2015-2016

Energy Flows

Students learn about the forms of energy, how energy is converted from one form to another, and how energy fl ws through systems in this hands-on activity.

Grade Levels:

- Elem Elementary
- Int Intermediate
- Sec Secondary

Subject Areas:

- Science
- Language Arts

SELECTED CLEAN

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.

Teacher Advisory Board Statement

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

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Energy Data Used in NEED Materials

NEED believes in providing the most recently reported energy data available to our teachers and students. Most statistics and data are derived from the U.S. Energy Information Administration's Annual Energy Review that is published yearly. Working in partnership with EIA, NEED includes easy to understand data in our curriculum materials. To do further research, visit the EIA website at www.eia.gov. EIA's Energy Kids site has great lessons and activities for students at www.eia.gov/kids.

NEED
National Energy
Education Development

1.800.875.5029
www.NEED.org

Energy Flows

NEED is proud to announce that this guide is a part of the CLEAN Collection! The Climate Literacy and Energy Awareness Network, or CLEAN, is a nationally recognized project led by science and education experts to support climate and energy education through the collection of educational resources. CLEAN resources are peer-reviewed by educators and scientists as well as annotated and aligned with standards and benchmarks. This NSF, DOE, and NOAA funded project is an excellent library of learning activities, visualizations, videos, and investigations. To learn more about CLEAN, view other activities in the CLEAN Collection, or to join the CLEAN community, visit http://cleanet.org/clean/about/selected_by_CLEAN.

Table of Contents

Standards Correlation Information

www.NEED.org/curriculumcorrelations

Next Generation Science Standards

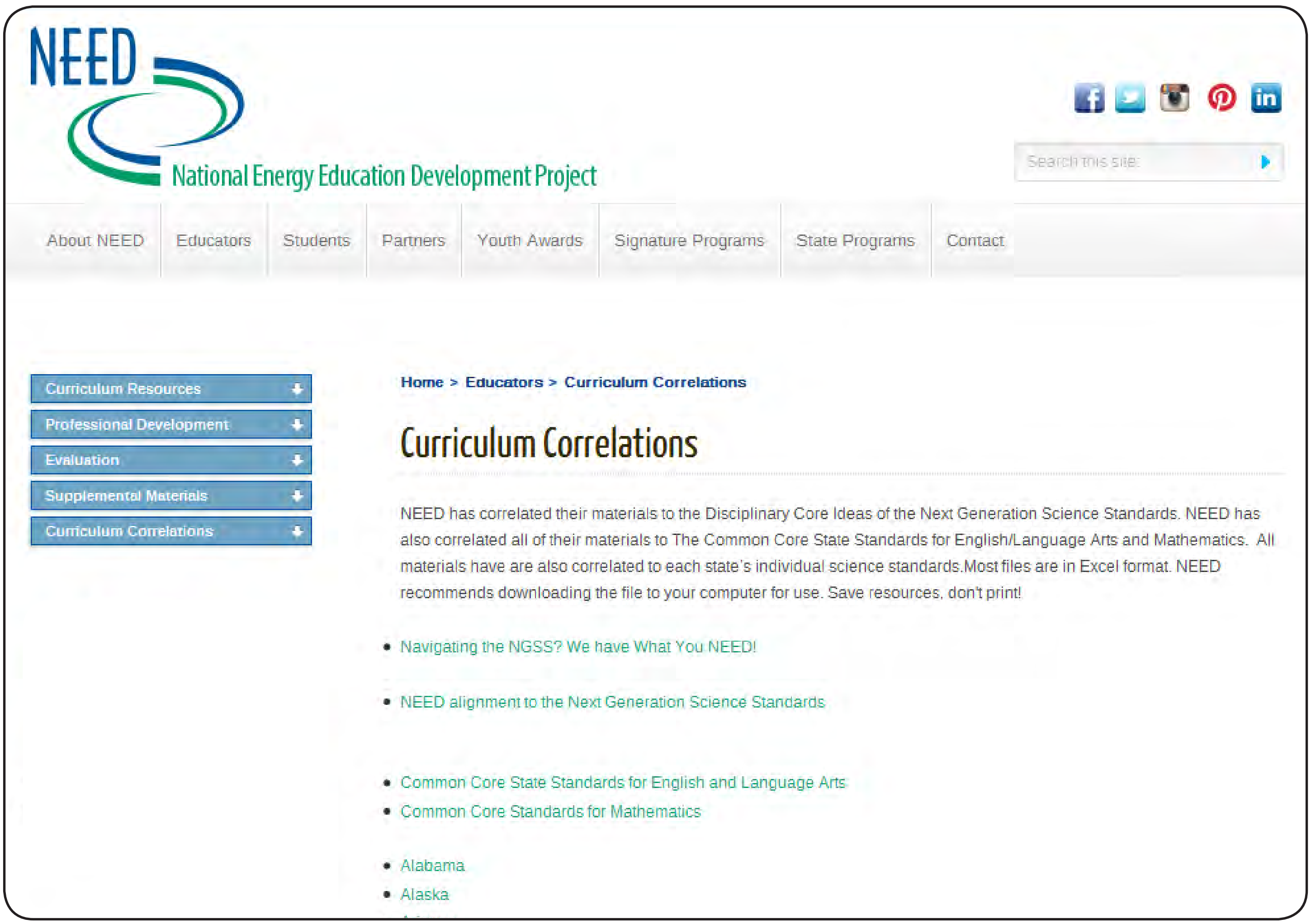
- This guide effectively supports many Next Generation Science Standards. This material can satisfy performance expectations, science and engineering practices, disciplinary core ideas, and cross cutting concepts within your required curriculum. For more details on these correlations, please visit NEED's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

