2017-2018

Primary Energy Infobook

A comprehensive classroom resource containing fact sheets with basic information that introduces students to energy and describes energy sources, electricity, consumption, and conservation. This guide also includes teacher background information and graphics for students, and can be used as a resource for many activities.

Grade Level:

Pri Primary

Subject Areas:

Science

Social Studies

Language Arts

Technology

NEED
National Energy Education Development Project

Teacher Advisory Board

NEED Mission Statement

The mission of The NEED Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs.

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Teacher Advisory Board

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

Energy Data Used in NEED Materials

NEED believes in providing teachers and students with the most recently reported, available, and accurate energy data. Most statistics and data contained within this guide are derived from the U.S. Energy Information Administration. Data is compiled and updated annually where available. Where annual updates are not available, the most current, complete data year available at the time of updates is accessed and printed in NEED materials. To further research energy data, visit the EIA website at www.eia.gov.

NEED
National Energy
Education Development

1.800.875.5029
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Primary Energy Infobook

For more in-depth information, inquiry investigations, and engaging activities, download these primary curriculum resources from www.NEED.org.

INTRODUCTORY ACTIVITIES	Energy Games and Icebreakers Energy Polls
STEP ONE: Science of Energy	Primary Science of Energy
STEP TWO: Sources of Energy	All About Coal Energy Games and Icebreakers Energy Stories and More Oil, Natural Gas, and Their Energy Primary Energy Infobook Primary Energy Infobook Activities The Sun and its Energy Water and Energy Wind is Energy
STEP THREE: Electricity and Magnetism	Energy Games and Icebreakers Energy Stories and More Primary Energy Infobook Activities Wonders of Magnets
STEP FOUR: Transportation	Energy Stories and More Hybrid Buses
STEP FIVE: Efficiency and Conservation	All About Trash Building Buddies Energy Games and Icebreakers Today in Energy Using and Saving Energy
STEP SIX: Synthesis and Reinforcement	Energy Fair Energy Games and Icebreakers NEED Songbook Primary Energy Carnival This Mine of Mine
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STEP EIGHT: Student Leadership and Outreach	Youth Awards Program Guide

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Standards Correlation Information

www.NEED.org/curriculumcorrelations

Next Generation Science Standards

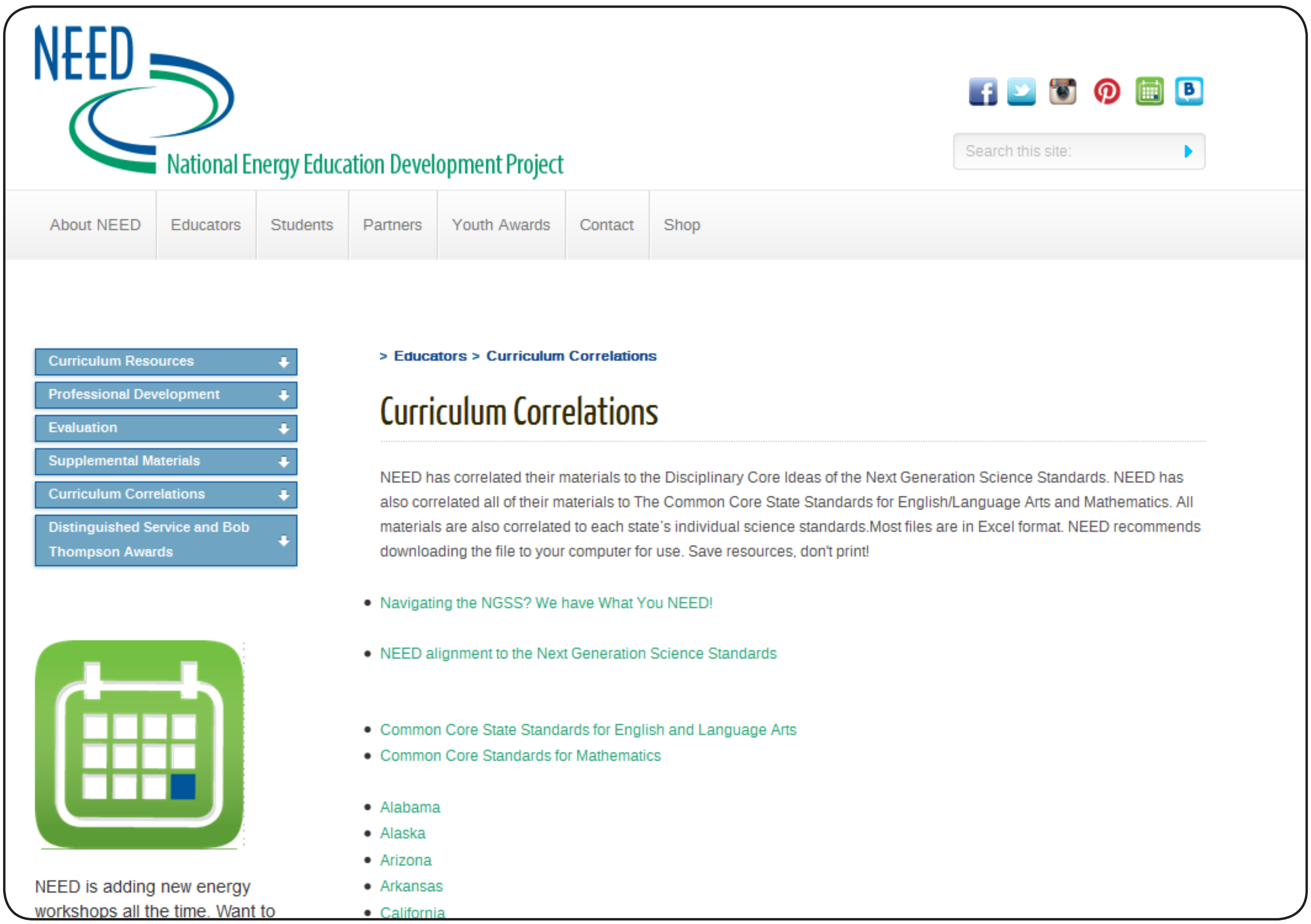
- This guide effectively supports many Next Generation Science Standards. This material can satisfy performance expectations, science and engineering practices, disciplinary core ideas, and cross cutting concepts within your required curriculum. For more details on these correlations, please visit NEED's curriculum correlations website.

Common Core State Standards

- This guide has been correlated to the Common Core State Standards in both language arts and mathematics. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED curriculum correlations website.

Individual State Science Standards

- This guide has been correlated to each state's individual science standards. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED website.



Teacher Guide

Background

The *Primary Energy Infobook* is designed to be read aloud in K-2 classrooms. Each section contains background information for the teacher and easy to understand informational text for students.

Preparation

- Highlight the information in the teacher background sections that you want to present to the students. All of the major energy sources are included in this guide, as well as information on electricity, conservation, and efficiency. For very young students, or depending on your goals, you may wish to introduce some of the energy sources and not others.
- Plan your unit and procure any materials you need to introduce or reinforce the information.

✔ Procedure

1. Introduce energy to the students with a brief discussion of what they know about energy or what they associate with the word.
2. Read the guide with the students, using the information you have highlighted.
3. Create a word wall or vocabulary list of important terms as you read together. Vocabulary terms have been suggested in bold within the teacher background information.
4. Conduct the activities you have planned to reinforce the information.

Extensions

- Additional activities focusing on energy basics can be found in the *Primary Science of Energy* curriculum. Specific units on coal, hydropower, wind, solar, and energy management are also available. Download these curriculum options from www.NEED.org.
- Supplemental activities to reinforce vocabulary and energy concepts can be found in the *Primary Energy Infobook Activities* guide. These activities and coloring pages can be downloaded at www.NEED.org/games.

Grade Level

- Primary, grades K-2

E-Publication

This guide is also available as an e-publication with color images for easy use with interactive boards or tablets. E-publications can be downloaded at www.NEED.org.

Photo Acknowledgements:

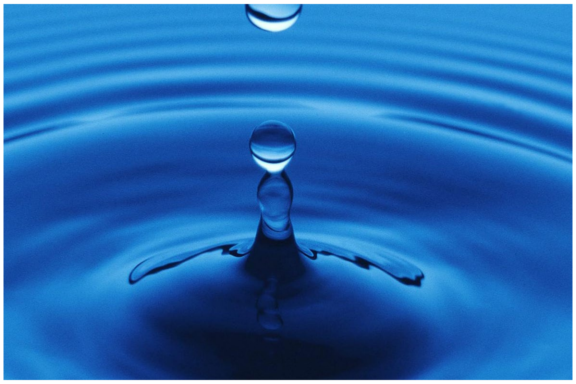
- **U.S. Environmental Protection Agency: 27**
- **U.S. Bureau of Land Management: 32**
- **BP: 49-50**
- **U.S. Nuclear Regulatory Commission: 61, 65-66**

Energy

TV

Car

Girl



Raindrop

Corn

Energy makes change.

Energy
TEACHER

What is Energy?

Energy makes change—it produces a change of some kind; it does things for us. We use energy to move cars along the road and boats over the water. Energy is used to bake a cake in the oven, and to keep ice frozen in the freezer. It provides power so we can listen to our favorite songs on the radio, and light our homes. Energy makes our bodies grow and allows our minds to think. Scientists define energy as the ability to do work.

Energy is found in many different forms such as **light**, **heat**, **motion**, **sound**, and **growth**.

Discussion Questions

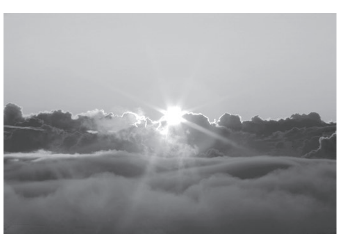
1. What changes occur with the objects in the pictures (on page 6)?
2. Where does the girl get her energy? *(food that she eats)* How is she using energy? *(to move, see, hear, think, stay warm or cool)*
3. Where does the television get its energy? *(electricity)* What kind of energy does it make? *(sound, light, heat)*
4. Where does the car get its energy? *(battery and gasoline)* What kind of energy does it make? *(motion, sound, heat)*
5. Where does the rain get its energy? *(the sun and gravity drive the water cycle)*
6. Where does the corn get its energy? *(light from the sun)*

Activity

1. Look around the classroom and point out things that are using energy. *(computer, clock, lights, plants, animals)* Decide where each item gets its energy and how it uses it.

Light

Compact Fluorescent Light Bulb (CFL)



Sun

Flashlight

Candle

Light makes change. Light is energy.

Light

TEACHER

Light is Energy

We use **light energy** every day. We use it to see things. Without light, our lives would be very different.

We use light energy for more than seeing. The energy in light helps plants grow. Doctors use special light to help in surgery. We can also use light to make products and electricity.

What is light? Light is energy that travels in **waves**. All the energy we get from the sun travels in waves or **rays**. Some of that energy is in light waves we can see—it is **visible light**.

Discussion Questions

1. How do the things in the pictures (on page 8) make light?
2. Why is light important to us?
3. What other things make light?
4. How is the light from the moon produced? *(Sunlight is reflected from the surface of the moon.)*
5. What is life like at home at night when the power goes off and you have no light?

Activities

1. Have the students close their eyes and imagine a world without light.
2. Turn down the lights in stages (and close the blinds) and notice the effect on what you can see.

Heat

Fire

Hairdryer

Iron

Grill

Heat makes change. Heat is energy.

Heat

TEACHER

Heat is Energy

We use **heat**, called **thermal energy**, every day. We cannot see heat, but we can feel it. Our bodies make heat, and our stoves and lights do too. We heat our houses, our food, and our water.

Sometimes there is too much heat and we move it. Refrigerators take heat away from the food inside. Air conditioners take heat from inside the house and move it outside. Swimming pools take heat from our bodies, so more people in a pool will make the temperature go up!

Discussion Questions

1. How do the things in the pictures (on page 10) make heat?
2. How is heat important to us?
3. What other things make heat? *(toaster, pets, clothes dryer, TV, oven, etc.)*
4. How do jackets help keep us warm? *(They hold in the heat from our bodies.)*
5. How do you keep your house warm in the winter? *(Turn on a heating system.)*

Activities

1. Have the students rub their hands together quickly to feel the heat produced by friction.
2. Have the students put one hand in the sun and one in the shade and feel the difference as the sunlight hits their skin and turns into heat.

Motion

Sailboats
Racing

Playing soccer

Drill

Ant

Motion is change. Motion is energy.

Motion
TEACHER

Motion is Energy

Look around you. Many things are **moving**. They are in **motion**. Motion is a change in an object's position. Clouds drift across the sky. Leaves fall from trees. A car speeds by. Birds fly. Hearts pound. Bells ring. Babies cry. Plants grow and so do you. The Earth moves, the air moves, and so does every living thing.

All of this motion takes energy. Nothing can move without energy. Cars get their energy from gasoline. The clouds move because of energy in the wind. The wind gets its energy from the sun. So do growing plants. All of your energy comes from the sun too.

Discussion Questions

1. Where do the things in the pictures (on page 12) get the energy to move?
2. What gives you the energy to move? *(The energy in the food you eat—which comes from the sun as plants absorb light.)*
3. What makes a ball roll down a hill? *(Gravitational potential energy—the force that pulls objects toward each other.)*

Activities

1. Have the students think of all the things moving within their bodies even when they are holding very still.
2. The forces of push, pull, and gravity are responsible for putting an object in motion. Take students to the playground. Have students identify the forces at work and types of motion as they play.

Sound

Drums

Phone

Radio

Bird

Sound is change. Sound is energy.

Sound
TEACHER

Sound is Energy

Energy is moving around you all the time—energy in the form of **sound waves**. Sound waves are everywhere. Even on the quietest night you can hear sounds. Close your eyes, hold very still, and listen for a moment. How many different sounds can you hear?

Sound is a special kind of kinetic, or motion, energy. Sound is energy vibrating through substances. All sounds are caused by **vibrations**—the back and forth motion of molecules. The molecules collide with each other and pass on energy as a moving wave.

Sound waves can travel through gases, liquids, and solids. The sounds you hear are usually moving through air. When a sound wave moves through air, the air molecules vibrate back and forth in the same direction as the sound. The vibrations push the air molecules close together, then pull them apart.

