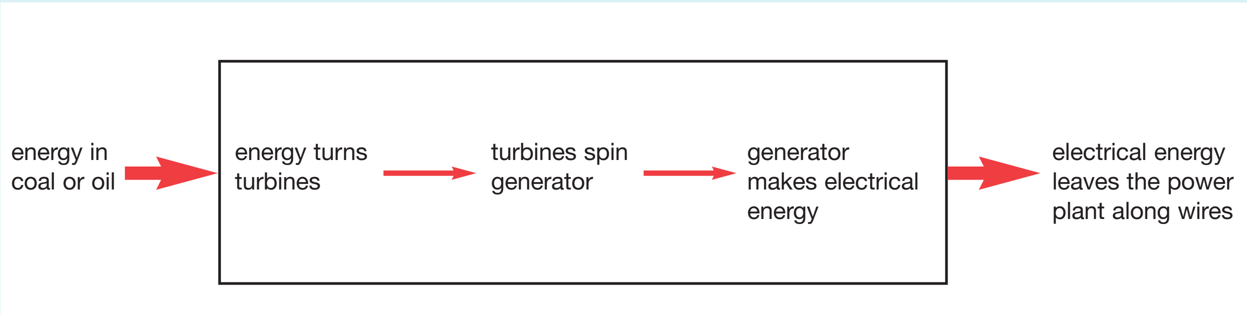
- Ask the students to use their journals to summarize how coal, oil, and gas are formed and describe two ways each is used.

Extensions

- Arrange a tour of a local coal mine, oil well, or gas well.
- Research and write a report explaining how coal, oil, or gas is formed, how scientists find it, and how it is taken from the ground.
- Research, then draw a picture of a coal mine, a piece of coal mining machinery, or an oil rig.
- Research and write a report about the history of coal, oil, or gas use by humans.
- Find and read the lyrics to several coal mining songs. Share a favorite song with classmates, then discuss what the song is about.

ACTIVITY 3

Exploring How Electricity is Generated at Power Plants



A fossil fuel power plant

Purpose

To understand how electricity is generated at fossil fuel, hydroelectric, and nuclear power plants.

Material

Electric kettle or kettle filled with water.

Electric stove or electrical outlet for the kettle.

Paper and felt markers for making labels.

Flip chart and felt marker.

Pinwheel that will turn when blown (the pinwheel can be made in advance by the students).

Large tin can with a row of nail holes punched in the side at vertical intervals of about 1 inch (2.5 cm). Place the row of holes at a slight angle, so that the flow from any one hole does not fall directly on the flow from the hole below.

Sink with a water tap.

Illustration, A fossil fuel power plant.

Illustration, A hydroelectric power plant.

Illustration, A nuclear power plant.

Illustration, Fission of a uranium atom.

Matter and Energy journals and pencils.

SAFETY NOTE: This activity involves the use of steam. Supervise closely so that students do not get too close to the steam or the kettle while it is boiling.

Presentation

- Most Montessori teachers present this concept in Year 6. This activity is best be carried out over several days, each devoted to one of the types of power plants.
- Announce to the students that they will have an opportunity to explore how electricity is made.
- Invite one of the students to put water in the kettle and plug it in or put it on the stove. While the water comes to a boil, invite the students to say where electricity comes from. Remember to unplug the kettle after it boils.

- If the students say the overhead power lines, look out of the window at any visible power lines, and then invite the students to say where the electricity in the power lines comes from.

- Explain that electricity is a type of energy and that it must be created from other types of energy. Introduce the concept of electrical generation in terms of a generator turning and producing electricity. At the bottom of the whiteboard, draw a box and label it "generator." Also draw some homes beside the generator and show power lines coming out of the generator and going to those homes.

- Explain that it takes energy to make the generator turn, and that there are three main sources of that energy: fossil fuels, water pressure, and nuclear fuel. Put these three names as labels across the top of the whiteboard.

- Present the paper and felt markers. Ask the students to make three large labels, one for each type of energy.

POWER FROM A FOSSIL FUEL POWER PLANT

- Place the fossil fuel label at the top of the flip chart.

- Beneath the fossil fuel label, draw and label a simple picture of a boiler, with a fire beneath a large kettle of water (or attach a ready-made drawing). Explain that coal, oil, or natural gas is burned to heat water in a tank.