These hands-on activities, manipulatives, and fl w charts will help students understand forms of energy, energy transformations, and the fl w of energy through systems.

Objectives

- Students will be able to name the various forms of energy and identify an everyday item that has or stores each form.
- Students will be able to describe how energy is transformed through various items.
- Students will be able to trace an energy fl w back to the sun (nuclear energy).

Materials

- Battery powered flashlig t
- Hand generated flashlig t
- Kitchen matches
- String (optional)
- Tape (optional)
- Index cards or cardstock (optional)

NOTE: Flashlights can be purchased from NEED. Call 1-800-875-5029 for more information.

Preparation

- Familiarize yourself with the entire guide and all of the energy fl ws showcased within. Decide if you will go through all of the energy sources and/or identify which specific sources you will be covering.
- Download or make copies of the masters needed to project for the class. See the chart on page 6 for titles and page numbers.
- Make copies of student worksheets, as necessary. See the chart on page 6 for titles and page numbers.
- Make copies of the energy fl w cards on pages 27-36. Make enough copies of each series of cards you wish to use so that each student or group has a set. Copy any of the substitute cards to focus on a different energy source or to assemble more complex fl ws. Depending on the age of your students, you may choose to pre-cut and fold the cards on the dotted lines. Cards may be copied onto cardstock or glued onto note cards for multiple uses. Group the cards by series using the numbers in the top left corner, and place each series in an envelope or baggie.

✔ Procedure

Part 1: Introduction

1. Introduce the activity by lighting a wooden match and asking students to describe what is happening using the word "energy". Ask students where the match gets its energy from. Explain that the match's energy can be traced all the way back to the sun. The match came from wood, which got its energy from the sun.

   Note: Older students may be asked to make a fl w chart to explain where the energy came from prior to having a discussion as a class.