Discussion Questions

1. How do the things in the pictures (on page 14) make sound?
2. How is sound important to us? *(communication, music, entertainment)*
3. What makes some sounds pleasant and some unpleasant? *(pitch, volume, personal choice)*
4. How does your throat make sounds? *(The muscles in your chest push air past your vocal chords, making them vibrate.)*

Activities

1. Have the students feel their throats while humming to feel the vibrations.
2. Have the students explore the range of sounds they can make with their voices.
3. Have the students tap different objects with a pencil and notice the difference in the sounds.

Growth

Puppies

Baby

Child

Woman

Growth is change.
Energy makes things grow.

Growth
TEACHER

Growth is Energy

Every living thing is growing all the time. Sometimes living things grow bigger. Sometimes they do not get bigger, but they still grow. They grow new cells to replace old ones.

It takes energy to grow—**chemical energy** stored in simple sugars. The energy to make these sugars comes from light energy. Most of this light energy comes from the sun. Plants absorb the light energy and store it in their leaves, stems, fruits, and roots as chemical energy. They use the energy to grow. When we eat the plants, we absorb the chemical energy. When we eat animals we absorb their chemical energy that came from the plants they ate.

Discussion Questions

1. How do the things in the pictures (on page 16) get their energy to grow?

2. Can you get energy straight from the sun to grow? *(No, but plants can.)*

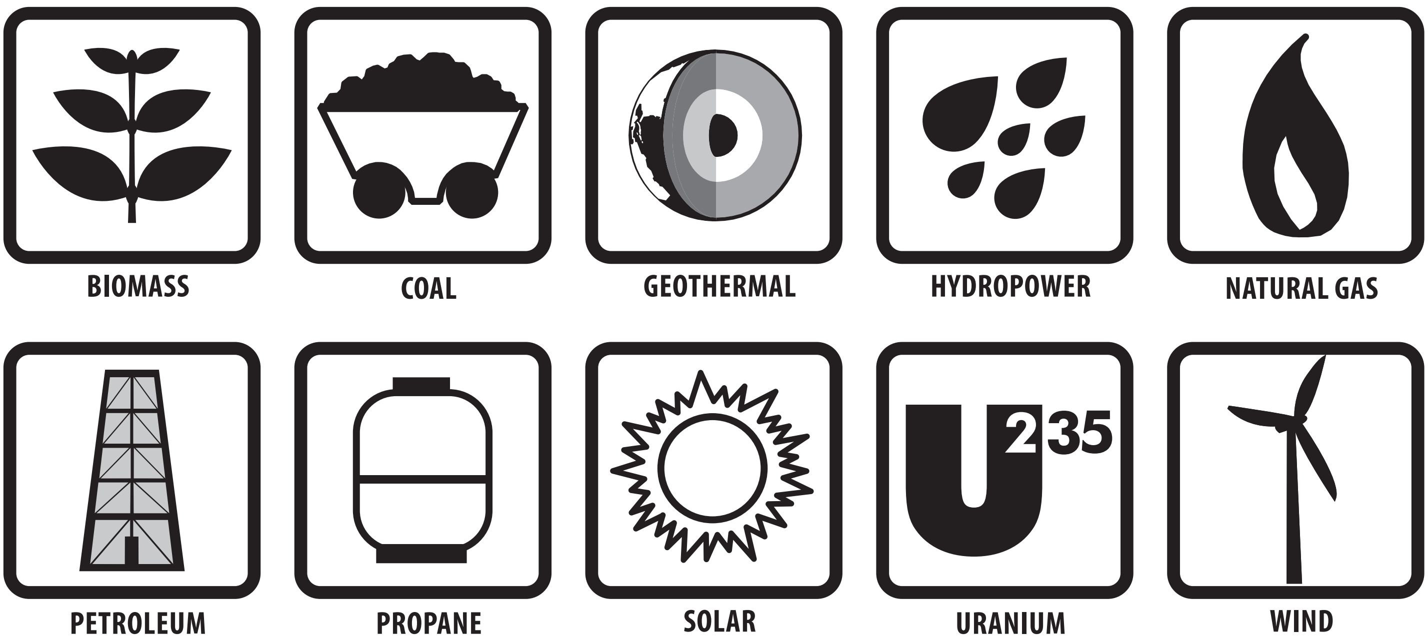
3. What happens if you eat more food than you need? Not enough food?

Activities

1. Have the students draw an energy flow from a carnivore (meat eater) back to the sun.

2. Look on packages of food at the calories. Calories are a measure of the energy in the food.

Energy Sources



We use many energy sources to do work.

Energy Sources

TEACHER

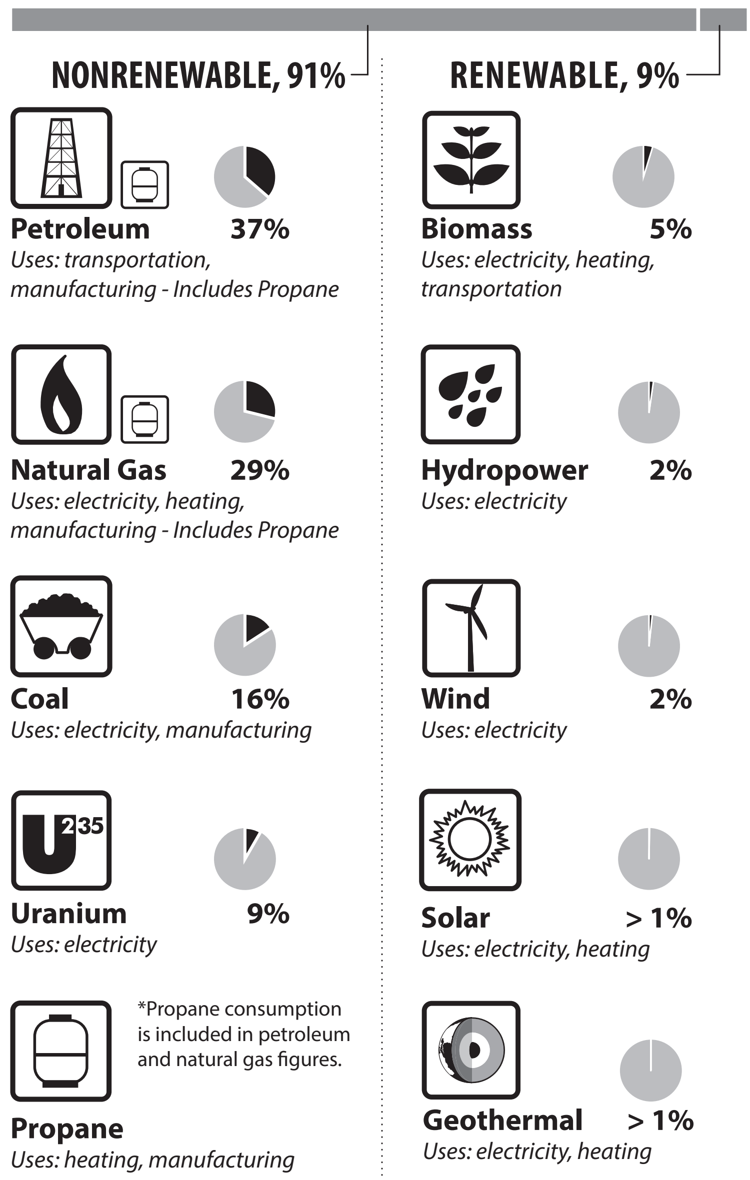
We use many different energy sources to do work for us. Energy sources are classified into two groups—nonrenewable and renewable. In the United States, most of our energy comes from nonrenewable energy sources. Coal, petroleum, natural gas, propane, and uranium are nonrenewable energy sources. They are used to make electricity, to heat our homes, to move our cars, and to manufacture all kinds of products.

These energy sources are called **nonrenewable** because their supplies are limited. Petroleum, for example, was formed hundreds of millions of years ago from the remains of ancient sea plants and animals that lived prior to dinosaurs. We cannot make more petroleum in a short time.

Renewable energy sources include biomass, geothermal energy, hydropower, solar energy, and wind energy. They are called **renewable** energy sources because they are replenished in a short time. Day after day the sun shines, the wind blows, and the rivers flow. We use renewable energy sources mainly to make electricity.

Electricity is different from the other energy sources because it is a **secondary source of energy**. We have to use another energy source to make electricity. In the United States, coal is the number one energy source for generating electricity.

U.S. Energy Consumption by Source, 2015



Data: Energy Information Administration
*Total may not equal 100% due to independent rounding.

Renewable

Re - NEW - a - ble

Able to be NEW again

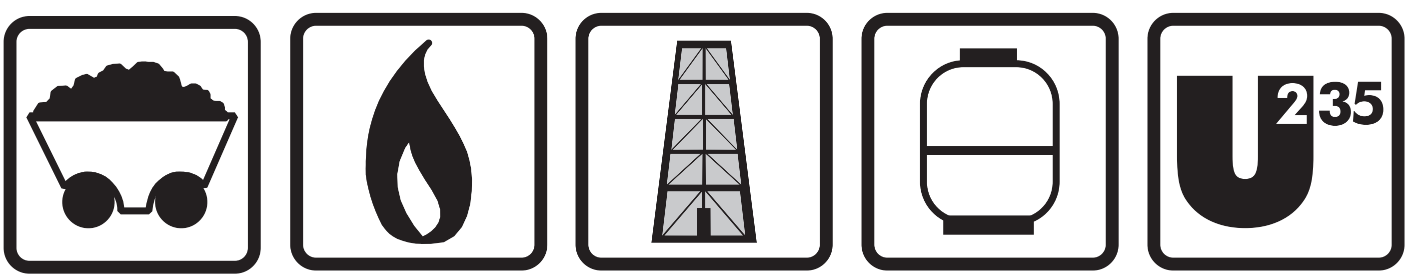
BIOMASS **GEOTHERMAL** **HYDROPOWER** **SOLAR** **WIND**

Some energy sources can
be made again quickly.

Nonrenewable

NON - re - NEW - a - ble

NOT able to be NEW again



COAL NATURAL GAS PETROLEUM PROPANE URANIUM

Some energy sources take millions of years to form.

Biomass

Grains

Wood

Garbage

Biomass is anything that is, or once was, alive. Biomass is wood, plants, and garbage.

Biomass
TEACHER

Biomass is anything that is alive. It is also anything that was alive a short time ago. Trees, crops, garbage, and animal waste are all biomass. Most of the biomass we use for energy today is wood. We burn wood to make heat.

Biomass gets its energy from the sun. Plants store the sun's energy in their leaves, stems, fruits, and roots. When we eat biomass, we use the energy to move and grow. When we burn biomass, we use the energy to make heat. We can also change the energy in biomass into gas and liquid fuels.

Biomass energy is **renewable**. That means we can make more. We can always grow more plants. We should plant new trees when we cut down old ones for wood. We also need to take care of the soil in which our crops grow.

People and animals get their energy from biomass. The energy in everything we eat comes from plants. Bread is made from wheat, a plant. Hamburgers were once cows that ate grass.

ENERGY CHANT

Garbage, wood, landfill gas... it's all BIOMASS!

Hold your nose while chanting, "Garbage, wood, landfill gas." During "it's all BIOMASS," shake your hands near your shoulders.

Until about 150 years ago, biomass gave people most of the energy they used. The cave dwellers and settlers burned wood for heat. They burned wood to cook food. In many developing countries, wood is still used for most energy needs. People also burn corn cobs and straw. In places without trees, people burn the waste from cows and pigs.

Biomass can be used to make electricity. Many towns burn their garbage in **waste-to-energy plants**. Instead of putting the garbage in landfills, they burn it to make electricity. This saves landfill space and gives them electricity, too.

Burning biomass does not cause as much pollution as burning coal or oil, but many people do not like to burn waste near their towns. Sometimes it smells bad. Waste-to-energy plants work hard to scrub the air from the burning waste to reduce pollution and odor.

Biomass can be used to make a gas called **methane**. Methane makes up the natural gas we use in our stoves and furnaces.

In China, farmers use all of their garbage, even animal waste, to make **biogas**, a gas made by biomass. They put the waste into a big tank without air. It makes methane as it rots. Farmers use the gas to cook food and light their homes. The waste that is left can be used as fertilizer to grow more crops.

Biomass can also be turned into a fuel like gasoline. Just as apples can be made into cider, corn, grass, and wheat can be made into ethanol. **Ethanol** is a fuel a lot like gasoline. Most gasoline contains some ethanol.

Plants store the sun's energy in their roots, stems, fruits, and leaves.

The energy in biomass comes from the sun.

Crops are biomass.

Biomass is renewable. You can grow more plants.

Wood is biomass.

You can burn biomass to make heat and electricity.

Ethanol Pump

We can turn biomass into fuels called ethanol and biodiesel. Ethanol and biodiesel can be used in many types of vehicles.

Coal

Coal

Coal is shiny, black rock that has energy.

Coal

TEACHER

Coal looks like shiny, black rock. Coal has lots of energy in it. When it is burned, it makes heat and light energy. Many years ago, Native Americans burned coal to make pots. The early settlers did not use much coal—they burned wood.

People began using coal in the 1800s to heat their homes. Trains and ships used coal for fuel. Factories used coal to make iron and steel. Today, we burn coal mainly to make electricity.

Coal was formed millions to hundreds of millions of years ago. Back then, much of the Earth was covered by huge swamps. They were filled with giant ferns and plants. As the plants died, they sank to the bottom of the swamps.

Over the years, thick layers of plants were covered by dirt and water. They were packed down by the weight. After a long time, the heat and pressure changed the plants into coal. Coal is called a **fossil fuel** because it was made from plants that were once alive. The energy in coal came from the sun.

The coal we use today took a very long time to form. We cannot make more in a short time. That is why it is called **nonrenewable**. There is a lot of coal in the U.S. There is enough to last more than 250 years.

ENERGY CHANT

COAL in the hole—makes light in the night!

During "COAL in the hole," point down with thumbs, hands in fists. During "makes light in the night," point thumbs upward in rhythm with the cadence of the chant.