- Ask a student to fill and plug in the kettle of water. When the water in the kettle is boiling, invite the students to say what happens when water boils in a kettle. Discuss and clarify that the steam rushes out because the steam exerts pressure. Remember to unplug the kettle after it boils.

- Explain that the steam pressure can be used to move things.

- Present the pinwheel, then invite one of the students to blow on the pinwheel, so that it turns.

- Point out that the turning of the pinwheel is like a special type of fan in a generator.

- On the flip chart, draw a circle just above the generator, with pipes coming from the tank and going to the circle (or attach a ready-made drawing). Explain that the steam from the boiler travels through pipes and is then forced to pass through a type of fan called a turbine, and that it makes the turbine turn in the same way that someone's breath blowing on the pinwheel makes it turn. Draw a fan in the circle and label it "turbine" (or attach a ready-made drawing).

- Explain that the turbine is attached to the generator and that when the turbine turns, so does the generator. Draw a shaft connecting the two (or attach a ready-made drawing).

- With the students, review the illustration of the fossil fuel power plant and clarify how it works.

- Ask the students to use their journals to make and label a drawing of the generator discussed.

POWER FROM A HYDROELECTRIC POWER PLANT

- Place the water pressure label at the top of the flip chart.

- Beneath the water pressure label, draw and label a simple picture of a dam, with a big lake of water behind it (or attach a ready-made drawing). Explain that dams are built to force water to accumulate high above where it wants to go, which is down to the sea. If needed, review what is meant by hydroelectric.

- Invite the students to say what happens when water builds up behind a dam. Discuss and clarify that the water wants to rush out, which means that it exerts water pressure on the dam.

- Invite a student to fill the can with water at the sink, turning the holes so that the water runs into the sink. The tap can be set to fill up the can at just the rate at which it empties, just like the rate of outflow from a dam is set to match the rate of inflow, so that the dam neither overflows nor runs out of water.

- Invite the students to say where the most water pressure exists in the can. Discuss and clarify that it is where the water is deepest, and so there are pipes from the bottom of the dam to the turbines.

- On the flip chart, draw pipes coming from the dam and going to the turbine above the generator (or attach a ready-made drawing). Explain that the water from the dam travels through pipes and is then forced to pass through a turbine, just as the steam from the fossil fuel plant did, and that it makes the turbine turn in the same way.

- With the students, review the illustration of the hydroelectric plant and clarify how it works.

- Ask the students to use their journals to make and label a drawing of the plant discussed.

POWER FROM A NUCLEAR POWER PLANT

- Place the nuclear fuel label at the top of the flip chart.
- Beneath the nuclear fuel label, draw and label a simple picture of a tank of water with a container inside of it that contains the nuclear fuel (or attach a ready-made drawing).
- Explain that in the container inside the water tank is uranium, a metal found in the earth. Explain that under certain conditions, uranium will change into other elements, and when it does, it gives off heat. Present the illustration of the fission reaction and discuss what happens.
- Explain that the heat given off by the uranium heats the water, just like fossil fuels are burned to heat water.
- Discuss and clarify that the rest of the process is very similar to a fossil fuel power plant, in that the water is turned to steam, which turns a turbine connected to a generator.
- On the flip chart, draw pipes going from the nuclear boiler to the turbine (or attach a ready-made drawing).
- With the students, review the illustration of the nuclear plant and clarify how it works.
- Ask the students to use their journals to make and label a drawing of the plant discussed.

Extensions

- Make a labeled poster illustrating the main elements of fossil fuel, hydroelectric, and nuclear power plants. In each case, include the source of heat or water pressure, the turbine, the generator, and electrical lines extending from the generator to homes.
- Research and write a report about where and how local electricity is generated.
- Arrange to visit to a local or regional power plant.
- Research and write a report about the Three Gorges Dam hydroelectric project in China. Address these questions: In what ways will the project be good for the Chinese people living near the dam? In what ways might it be bad for them?
- Write a report comparing and contrasting fossil fuel, hydroelectric, and nuclear power plants. Include an illustration of each type of plant.
- Research and write a report about the Chernobyl disaster in Russia.
- Research and write a report about who invented the electrical generator.
- Read a novel or other book about life before electricity was available in homes. Make a list of what people used instead of electricity for heat, light, and cooking.
- In many parts of the world, people do not have electricity in their homes or schools. Find out about life in a place without electricity. Write a story about a student's typical day in that place.