2. Use the *Forms of Energy* master on page 8 to provide an introduction or review of the forms of energy.

Grade Levels

- Elementary, grade 5
- Intermediate, grades 6–8
- Secondary, grades 9–12

Time

- One to three 45-minute class periods

Additional Resources

- For comprehensive background information on energy sources, download one of the *Energy Infobooks* from www.NEED.org.
- Supporting activities that reinforce energy concepts and the sources of energy can be found in the *Energy Infobook Activities* guides at www.NEED.org.
- For hands-on science investigations about energy transformations, download *Elementary, Intermediate,* or *Secondary Science of Energy* from www.NEED.org.
- For language arts connections, visit NEED's book list for a searchable database of fi tion and nonfi tion titles related to energy.

3. Distribute the *Forms and Sources of Energy* worksheet on page 9. Instruct students to identify the forms of energy that are stored in or delivered by each of the sources of energy. If students are less familiar with each source, use the *Energy Infobooks* for text-based support, or *Energy Infobook Activities* for a matching worksheet that outlines the various sources.
4. Have students then calculate the percentages of energy provided by each form and category. This can be done as a class or individually, depending on the level of your students.
5. Discuss the answers as a class. Answers can be found on page 7.

Part 2: Flashlights and Energy Flow

1. Demonstrate a regular battery-powered flashlig t and a hand generated flashlig t. Ask the class to explain what energy transformations are happening within each flashlig t.
2. Ask students to write out or share the energy fl w from the sun to the hand generated flashlig t.
3. Use the *Energy Transformations in a Hand Generated Flashlight* master on page 10 to discuss as a class. Compare how each flashlig t's energy fl w might differ.

Note: For more information about hand generated flashlig ts and how they work, check out NEED's *Science of Energy* guides at the elementary, intermediate, or secondary level.

Part 3: Power Plants, Energy Sources, and Energy Flow

1. Discuss how different sources of energy are used to generate power. See the chart below for specific pages and relevant information. Older or more independent students may be able to choose (or be assigned) a source and explain the transformations and processes to the class.
2. Discuss the similarities and differences between fossil fuel power plants, wind turbines, hydropower plants, and nuclear power plants.

Energy Source	Introduction	Masters to explain generation by source.	Student Energy Flow Worksheet
Fossil Fuels	Review with students what fossil fuels are. Tell them that coal and natural gas are responsible for generating more than 60 percent of the electricity consumed in the U.S. Fossil fuels are used in thermal power plants because the fuel is burned.	*Fusion*, page 11 *Photosynthesis*, page 12 *How Coal Was Formed*, page 13 *Oil and Natural Gas Formation*, page 14 *Burning Fossil Fuels to Generate Electricity*, page 15	*Fossil Fuel Energy Flow*, page 16
Wind	Tell students that wind generates just about 4 percent of the electricity in the United States. It is the fastest growing energy source for generating electricity.	*Fusion*, page 11 *How Wind is Formed*, page 17 *Harnessing the Wind to Generate Electricity*, page 18	*Wind Energy Flow*, page 19
Hydropower	Tell students that there are more than 2,200 hydropower plants generating electricity in the U.S. The amount of electricity generated by hydropower (currently a little more than 6 percent) varies depending on rainfall amounts and droughts.	*Fusion*, page 11 *The Water Cycle*, page 20 *Harnessing Hydropower to Generate Electricity*, page 21	*Hydropower Energy Flow*, page 22
Uranium	Tell students that nuclear energy is responsible for generating a little less than 20 percent of the electricity in the U.S. Nuclear power plants are also considered thermal power plants. Even though uranium isn't burned, thermal energy is produced from the fission eactions.	*Fission,* page 23 *Uranium Fuel Cycle*, page 24 *Using Nuclear Energy to Generate Electricity*, page 25	*Nuclear Energy Flow*, page 26

Part 4: Energy Flow Cards

1. Put students into groups, if desired, or students may work individually.
2. Distribute the desired series of energy flow cards. Depending on the level of the students, you may have all students working on one series at a time, or differing series can be passed out at one time. Some groups may also be given more than one series at a time.
3. Have students correctly arrange the energy flow in each series of cards. Students should write out or verbally explain the forms of energy present in each step of the energy flow. You may have them use string and tape to connect each step of the flow, if desired.