Most coal is buried under the ground. We must dig it out, or **mine** it. If coal is near the surface, miners dig it up with huge machines. First, they scrape off the dirt and rock, then dig out the coal. This is called **surface mining**.

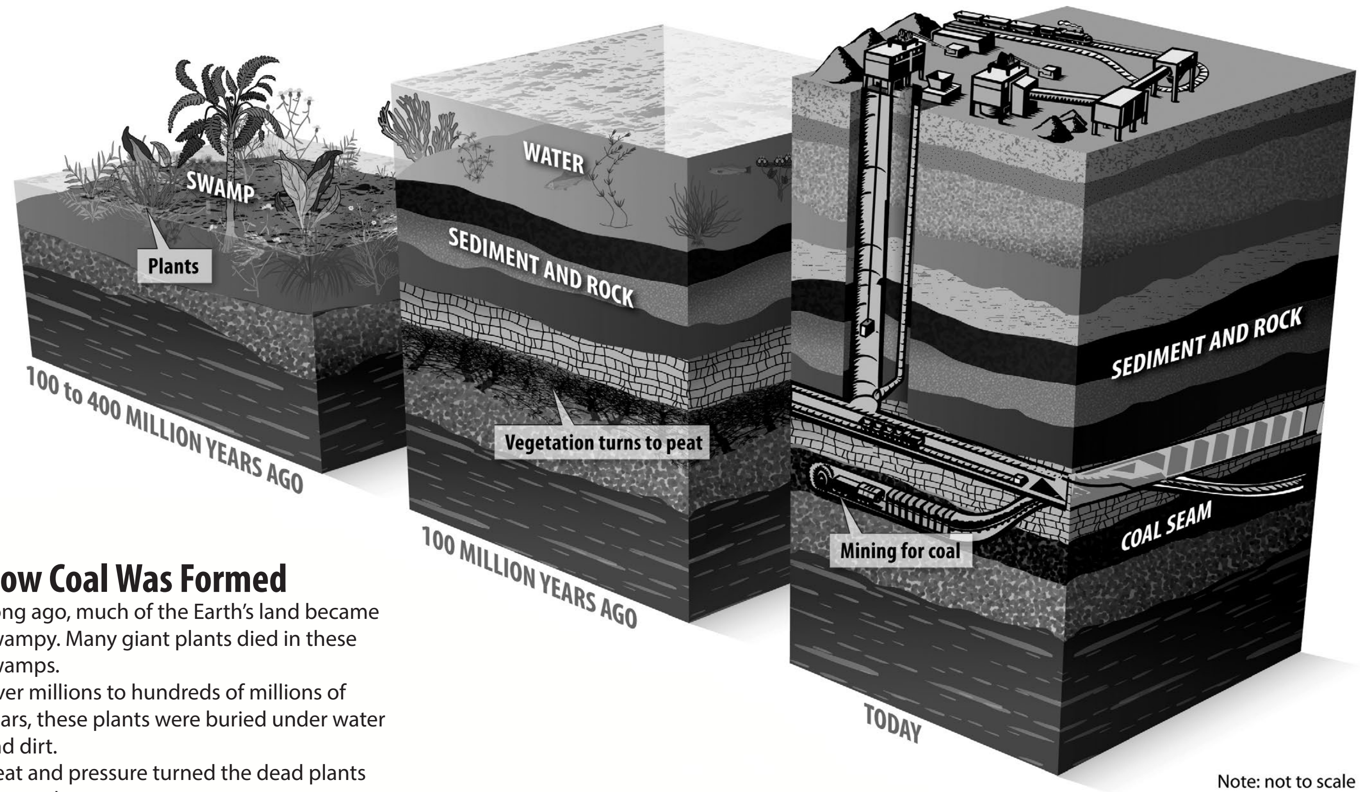
After the coal is mined, they put back the dirt and rock. They plant trees and grass. The land can be used again. This is called **reclamation.**

If the coal is deep in the ground, tunnels called **mine shafts** are dug down to reach the coal. Machines dig the coal and carry it to the surface. Some mine shafts are 1,000 feet deep. This is called **deep mining**.

After the coal is mined, it is cleaned and shipped to market. Most coal is moved by trains to power plants and factories. Sometimes it is moved on barges along rivers.

Power plants burn the coal to make electricity. Coal is one of our most important energy sources. It gives us 33 percent of the electricity we use and 16 percent of our total energy.

When coal is burned, it can **pollute** the air because it produces smoke. Power plants and factories work hard to keep the pollution from getting into the air. They clean the coal before they burn it. They use **scrubbers** to clean the smoke before it goes into the air.



How Coal Was Formed

Long ago, much of the Earth's land became swampy. Many giant plants died in these swamps.

Over millions to hundreds of millions of years, these plants were buried under water and dirt.

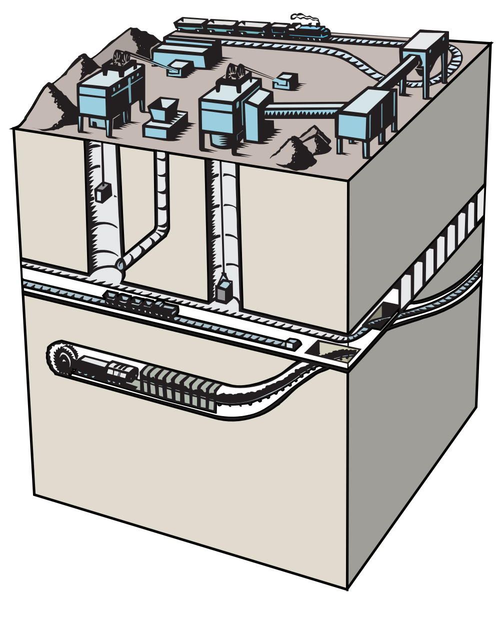
Heat and pressure turned the dead plants into coal.

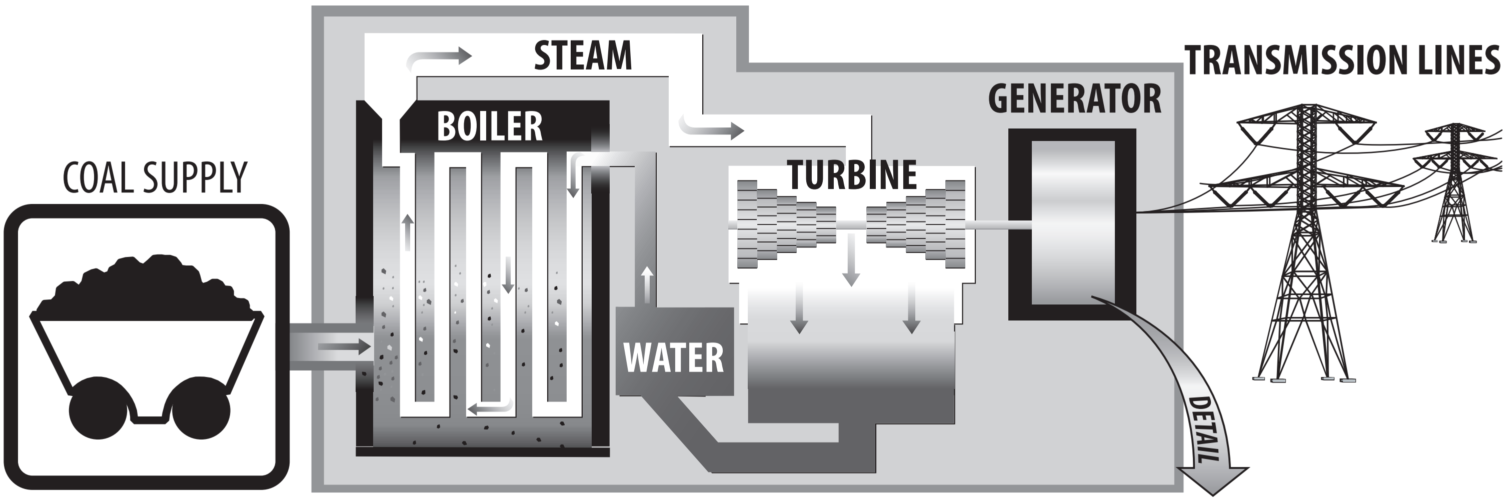
Coal is nonrenewable. We cannot make more coal quickly.

This machine is called a **dragline**. A bucket is dragged along the ground to collect coal.

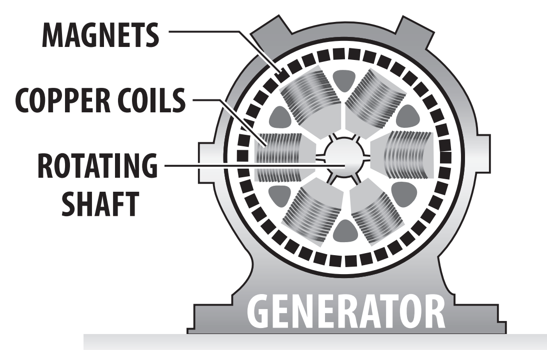
We mine coal with big machines.

We dig tunnels under the ground to get coal.





1. In a power plant, coal is burned to create heat.
2. The heat changes water into steam.
3. The steam travels through pipes and spins a turbine.
4. The turbine spins coiled wire inside of magnets, creating electricity.
5. Electricity travels through wires from the power plant to your house.



We burn coal to make electricity.

Geothermal Energy

A geyser releases hot water and steam into the air.

Geothermal energy is
heat inside the Earth.
Geothermal energy is renewable.

Geothermal Energy

TEACHER

Geothermal comes from the Greek words **geo** (earth) and **therme** (heat). Geothermal energy is heat inside the Earth. The inside of the Earth is very hot. Sometimes this heat comes near the surface. We can use this heat to warm our houses. We can make electricity with it.

The Earth is made of layers or parts, like a hard boiled egg. It has three layers—core, mantle, and crust. At the center is a solid **core** of iron. Around that is the outer core, made of iron and rock so hot the rock is melted. This liquid rock is called **magma**. The middle layer is a mixture of rock and magma called the **mantle**. The shell of the Earth—with the oceans and mountains—is called the **crust**.

In some places, magma comes close to the Earth's surface. It heats the water underground. We can use this heated water. We dig wells and pump the hot water and steam out of the ground.

The hot water we use will be replaced by rain. The heat inside the Earth will always be there. More heat is made every day in the Earth's core. We won't run out of geothermal energy. It is **renewable** energy.

ENERGY CHANT

Geo-Earth,
Thermal-heat—
GEOTHERMAL—
Earth-heat!

Hold arms in a circle in front of you during "Geo-Earth." Cross arms and hug yourself for "Thermal-heat." Shout "GEOTHERMAL," then repeat the motions quickly for "Earth-heat."

Geothermal energy is everywhere under the ground, but sometimes it is hard to reach. In most places, the crust is miles thick. Magma is near the surface in only a few places.

Earthquakes and volcanoes are signs that magma is near the surface. The lava from volcanoes is magma that has reached the surface of the Earth. Most of the geothermal energy in the United States is found in the western states and in Hawaii.

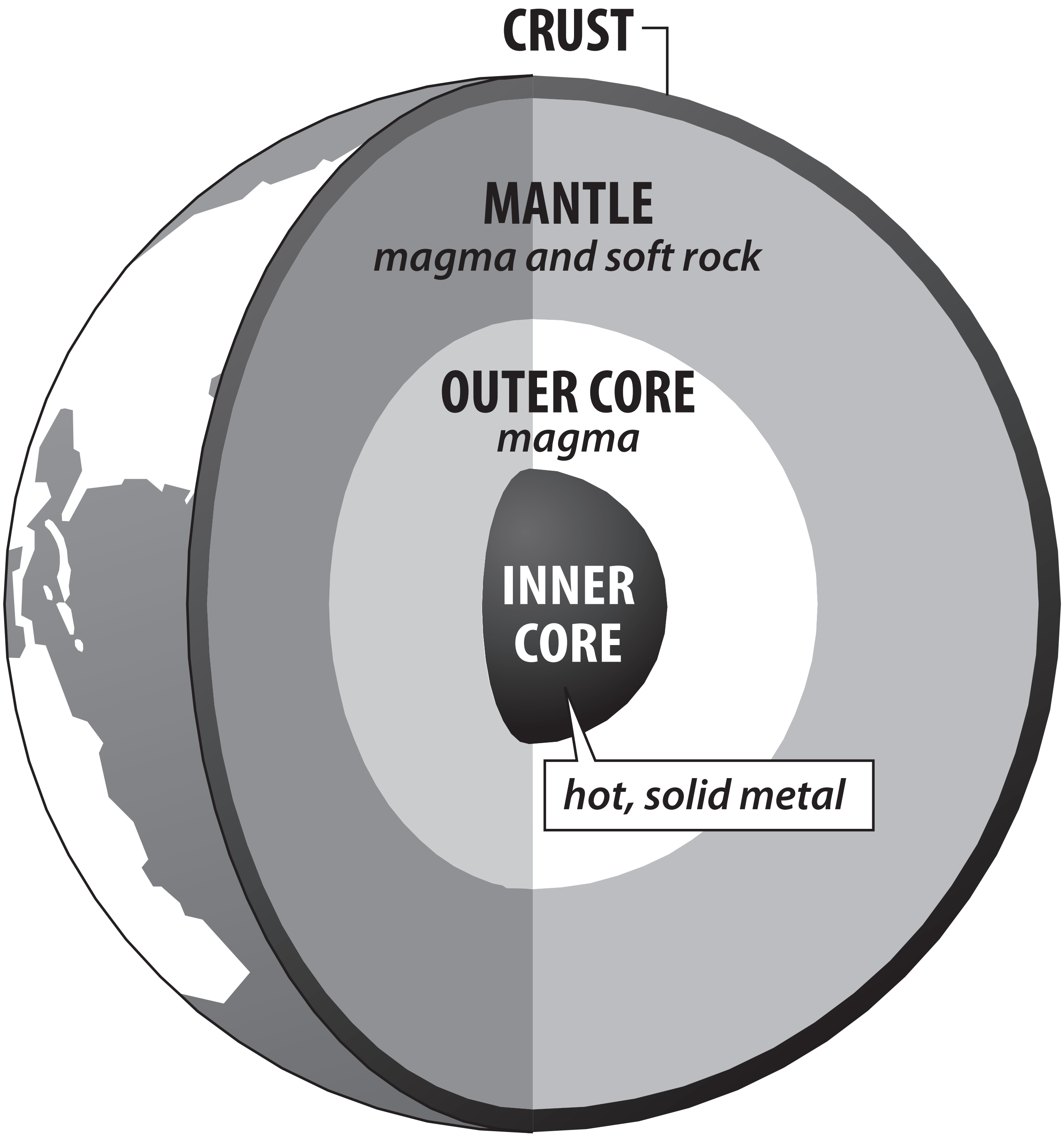
People have used geothermal energy for thousands of years. In some places, there are pools of water that are always hot. They are warmed by underground springs. These **hot springs** have often been used for bathing. Many people believe these springs have healing powers.