ACTIVITY 4

Conserving Energy and Natural Resources

Purpose

To learn about ways of conserving energy and other natural resources.

Material

Whiteboard and marker.

Soda can.

Plastic soda bottle.

Stack of paper.

Ordinary light bulb.

Energy-efficient light bulb.

Sweater.

Bus ticket.

Pair of shoes.

Cycling helmet.

Matter and Energy journals and pencils.

Presentation

- Most Montessori teachers present this concept in Year 4 and explore it in more detail in Years 5 and 6.

- Announce to the students that they will have an opportunity to investigate ways of conserving energy and other natural resources.

YEAR 4: WHY TO CONSERVE NATURAL RESOURCES

- Review the definition of a natural resource as something that occurs in nature and that people use in large amounts to make things or do things.

- Pass around the soda can, plastic soda bottle, and stack of paper. Ask the students what natural resources were used to make each. (Soda can = aluminum; plastic bottle = oil; paper = trees.)

- Point out that factories use large amounts of energy to turn natural resources into finished products, and that the energy used likely comes from coal, oil, or gas.

- Invite the students to suggest how humans could use less aluminum, oil, paper, and energy. Write the suggestions on the whiteboard.

- Review the definition of resource conservation as not wasting natural resources. Present the concept of the three Rs: Reduce, Re-use, and Recycle (or review if the students have already studied these concepts). Discuss and clarify how each of these methods of dealing with natural resources helps to conserve them.

- Ask the students to use their journals to write the definition of a natural resource, the definition of resource conservation, and at least five ways to conserve natural resources.

YEAR 5: HOW INDIVIDUALS CAN CONSERVE FOSSIL FUELS

- Review the definitions of natural resource and resource conservation with the students.

- Explain that a large percentage of fossil fuels is used for heating and cooling buildings, running electrical appliances, and providing fuel for transportation.

- Ask the students to provide examples of heating and cooling equipment, electrical appliances, and transportation that depend on fossil fuels. (Examples: home furnace, air conditioner, refrigerator, freezer, stove, car, bus, airplane.)

- Ask who is responsible for making choices about how energy is used in people's daily lives. (Individuals and communities are.)

- Present the light bulbs, bus ticket, sweater, shoes, and cycling helmet. Encourage the students to examine the items.

- Invite the students to suggest ways that a person could use less energy from fossil fuels, referring to the display items if needed to generate ideas. (Examples: use energy-efficient lighting, take the bus instead of driving a car, wear a sweater indoors in the winter, keep the house warmer in summer, and walk or cycle instead of driving.)

- Ask the students to use their journals to record the group's ideas about conserving fossil fuels.

YEAR 6: HOW SOCIETY CAN CONSERVE FOSSIL FUELS

- Review the definitions of natural resources and energy conservation.

- Review the idea that individuals are responsible for the quantity of natural resources they use in their daily lives.

- Explain that natural resources are also used in factories, power plants, bus companies, airlines, businesses, and schools. Add that communities are also responsible for making sure these organizations use resources wisely.

- Ask the students to suggest ways that their school could conserve natural resources. (Examples: use less paper, encourage recycling, put timers on lights, set the hot water tank at a lower temperature, draw blinds and curtains after hours to keep the building warm or cool, do not overheat the building, keep the furnace and/or air conditioner working properly, buy an energy-efficient refrigerator for the staff room.)

- Explain that, just like the school, other government organizations, businesses, and industries can find ways to conserve natural resources. Invite the students to describe some conservation methods they have seen or read about.

- Ask the students to use their journals to write down ways the school could conserve natural resources.

Extensions

- Research and write a report about a local or regional recycling plant. Find out what materials the plant does and does not recycle. Describe what happens to materials the plant does recycle, and why the plant does not recycle other materials.

- Using a notepad, for two days keep a log of the natural resources you use. (Example: I read a paper book in bed using electric light; I drank from a plastic bottle; Mom drove me to school.) After two days, review the list and describe five ways that you might use fewer natural resources in your daily life.

- Write a humorous story or poem about a pig called the Energy Hog and all the ways the pig could waste energy.

- Write a local or regional electric company and ask what it is doing about conserving fossil fuels.

- Research and create a poster about one of the alternatives to fossil fuels, such as wind energy, solar energy, or energy from waves and tides.