Variations and Extensions

- Make the cards into necklaces. Have students make a human chain demonstrating the correct order of each energy flow.
- Give each group of students a different series of cards. Have each group explain their energy flow to the class using forms of energy vocabulary.
- Combine one or more parts of each series to create a multiple-conversion process. Have students connect each step in the flow. (Some steps will have multiple connections.)
- Act out *A Cool Coal Story* (see pages 37-39).
- Have students write and act out an energy flow of their choice using props and a script.

☑Evaluation

- Have the students demonstrate comprehension of the forms of energy and energy transformations (flow) by designing energy flow cards for a multiple-conversion process not discussed in class.
- Evaluate the activity using the form on page 40 and return it to NEED.

☑Forms and Sources of Energy Answer Key

NONRENEWABLE	RENEWABLE
Petroleum - chemical	Biomass - chemical
Coal - chemical	Hydropower - motion
Natural Gas - chemical	Wind - motion
Uranium - nuclear	Solar - radiant
Propane - chemical	Geothermal - thermal

- Chemical - 86.7%, Nuclear - 8.5%, Motion - 4.2%, Thermal - 0.2%, Radiant - 0.3%
- Nonrenewables - 90.4%, Renewables - 9.4%

Forms of Energy

All forms of energy fall under two categories:

POTENTIAL

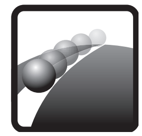
Stored energy and the energy of position (gravitational).

CHEMICAL ENERGY is the energy stored in the bonds of atoms and molecules. Gasoline and a piece of pizza are examples.

NUCLEAR ENERGY is the energy stored in the nucleus of an atom – the energy that holds the nucleus together. The energy in the nucleus of a plutonium atom is an example.

ELASTIC ENERGY is energy stored in objects by the application of force. Compressed springs and stretched rubber bands are examples.

GRAVITATIONAL POTENTIAL ENERGY is the energy of place or position. A child at the top of a slide is an example.



KINETIC

The motion of waves, electrons, atoms, molecules, and substances.

RADIANT ENERGY is electromagnetic energy that travels in transverse waves. Light and x-rays are examples.

THERMAL ENERGY or heat is the internal energy in substances – the vibration or movement of atoms and molecules in substances. The heat from a fi e is an example.

MOTION is the movement of a substance from one place to another. Wind and moving water are examples.

SOUND is the movement of energy through substances in longitudinal waves. Echoes and music are examples.

ELECTRICAL ENERGY is the movement of electrons. Lightning and electricity are examples.

Forms and Sources of Energy

In the United States we use a variety of resources to meet our energy needs. Use the information below to analyze how each energy source is stored and delivered.

1 Using the information from the *Forms of Energy* chart, and the graphic below, determine how energy is stored or delivered in each of the sources of energy. Remember, if the source of energy must be burned, the energy is stored as chemical energy.

NONRENEWABLE		RENEWABLE	
Petroleum	________________	Biomass	________________
Coal	________________	Hydropower	________________
Natural Gas	________________	Wind	________________
Uranium	________________	Solar	________________
Propane	________________	Geothermal	________________

2 Look at the U.S. Energy Consumption by Source graphic below and calculate the percentage of the nation's energy use that each form of energy provides.

What percentage of the nation's energy is provided by each form of energy?