Most people in Iceland use hot water from geothermal wells to heat their homes. Some scientists think that someday we will be able to capture the energy in volcanoes.

Power plants use steam from geothermal wells to make electricity. The steam is used to spin turbines. The turbines spin magnets in coils of copper wire to make electricity.

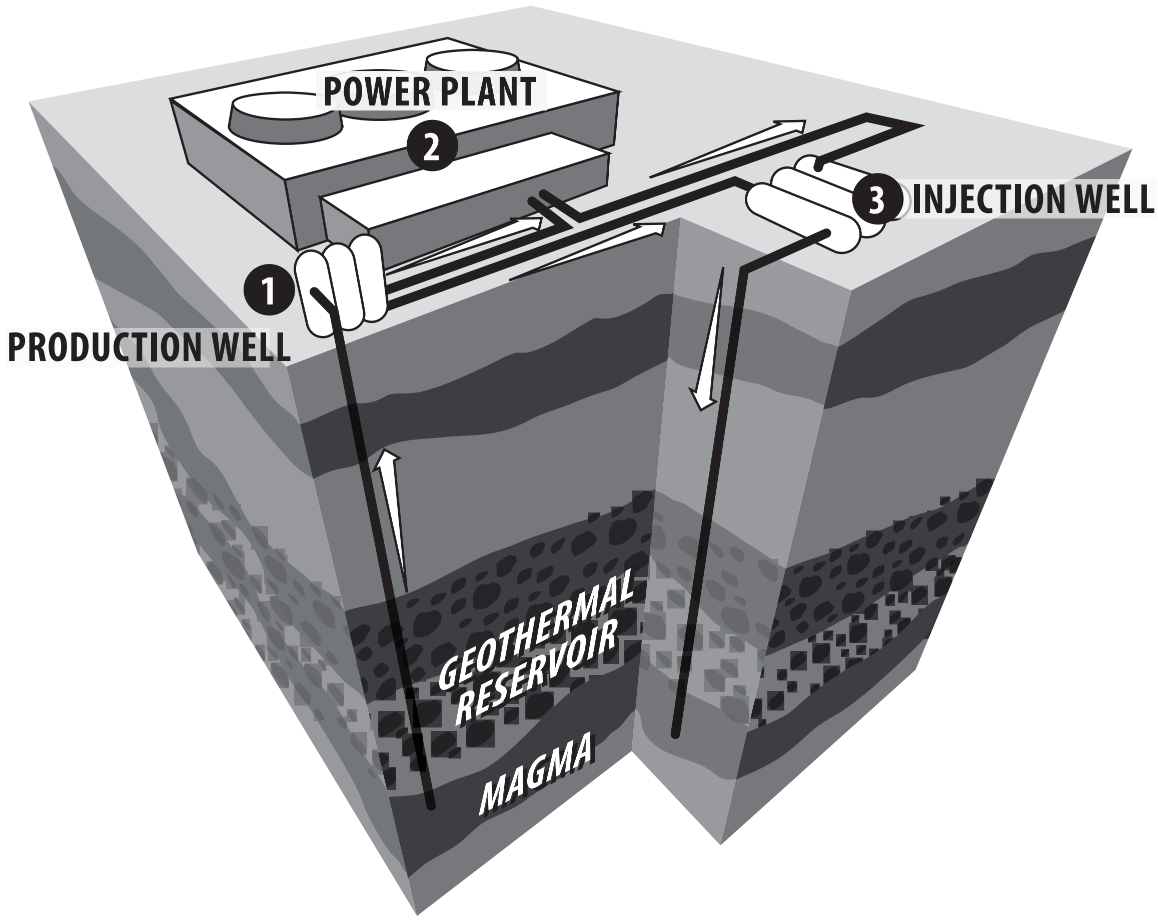
The power plants are built close to the wells. The steam is pumped straight from the wells to the power plants.

Geothermal energy is clean energy. No fuel is burned, so there is no air pollution. The steam is turned into water and put back into the Earth. And geothermal energy is cheap—once they are built, new power plants can make electricity for less cost than coal or natural gas plants.



The Earth is made of layers.

Geothermal Power Plant



1. **Production Well:** Geothermal fluids, such as hot water and steam, are brought to the surface and piped into the power plant.
2. **Power Plant:** Inside the power plant, the geothermal fluid turns the turbine blades, which spin a shaft, which spins magnets inside a large coil of wire to generate electricity.
3. **Injection Well:** Used geothermal fluids are returned to the reservoir.

Geothermal power plants make electricity.

Hydropower

Moving water has energy.

Hydropower
TEACHER

Hydro means water. **Hydropower** is the energy we make with moving water. Moving water has a lot of energy. We use that energy to make electricity.

Gravity—the force of attraction between all objects—makes the water move. Gravity pulls the water from the clouds to the ground, and from high ground to low ground. The rain that falls in the mountains flows down the valleys to the oceans.

The sun heats the water in the oceans, turning it into **water vapor**, a gas. This is called **evaporation**. The water vapor rises. It turns into clouds when it reaches the cold air above the Earth. The clouds release the water as **precipitation**—rain or snow—and the cycle starts again. This is called the **water cycle**.

The water cycle will keep going forever. The water on Earth will always be there. We will not run out of it. That is why we call hydropower a **renewable** energy source.

Water wheels can use the energy in moving water. A water wheel has buckets around a big wheel. The buckets fill with water at the top of the wheel. The weight of the water (gravity) turns the wheel and dumps the water at the bottom.

ENERGY CHANT

**Falling water,
HYDROPOWER,
HYDROPOWER!**

With your finger tips touching, hold your hands under your chin and glide your hands down like a waterfall during "Falling water." For "HYDROPOWER, HYDROPOWER" spin your hands like a turbine.

Early settlers used water wheels to grind grain and run sawmills. Factories used water wheels to run their machines. In many countries, water wheels are still used.

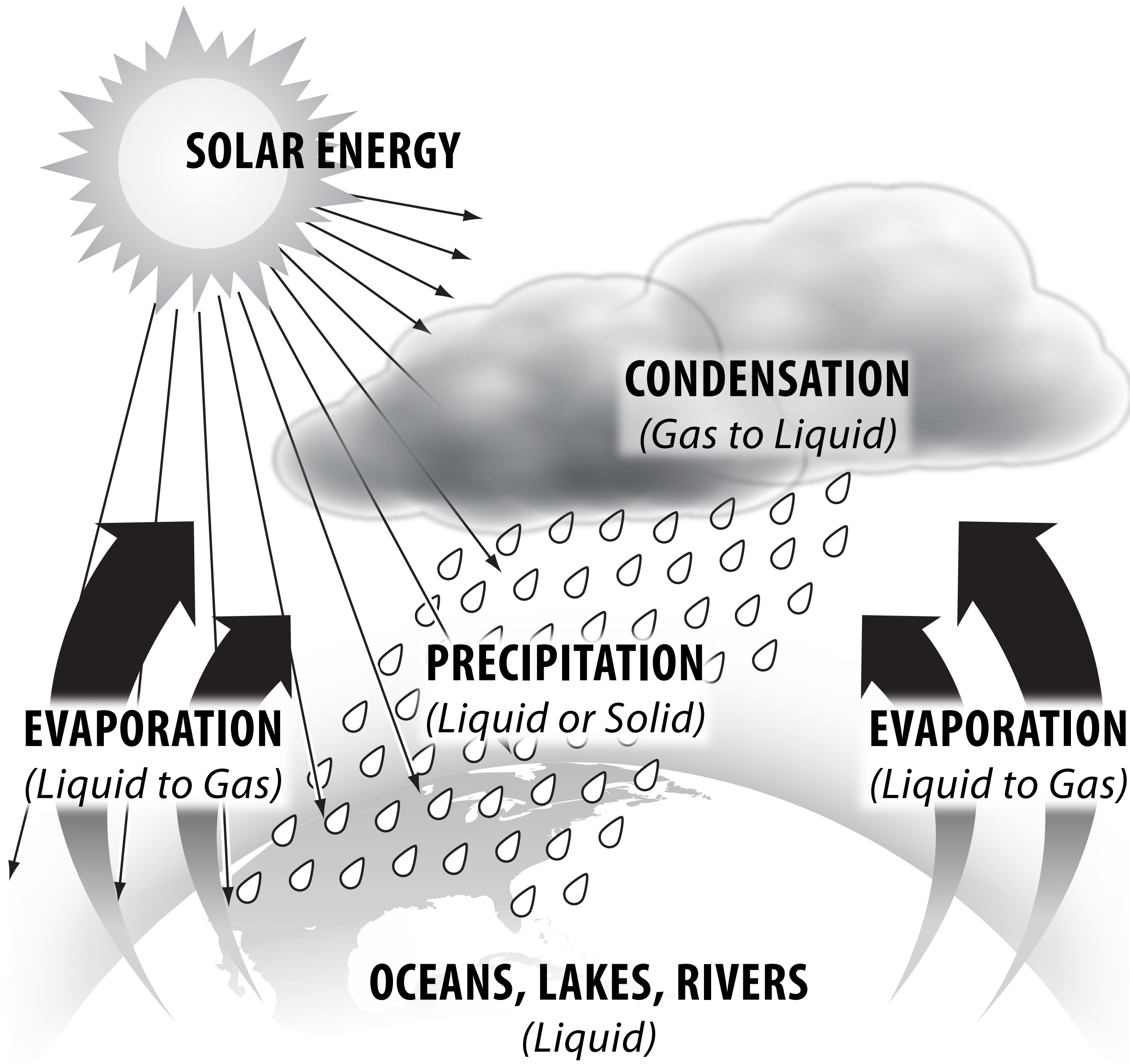
Moving water can be used to make electricity. First, a dam is built across a river. This stops the water and makes a big lake behind the dam. This lake is called a **reservoir**.

When the gates of the dam are opened, the water rushes from the reservoir into the dam. Gravity pulls it. The water flows down big tubes called **penstocks** and turns giant wheels, called **turbines**. The spinning turbines are attached to **generators** that make electricity. The first hydropower plant was built on the Fox River in Appleton, Wisconsin, in 1882. Today, there are more than 2,200 dams in the United States that make electricity.

Hydropower is a clean source of energy. No fuel is burned, so the air is not polluted. It is the cheapest source of electricity, because the water is free to use. And we won't run out of water—it is renewable.

The reservoirs behind dams can be used for swimming, fishing, boating, and other sports. When dams are built, however, the reservoirs flood a lot of land. They change the flow of the rivers. Sometimes, fish in the rivers cannot swim and lay their eggs like they could before. Dams have to provide a way for fish to get across the dam to lay eggs.

The Water Cycle

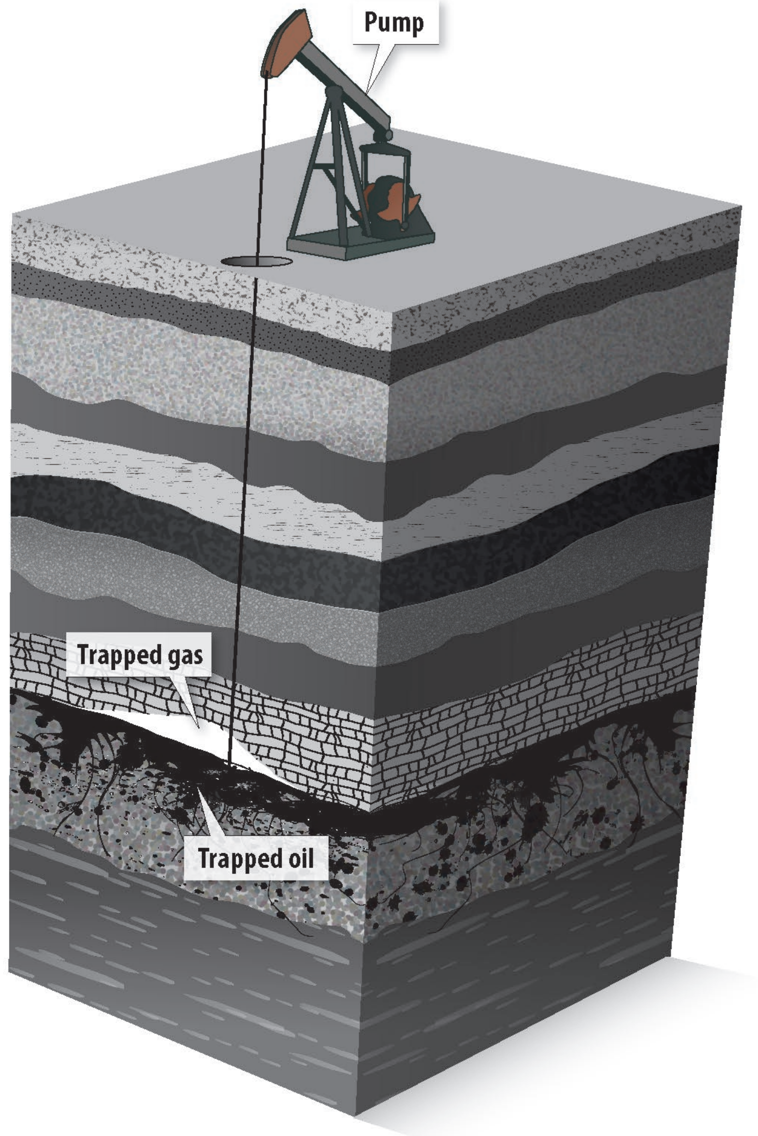


Hydropower is renewable.

The Glen Canyon Dam in Arizona.

A hydropower plant makes electricity.

Natural Gas



Natural gas is nonrenewable.
Natural gas has no color or smell. It is a gas when it comes from the ground.

Natural Gas

TEACHER

Natural gas is like air. You cannot see it, or smell it, or taste it. Natural gas has a lot of energy in it. You can burn it to make heat. The early Chinese burned natural gas to get salt from sea water.

Natural gas was formed hundreds of millions of years ago, before the dinosaurs roamed the Earth. Oceans covered much of the Earth, filled with tiny sea plants and animals. When the plants and animals died, they sank to the bottom and were covered by sand. Layers of dead plants, animals, and sand built up over time. Heat and pressure turned the plants and animals into natural gas and petroleum. Since natural gas is made from plants and animals, it is called a **fossil fuel**. The plants and animals got their energy from the sun. It was stored in them when they died. This is the energy in natural gas.

The natural gas we use today took a very long time to form. That is why we call it a **nonrenewable** energy source. We cannot make more in a short time. Someday, most of the natural gas we can reach by drilling underground will be gone.

ENERGY CHANT

Burn clean, burn fast—

NATURAL GAS!

During "Burn clean," bring one hand up in front of you, palm facing inward. During "burn fast," bring the other hand up to the first hand. During "NATURAL GAS," move hands upward together to make the shape of a flame.

Natural gas is found underground in pockets of rock. We drill wells into the ground and pump out the gas. Some wells are a mile deep! The natural gas is shipped from the wells to plants that clean it. A chemical that smells like rotten eggs is added so that we can detect any leaks.

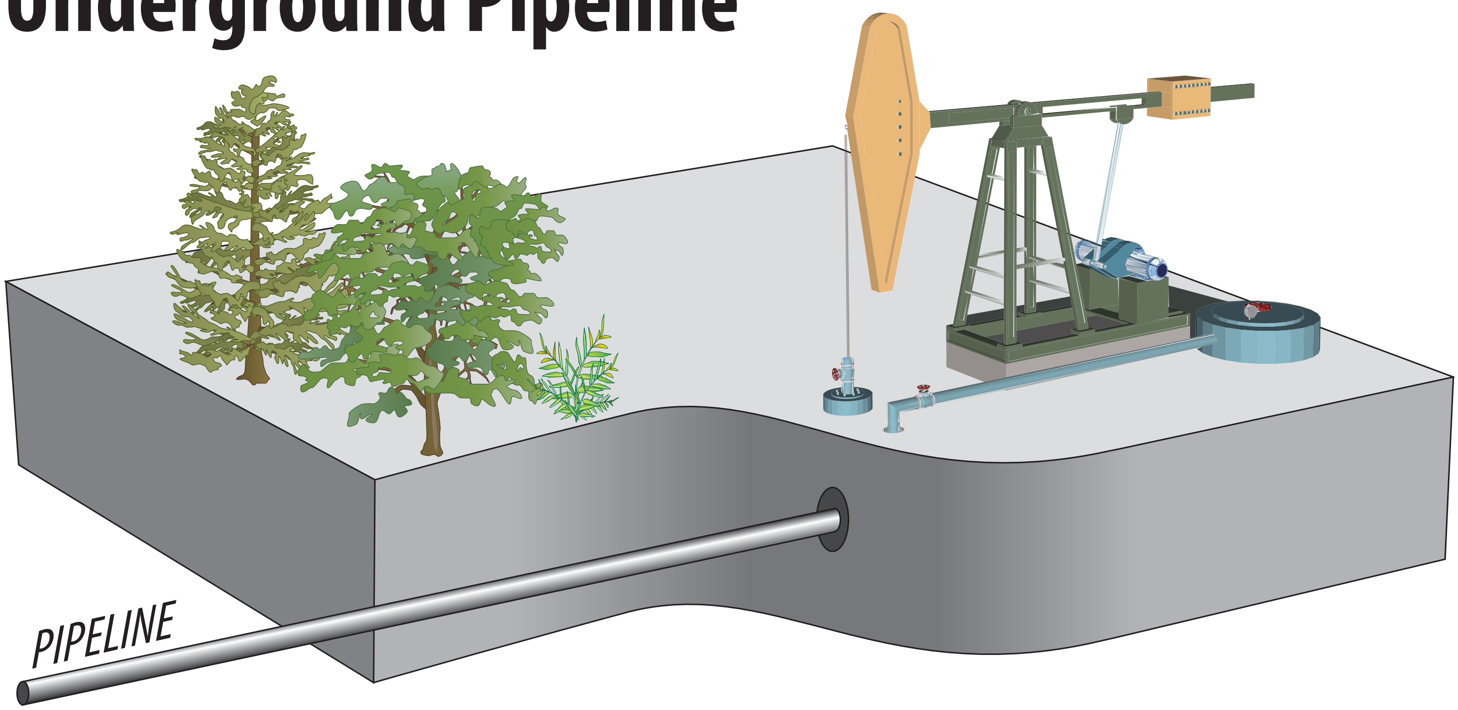
We move natural gas from one place to another in long chains of underground pipes called **pipelines**. There are more than two million miles of pipelines in the United States alone.

Many people use natural gas. Most homes use natural gas for heat. So do schools and hospitals. Many stoves and water heaters use natural gas, too. Factories burn natural gas to make products like paper, chemicals, fertilizer, and cement. Natural gas is also an ingredient in paint, glue, fertilizer, and many other products.

Power plants burn natural gas to make electricity. Most new power plants burn natural gas. Sometimes, natural gas is even used to run cars, trucks, and buses.

Natural gas is the cleanest burning fossil fuel. It does not pollute the air as much as burning coal or oil. That's why it is a good fuel for heating our homes.

Underground Pipeline



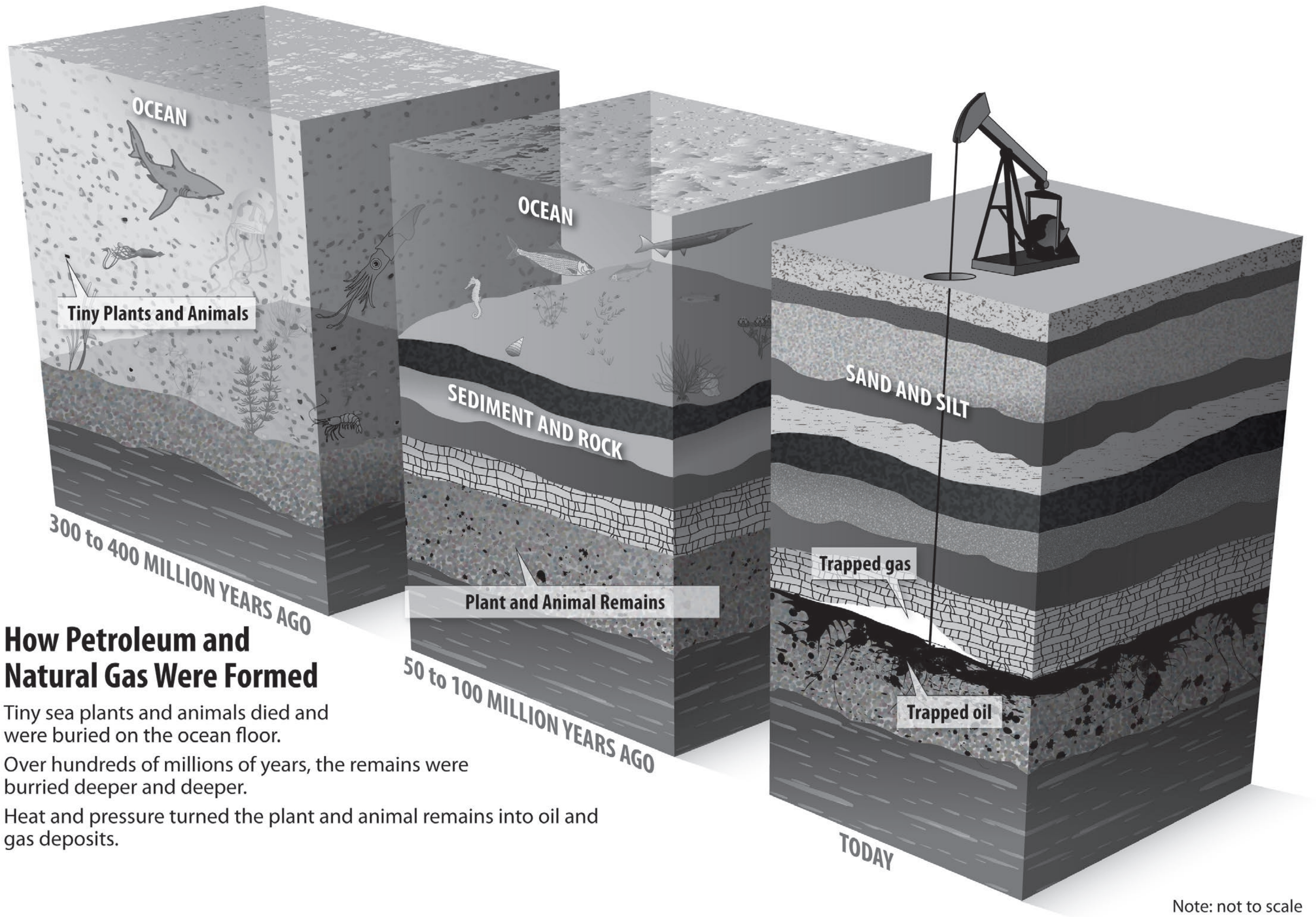
We move natural gas in pipes under the ground.
Never play or dig near pipelines.

Natural Gas Stove

We burn natural gas for heat.

It can cook our food and warm our homes.

Petroleum



Petroleum is a liquid we find underground. Petroleum is nonrenewable.

Petroleum

TEACHER

Petroleum is a liquid that is found underground. Sometimes we just call it oil or crude oil. Oil can be as thick and black as tar or as thin as water. Petroleum has a lot of energy. We can turn it into different fuels—like gasoline, kerosene, and heating oil. Most plastics are made from petroleum, too.

People have burned oil for a long time. Long ago, they did not dig for it. They gathered oil that seeped from under the ground into ponds. It floated on the water.

Long before the dinosaurs, oceans covered most of the Earth. They were filled with tiny sea animals and plants. As the plants and animals died, they sank to the ocean floor. Sand covered them. Hundreds of millions of years passed. The weight of the sand and water and heat from the Earth turned them into petroleum and natural gas.

Petroleum is called a **fossil fuel** because it was made from plants and animals. The energy in petroleum came from the energy in the plants and animals that were once living and buried. That energy came from the sun.

ENERGY CHANT

Pump, pump—
PETROLEUM!

Place hands together in fists in front of you. During "Pump, pump," partially extend fingers twice and return to fist. During "PETROLEUM," fully extend hands and move them upward, representing oil shooting from a well.

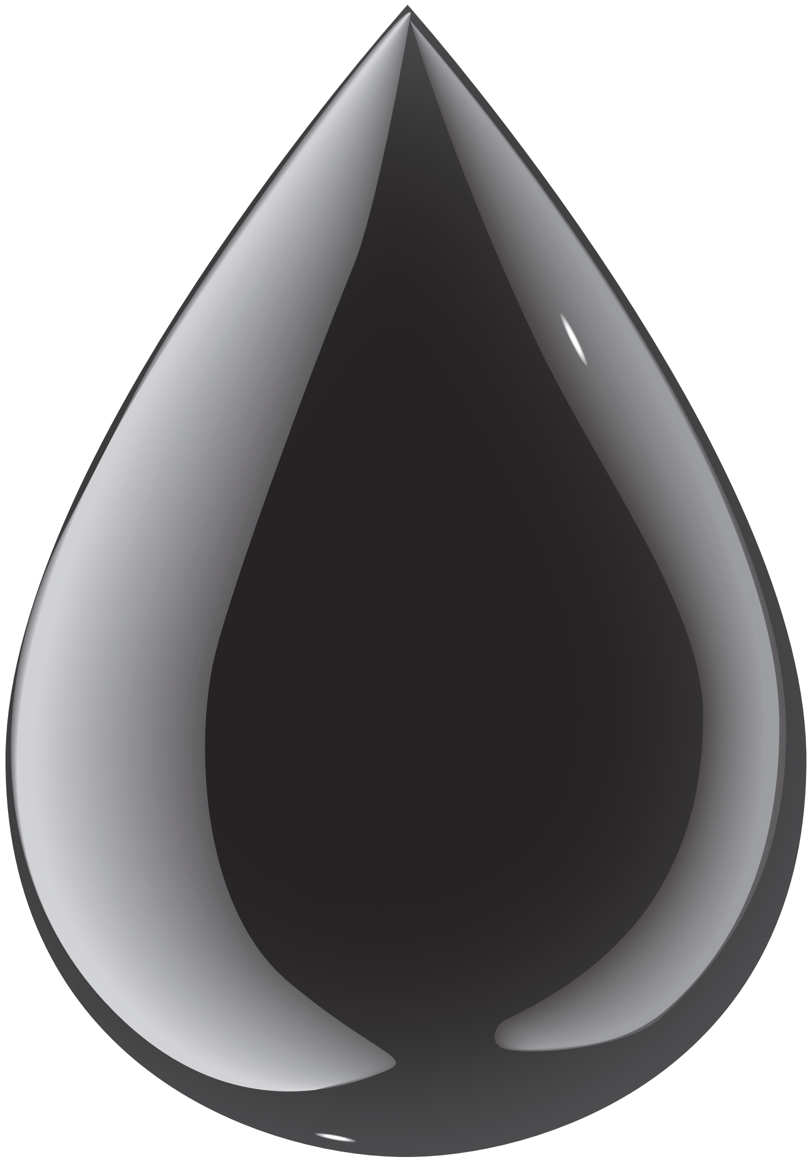
The petroleum we use today was made a very long time ago. It took hundreds of millions of years to form. We cannot make more in a short time. That is why we call petroleum **nonrenewable**. The United States does not drill enough oil to meet our needs. We buy 48 percent of the oil we use from other countries.

Petroleum is buried underground in tiny pockets in rocks. We drill **oil wells** into the rocks to pump out the oil. A normal well is over one mile deep. Texas is the state that drills the most oil. A lot of oil is under the oceans and along our shores. Offshore oil rigs are used to reach this oil. Most of these wells are in the Gulf of Mexico.

After the oil is drilled, it is sent to **refineries**. At the refineries, it is cleaned and made into different fuels. Most of the oil is made into **gasoline** for vehicles. The oil is moved from one place to another by ships and trucks, and through pipelines.

What would we do without petroleum? Right now, our country would come to a stop! Our cars, trucks, and planes all use fuel made from oil. Our factories use oil to make plastics and paints, medicines and soaps. We sometimes even burn oil to make electricity. We use more petroleum than any other energy source.

Petroleum keeps us going, but it can damage our environment. Burning oil can pollute the air. Pollution from cars is a big problem in many parts of the country. Oil companies are making cleaner gasoline and other fuels every year. Oil can also pollute the soil and water if it is spilled. Oil companies work hard to drill and ship oil as safely as possible. They try hard to clean up any oil that spills.



Petroleum is also called oil.
It is a liquid when it comes from the ground.

An oil rig on land.

An oil rig on water.

We drill to get the oil from the ground. Some wells are on land and some are below water.

A tanker ship transports oil across the ocean.

We move oil in big ships called tankers. We also move oil in pipes under the ground.

Lipstick

Action figures

Rubber bands

Tape

CDs

Pens

We use oil to make many different products.

Propane

Propane is a gas.
It comes from oil and natural gas.

Propane

TEACHER

Propane is the gas we use to fuel our backyard grills and heat some homes. It is a lot like natural gas—you cannot see it, smell it, or taste it, but you can burn it to make heat energy.

Propane is a **fossil fuel**. It was formed hundreds of millions of years ago, long before the dinosaurs. Like oil and natural gas, it was formed from tiny sea animals and plants. The plants got their energy from the sun. This is the energy in propane. Propane's energy came from the sun.

Propane is buried underground mixed with natural gas and petroleum. It has to be separated out at natural gas cleaning plants and oil refineries. Even though propane has been around for millions of years, it was only discovered a little more than 100 years ago! Right away scientists knew they had found a good energy source.

Many farms in the United States use propane to dry crops, run tractors, and heat barns. Businesses use propane for heating and cooking. Most vehicles that we drive inside buildings, like forklifts and carts, use propane for fuel. It is a clean fuel. It does not pollute the air.

ENERGY CHANT

Put a little pressure on me—PROPANE!

Begin with hands wide apart and bring palms closer together at each word of the chant.

Some people in the country cannot get natural gas pipelines to their homes. They use propane instead. They put big propane tanks outside their houses. Small trucks bring the propane right to their houses.

When propane comes out of the ground, it is a gas. When it is put under pressure, it becomes a liquid. A lot more liquid can be put into a tank than gas. A tank of propane gas might last a week. The same sized tank of liquid propane would last five years!

Liquid propane is easy to move from place to place in tanks. It is **portable**—that means easy to move. We use small tanks of propane for our barbecue grills. One tank can last all summer.

Some cars and buses use propane for fuel. It is a very clean fuel. It does not pollute the air like gasoline does. Engines must be changed to use propane though, and that is expensive.

Propane Grill

Propane makes heat when it is burned. We can use it to cook food.

Propane is a clean fuel. We can use it to fuel machines used indoors.

Forklift

Solar Energy

Solar energy is light energy.
Solar energy is renewable.

Solar Energy

TEACHER

We get most of our energy from the sun. We call it **solar energy**. It travels from the sun to the Earth in waves or rays. Some are light rays that we can see. Some rays we cannot see, like x-rays. The sun is a star. It is a giant ball of gas. It sends out huge amounts of energy every day. Most of the energy goes off into space. Only a small part reaches the Earth.

We use solar energy in many ways. All day, we use sunlight to see what we're doing and where we're going. Sunlight turns into heat when it hits things. Without the sun, we couldn't live on the Earth—it would be too cold. We use the sun's energy to heat water and dry clothes.

Plants use the light from the sun to grow. Plants take the energy in light and store it in their roots, stems, fruits, and leaves. That energy feeds every living thing on Earth. We can also burn plants to make heat.

The energy from the sun makes rain fall and wind blow. We can capture that energy with dams and windmills. Coal, oil, and natural gas were made from prehistoric plants and animals. The energy in them came from the sun. We use that energy to cook our food, warm our houses, run our cars, and make electricity.

ENERGY CHANT

SOLAR ENERGY—
sun shine bright,
SOLAR ENERGY—
give me light!

Begin with arms over head in a big circle, swaying from side to side during "SOLAR ENERGY." Spread arms out wide during "sun shine bright." Repeat motions for second part of chant.

Solar energy is free and clean. There is enough for everyone and we will never run out of it. Solar energy is **renewable**. The sun will keep making energy for millions of years. Why do we not use the sun for all our energy needs? We do not know how to yet. The hard part is capturing the sunlight. It shines all over the Earth and only a little bit reaches any one place. On a cloudy day, most of the light never reaches the ground at all.

Lots of people put **solar collectors** on their roofs. Solar collectors capture the sunlight and turn it into heat. People heat their houses and their water using the sun's energy. **Solar cells** can turn light energy into electricity. Some toys and calculators use solar cells instead of batteries. Big solar cells can make enough electricity for a house. They are expensive, but good for houses far away from power lines. Today, solar energy provides only a small amount of the electricity we use, but it is more and more each year as solar cells get used more. In the future, it could be a major source of energy. Scientists are looking for new ways to capture, store, and use solar energy more efficiently.

Plants convert the sun's energy to food.

Solar energy makes plants grow.

Solar energy heats land and water.

When solar energy comes in contact with an object it turns into heat.

Some people hang clothes outside to dry.

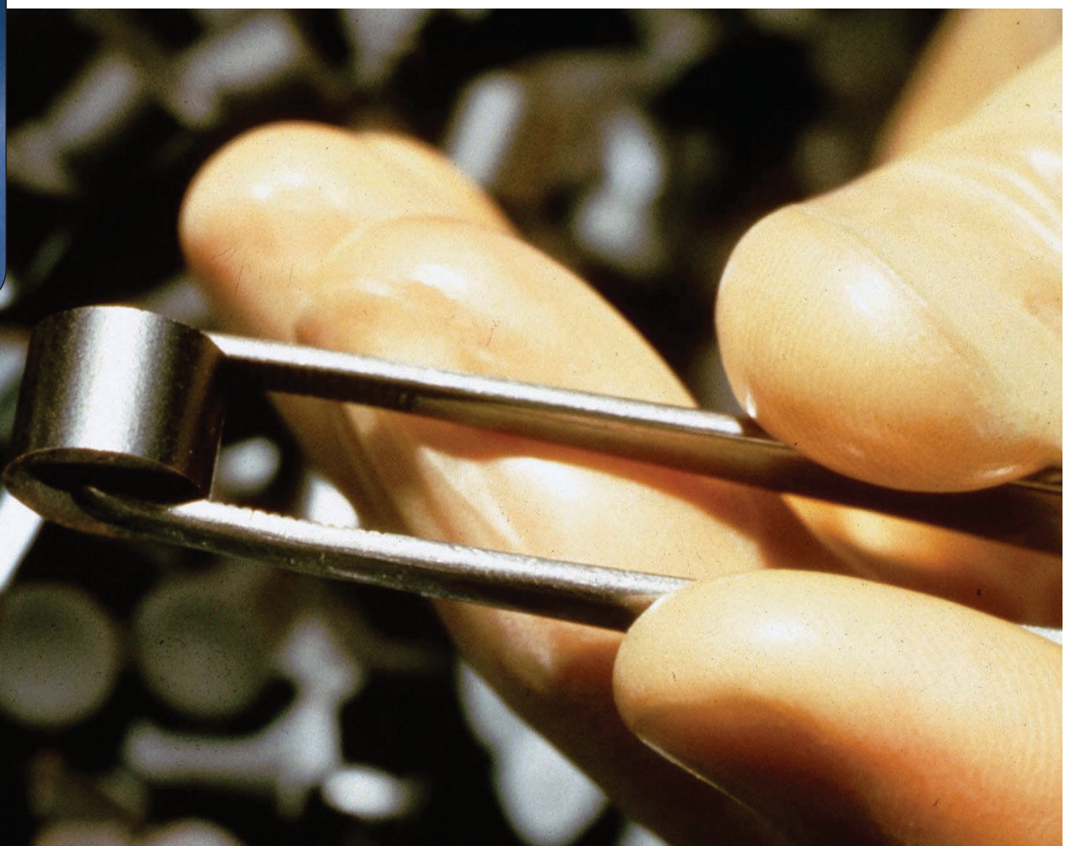
We can use solar energy to dry our clothes.

Solar panels are made of many solar cells. People put solar panels on their homes to turn solar energy into electricity.

Solar cells turn sunlight into electricity.

Uranium

Uranium ore



Uranium is made into fuel pellets, which are used in a nuclear reactor.

Uranium is a mineral buried in the ground. It has energy in it. Uranium is nonrenewable.

Uranium
TEACHER

Uranium is a mineral found in rocks in the ground. Uranium is **nonrenewable**. We cannot make more. There is plenty of uranium, though. We split uranium atoms to get energy.

Everything is made of atoms. Stars, trees, horses, air—all are made of atoms. **Atoms** are tiny, tiny particles. Every atom is made of even smaller particles. In the center of an atom is the **nucleus**. It has **protons** and **neutrons** in it. Moving around the nucleus are **electrons**.

The number of protons tells us what kind of atom it is. So far, 118 different atoms have been found. You have not heard of most of them. There are some you do know. Hydrogen is a gas—every atom of hydrogen has one proton. Oxygen has eight protons, tin has 50, and uranium has 92.

There is energy stored in the nucleus of an atom. It is called **nuclear energy**. It holds the atom together. To use this energy, we have to set it free. There are two ways to free the energy in atoms.

The first way is to combine atoms to make a new atom. This is called **fusion**. The energy from the sun is from fusion. Inside the sun, hydrogen atoms combine to make helium. Helium atoms do not need as much energy to hold them together. The extra energy is released as light and heat.

ENERGY CHANT

URANIUM, URANIUM—Split goes the atom!

Clap twice during "URANIUM, URANIUM." During "Split goes the atom," clap and bring hands out and up, representing the splitting atom.

Another way to free the energy in atoms is to split them apart. We can split one atom into two smaller atoms. This is called **fission**. The two smaller atoms do not need all the energy that held the larger atom together. The extra energy is released as heat and **radiation**.

Power plants use fission to make electricity. Atoms of uranium are split into two smaller atoms. The extra energy is released as heat. This heat is used to make electricity.

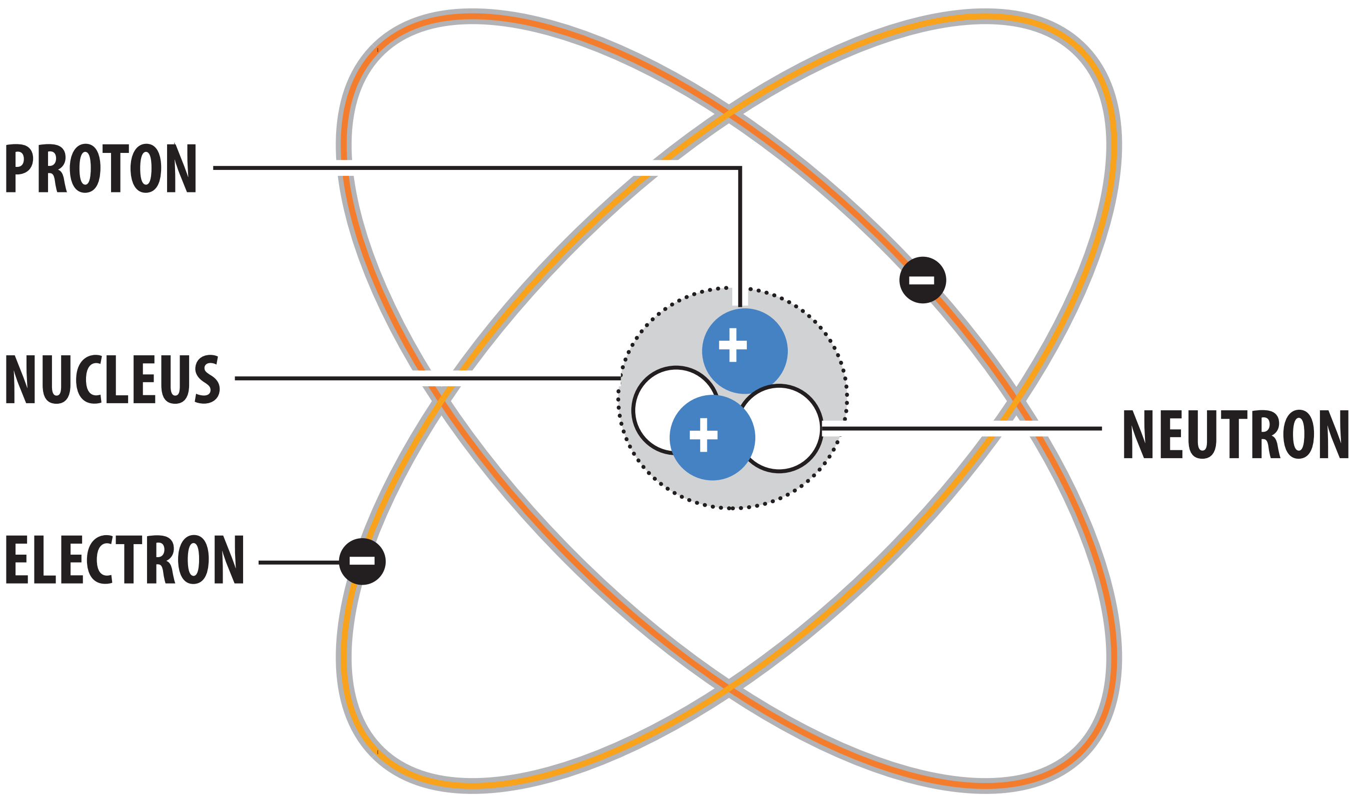
Nuclear power is clean, since no fuel is burned to pollute the air. And uranium is a cheap fuel. Right now, about 19 percent of our electricity comes from splitting atoms of uranium in nuclear power plants.

During fission, heat is not the only energy that is released. Rays of energy, like x-rays, are also given off. These rays of energy, called radiation, can be dangerous in large amounts. Radiation is everywhere. It comes from the sun, older TV sets, and even food. Small amounts of radiation are harmless.

Some radiation is helpful. When we go to the doctor or dentist and get pictures of our bones or teeth, they use x-rays, which is a form of radiation. Some medicine has radiation in it that helps the doctors to look at organs inside our bodies. Doctors are very careful that we do not get too much radiation. Large amounts of radiation can kill our cells and poison our food and water. Power plants are very careful to keep radiation from escaping. The power plants in the United States are very safe.

The fuel from nuclear power plants produces radiation for a long time. After the fuel is used, it is still **radioactive**—it gives off radiation. It cannot be put into a landfill. It must be carefully stored away from people. Some people do not think we should use nuclear energy. They think the radiation is too dangerous. Other people think nuclear energy is a clean, safe way to make electricity.

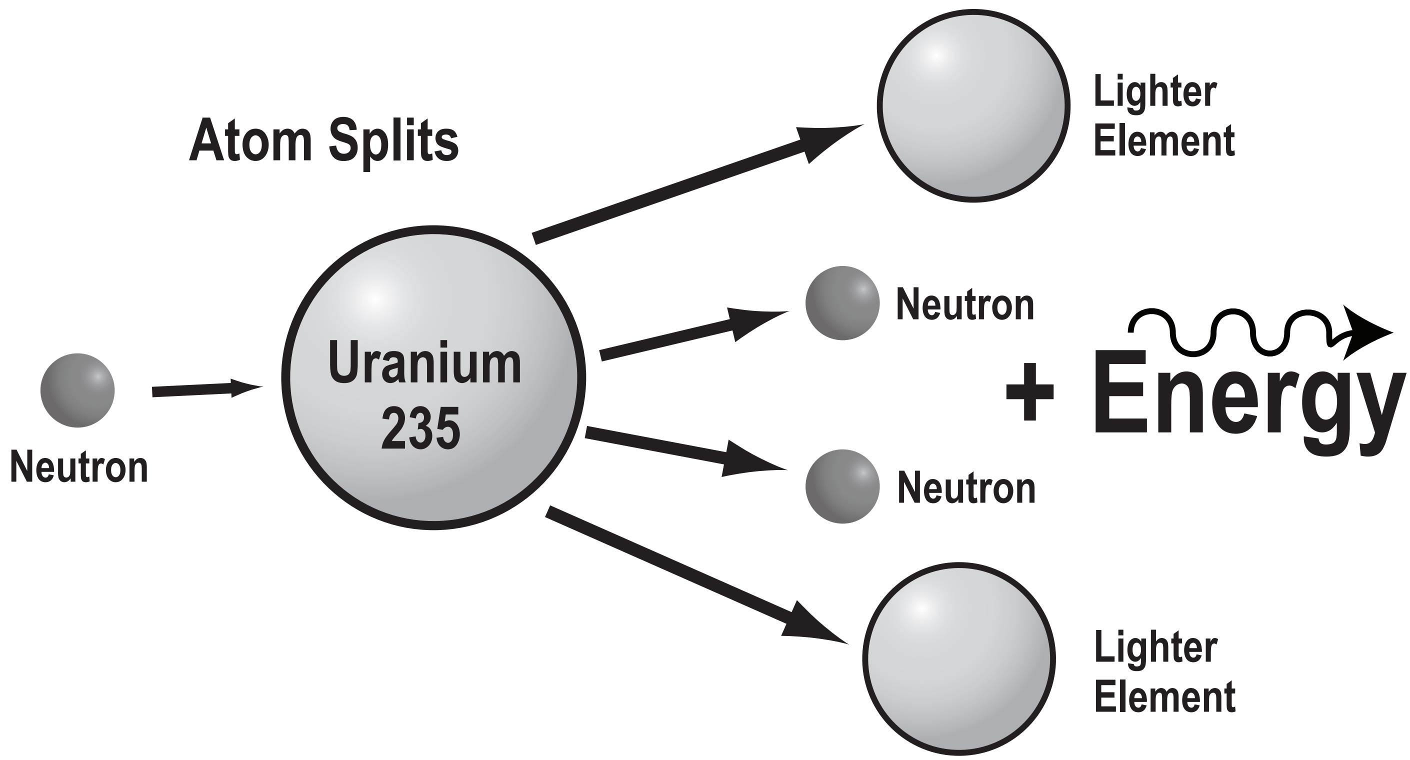
Atom



An atom is made of tiny particles.

All matter is made of atoms. There are over 100 different types of atoms.

Fission



Splitting atoms is called fission.

We can split uranium atoms to get heat energy.

Diablo Canyon Nuclear Power Plant in California.

A nuclear power plant splits uranium atoms to make electricity.

Used nuclear fuel is often stored in large used fuel casks at a nuclear power plant.

Used nuclear fuel can be dangerous and must be stored carefully.

Wind Energy

Wind is moving air.
There will be wind as long as the sun shines.

Wind Energy

TEACHER

ENERGY CHANT

Energy is flowin' in the WIND!

Make big arm circles, mimicking a wind turbine, as you say this chant.

Wind is moving air. We can use the energy in wind to do work. Early Egyptians used the wind to sail ships on the Nile River. People still use wind to move them in sailboats. In the Netherlands, people used windmills to grind wheat. The Pilgrims used windmills to grind corn, to pump water, and to run sawmills. Today, we use wind to make electricity.

The energy in wind comes from the sun. When the sun shines, it heats the Earth. Some parts of the Earth get hotter than others. An area where land and water meets is a good example. Land usually absorbs and releases energy more quickly than water. The air over the land gets hotter than the air over the water. The warm air rises and cooler air rushes in to take its place. The moving air is wind.

As long as the sun shines, there will be winds on the Earth. We will never run out of wind energy. It is a **renewable** energy source. It is also free, since no one can own the sun or the air.

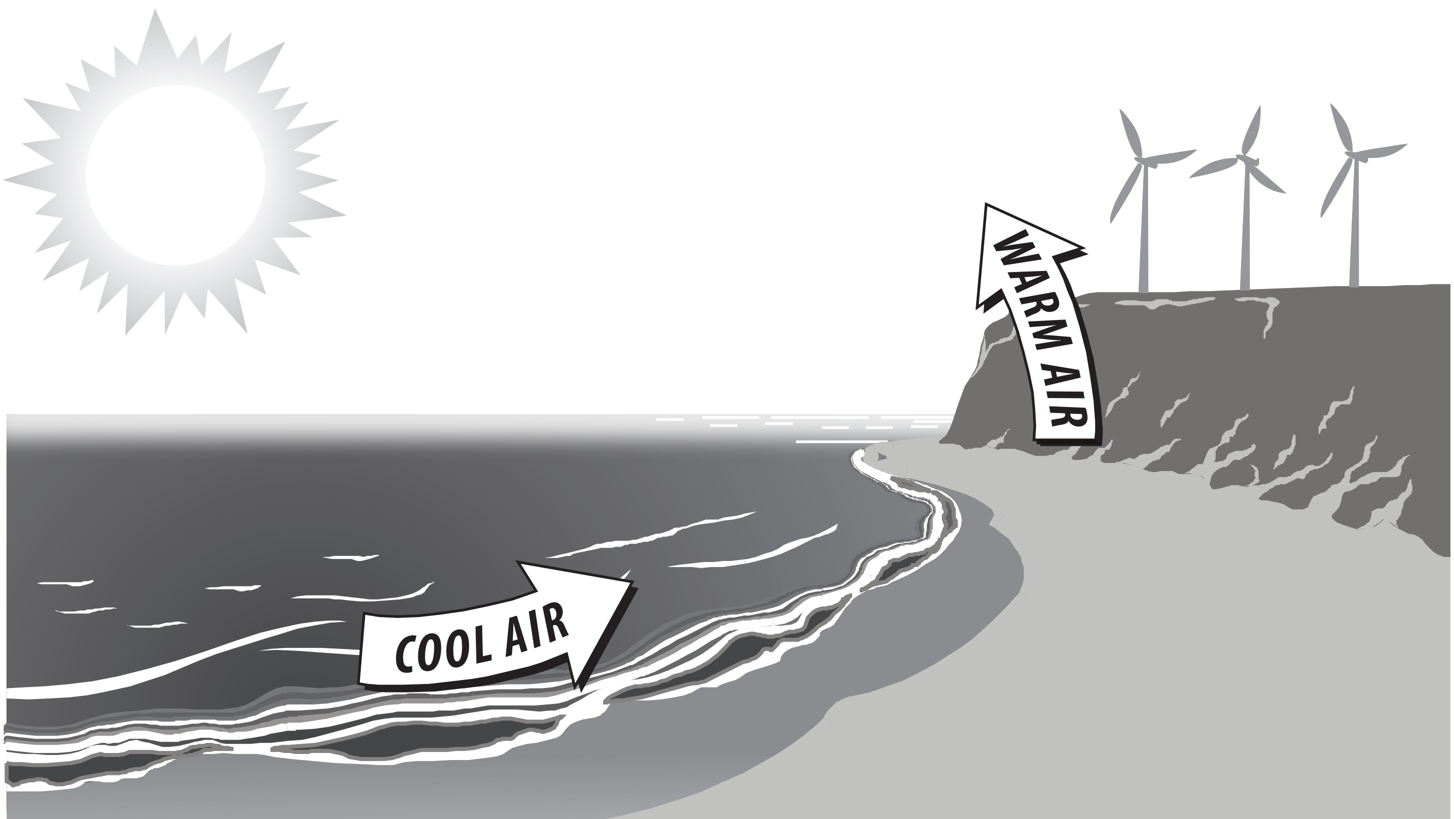
Some places have more wind than others. Areas near the water usually have a lot of wind. Flat land and mountain passes are good places for the wind too. Today, we use big **wind turbines** to catch the wind. Sometimes, there are hundreds of wind turbines in one place. This is called a **wind farm**. Not all wind farms are on land; some countries have wind farms on the water. These are called **offshore wind farms**. The first offshore wind farm in the United States was built off the coast of Block Island, Rhode Island. The five-turbine wind farm began generating electricity for Block Island in 2016.

Many of the wind turbines on wind farms are very tall so they can catch the most wind. Some wind turbines are as tall as a 20-story building! Not all wind turbines are that big though. Some wind turbines might be only 30 feet tall. People can put these small turbines up in their backyards to generate electricity to use at home. Schools can put small wind turbines on their property to make electricity, too. Small wind turbines can even be put on sailboats so people have electricity when they are sailing on the water.

When the wind blows, it pushes against the blades of the wind turbines. The blades spin around. They turn a **generator** to make electricity. The wind turbines do not run all the time, though. Sometimes the wind does not blow at all. Sometimes the wind blows too hard. Most wind turbines operate 65 to 90 percent of the time.

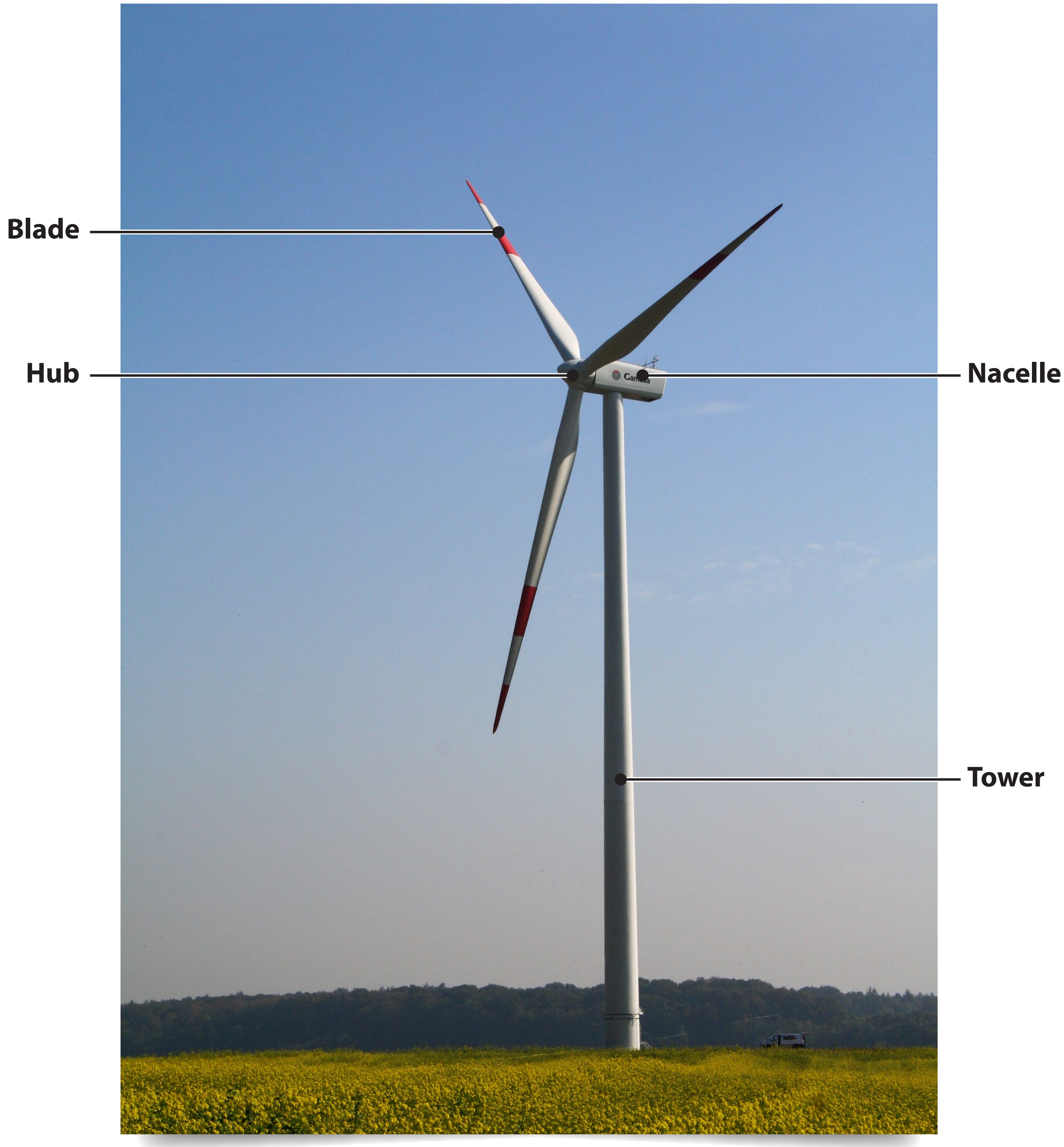
Today, wind energy makes only a little of the electricity we use. Most of the big wind farms are in Texas, Iowa, Oklahoma, California, and the Midwest. More wind turbines and wind farms are popping up all over the country.

How Wind is Formed Where Water Meets Land



1. The sun shines on land and water.
2. Land heats up faster than water.
3. Warm air over the land rises.
4. Cool air over the water moves in.

Wind Turbine



Wind turns the turbine blades, which spin magnets and wires inside the nacelle to generate electricity.

A wind turbine turns wind energy into electricity.

Electricity

Electricity travels long distances through transmission lines.

Electricity is the flow of electrons through wires.

Electricity
TEACHER

Electricity is a mysterious force. We cannot see it like we see the sun. We cannot hold it like we hold coal. We know when it is working, but it is hard to know exactly what it is. Electricity is simply moving **electrons**.

Electricity has been around forever. Lightning is electricity. It is electrons moving from one cloud to another or jumping to the ground.

Power plants use many fuels to make electricity. Most of our electricity comes from burning coal. Uranium, natural gas, wind, hydropower, biomass, and oil are also used to make electricity.

From a power plant, electricity flows through **transmission lines** held up by **power towers**. The transmission lines carry large amounts of electricity to **electric poles** in cities and towns. **Distribution lines** carry small amounts of electricity from the electric poles to houses and businesses.

Electricity does a lot of work for us. We use it many times each day. It lights, warms, and cools our homes. It runs our TVs, DVDs, video games, computers, and refrigerators. It cooks our food and washes the dishes. It mows our lawns and charges our cell phones. It can even run our cars. We use more electricity every year.

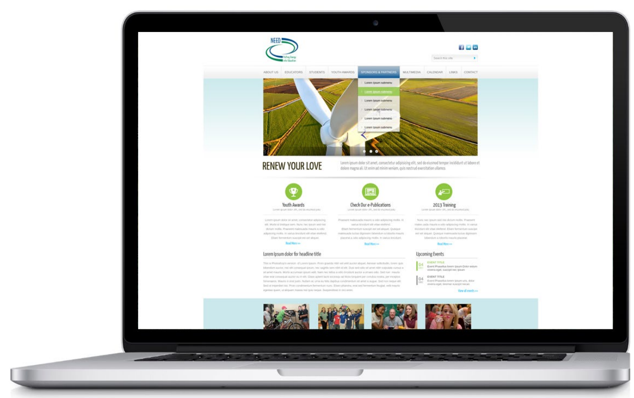
Electricity can be dangerous though. It can cause fires and injuries, even death. Here are some rules for using electricity safely:

1. Do not put anything into an outlet except a plug.
2. Do not pull on the cord to unplug an appliance, hold the plug and pull.
3. Dry your hands before you plug in or unplug a cord.
4. If a plug is broken or a cord is cut or worn, do not use it.
5. Do not plug too many cords into one outlet.
6. Keep appliances away from water. Do not use a hair dryer if there's water in any nearby sink.
7. If there is a big storm, turn off the TV and computer.
8. Do not touch any power lines outside.
9. Some power lines are buried underground. If you are digging and find a wire, do not touch it.
10. Do not fly a kite or climb a tree near a power line.

TV

Clothes Washer

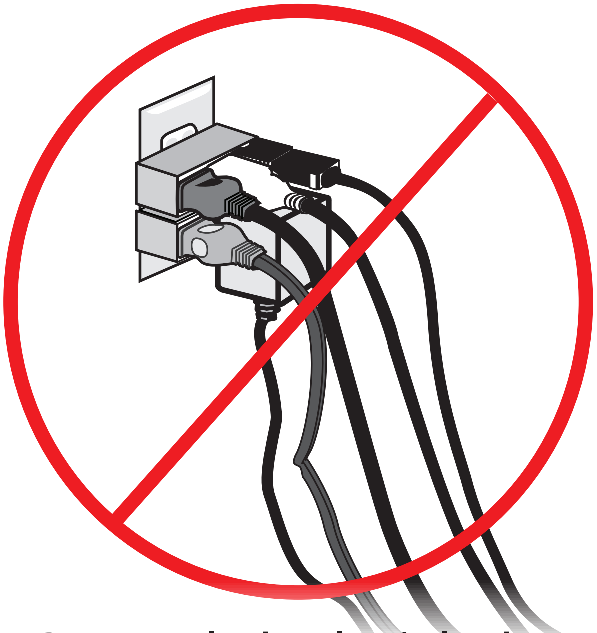
Compact Fluorescent Light Bulb



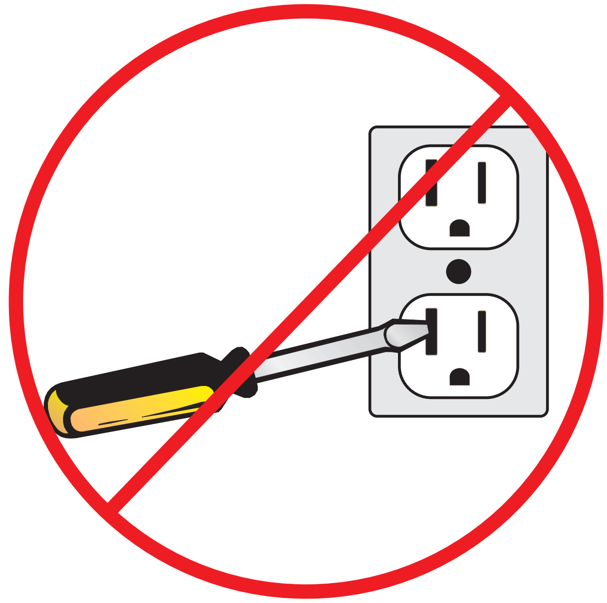
Computer

We use electricity many times every day.

Electrical Safety



Do not overload an electrical socket.
Use a power strip if you need to plug in more than two items.



Do not put fingers or objects into an electrical outlet.

Do not play or climb trees near power lines.
Do not touch a fallen power line.

Electricity can be dangerous.

Saving Energy

When you save energy you save money and natural resources.

Saving Energy
TEACHER

Most of the energy we use today comes from coal, oil, and natural gas. They are **fossil fuels**. They take hundreds of millions of years to form. We cannot make more quickly. They are **nonrenewable**. We need to save energy whenever we can. You can help.

Reduce: A good way to save energy is by not wasting things. Do not use paper plates or cups all the time. They are only used once before they are thrown away. Write on both sides of your paper. Use a lunch box and re-usable bottle instead of paper bags and boxed drinks. Buy one big bottle of juice instead of six little ones. Buy one big bag of chips—not ten little ones. Reducing waste saves energy. It takes energy to make things and to get rid of them. Buy things without a lot of packaging. Some candy has more wrapping around it than food in it. What a waste!

Reuse: Try to use things more than once. Clean plastic containers and use them again. Use the comics from newspapers to wrap presents. Buy toys and games at yard sales or exchanges. You can save energy and money too by giving your old clothes and toys to someone who needs them—do not throw them away.

Repair: Fix old things whenever you can. Paint an old bike instead of buying a new one.

Compost: Put grass clippings, leaves, branches, and food waste into a compost pile instead of throwing them away. It makes great fertilizer for your lawn or garden.

Recycle: You can recycle lots of things—cans, paper, glass, and plastic. It only takes a minute to recycle and it saves energy. It takes a lot of energy to dig up metal and make a can. It only takes a little energy to make a new can from an old one, and cans can be recycled over and over again. Plastic bottles can be recycled into clothes and rugs or more plastic bottles. Paper can be recycled into boxes and bags. Do not throw away anything you can recycle.

Save electricity: You use a lot of electricity every day. Use only what you need. Do not turn on two lights if you only need one. Remember to turn off the lights when you leave a room. Turn off the TV and video games, too. On a sunny day, read by a window. It's a simple way to save energy. Keep the refrigerator door closed and know what you want before you open the door. If you're pouring a drink, do not leave the door open. It takes a lot of energy to cool things. If the air conditioner is on, keep doors and windows closed. Do not go in and out, in and out. If you can, just use a fan and wear light clothes.

Save heat: It takes a lot of energy to heat houses and water. If the heat is on, keep doors and windows closed. Wear warm clothes instead of turning up the heat. At night, use blankets to stay warm. When you take a bath, use only the water you need. Do not stand in the shower for a long time. Heating water uses energy.

Save gasoline: It takes a lot of energy to operate a car. Walk or ride your bike wherever you can. If you and some of your friends are going to the same place, go together. Take the bus instead of asking for a ride to school.

The things you do every day make a difference. If everyone saves just a little energy, it adds up to a lot.

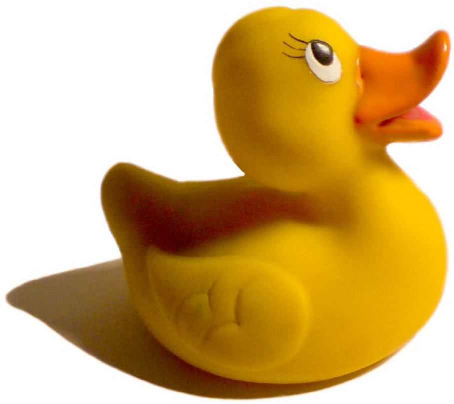
Save Energy Every Day

Keep windows and doors closed when heating or cooling a home.

Turn off the water while you brush your teeth.

Turn off lights, televisions, radios, computers, video games, and other machines when you leave the room.

Use energy-saving CFL and LED bulbs. They save energy and money.



Take a short shower
instead of a bath.

Use a programmable thermostat.

Make sure the dishwasher is full
before turning it on.

Decide what you want before
opening the refrigerator door.

Transportation

Ride the bus.

Ride a bike.

Walk to school.

When appropriate, save energy by using public transportation, riding your bike, or walking.

Reduce, Reuse, Recycle

Reduce the amount of waste to save energy.

Buy a small can of frozen juice to make at home instead of buying a large carton of juice.

Reuse things instead of throwing them away.

Use a lunch box again and again instead of a lunch sack that you throw away.

Recycle everything you can. Recycling saves energy.

You can recycle paper, aluminum, plastic, and glass.

Repair

Usually you can fix a flat bicycle tire with a patch.

Repair things instead of throwing them away.

Protect the Environment

Saving energy protects our environment.

Games, Puzzles, and Activities

Looking for some fun energy activities? There are plenty of fun games, puzzles, and activities available at www.NEED.org/games.

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Eversource
Exelon Foundation
Foundation for Environmental Education
FPL
The Franklin Institute
George Mason University – Environmental Science and Policy
Gerald Harrington, Geologist
Government of Thailand–Energy Ministry
Green Power EMC
Guilford County Schools – North Carolina
Gulf Power
Hawaii Energy
Idaho National Laboratory
Illinois Clean Energy Community Foundation
Illinois Institute of Technology
Independent Petroleum Association of New Mexico
James Madison University
Kentucky Department of Energy Development and Independence
Kentucky Power – An AEP Company
Kentucky Utilities Company
League of United Latin American Citizens – National Educational Service Centers
Leidos
Linn County Rural Electric Cooperative
Llano Land and Exploration
Louisville Gas and Electric Company
Mississippi Development Authority–Energy Division
Mississippi Gulf Coast Community Foundation
Mojave Environmental Education Consortium
Mojave Unified School District
Montana Energy Education Council
The Mountain Institute
National Fuel
National Grid
National Hydropower Association
National Ocean Industries Association
National Renewable Energy Laboratory
NC Green Power
New Mexico Oil Corporation
New Mexico Landman's Association
NextEra Energy Resources
NEXTracker
Nicor Gas
Nisource Charitable Foundation
Noble Energy
Nolin Rural Electric Cooperative
Northern Rivers Family Services
North Carolina Department of Environmental Quality
North Shore Gas
Offshore Technology Conference
Ohio Energy Project
Opterra Energy
Pacific Gas and Electric Company
PECO
Pecos Valley Energy Committee
Peoples Gas
Pepco
Performance Services, Inc.
Petroleum Equipment and Services Association
Phillips 66
PNM
PowerSouth Energy Cooperative
Providence Public Schools
Quarto Publishing Group
Read & Stevens, Inc.
Renewable Energy Alaska Project
Rhode Island Office of Energy Resources
Robert Armstrong
Roswell Geological Society
Salt River Project
Salt River Rural Electric Cooperative
Saudi Aramco
Schlumberger
C.T. Seaver Trust
Secure Futures, LLC
Shell
Shell Chemicals
Sigora Solar
Singapore Ministry of Education
Society of Petroleum Engineers
Society of Petroleum Engineers – Middle East, North Africa and South Asia
Solar City
David Sorenson
South Orange County Community College District
Tennessee Department of Economic and Community Development–Energy Division
Tesla
Tesoro Foundation
Tri-State Generation and Transmission
TXU Energy
United Way of Greater Philadelphia and Southern New Jersey
University of Kentucky
University of Maine
University of North Carolina
University of Tennessee
U.S. Department of Energy
U.S. Department of Energy–Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy–Wind for Schools
U.S. Energy Information Administration
United States Virgin Islands Energy Office
Wayne County Sustainable Energy
Western Massachusetts Electric Company
Yates Petroleum Corporation