Chemical _____

Nuclear _____

Motion_____

Thermal _____

Radiant _____

What percentage of the nation's energy is provided by nonrenewables? ______

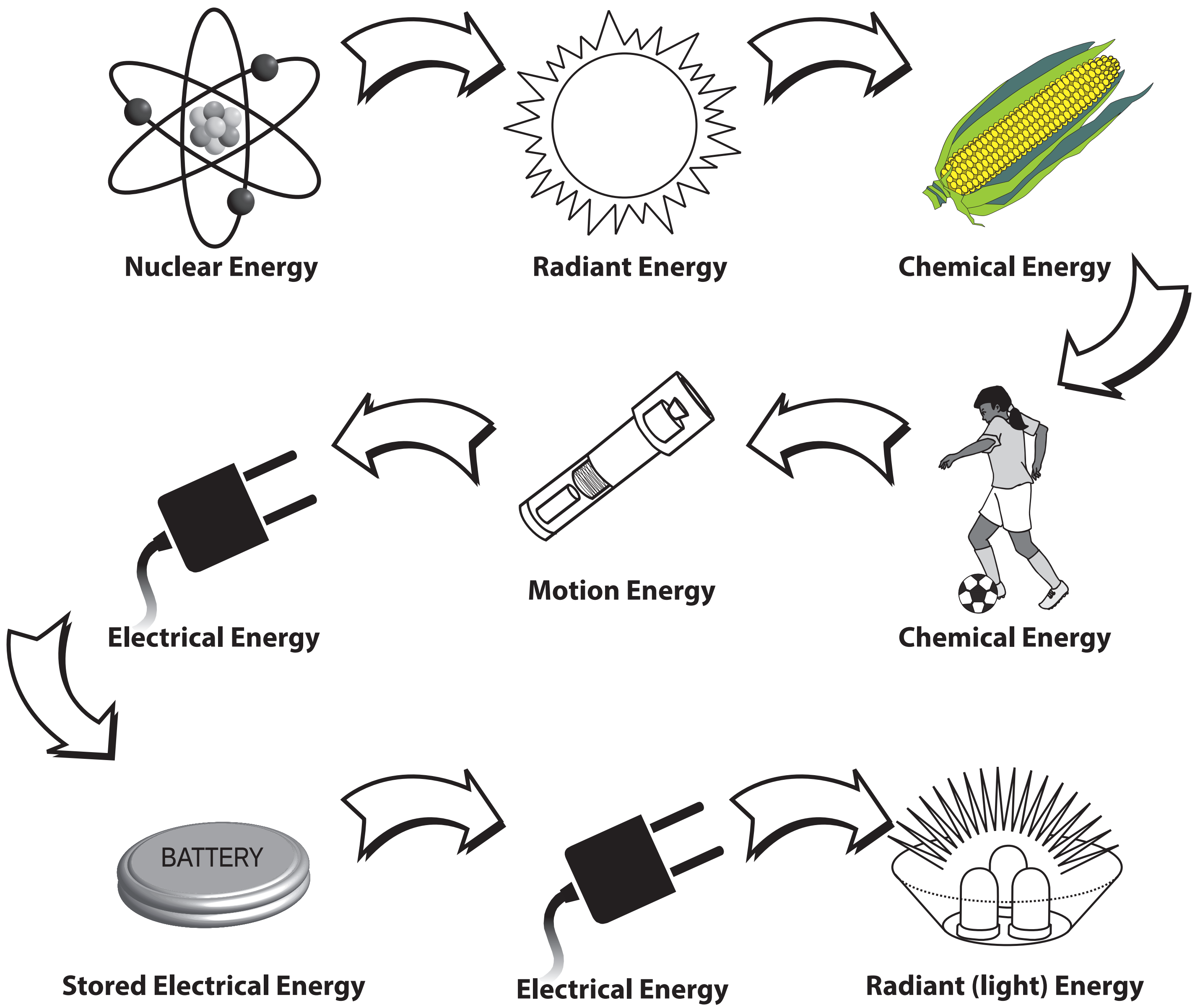
by renewables? ______

U.S. Energy Consumption by Source, 2013

NONRENEWABLE		RENEWABLE	
PETROLEUM *Uses: transportation, manufacturing*	**35.2%**	**BIOMASS** *Uses: heating, electricity, transportation*	**4.7%**
NATURAL GAS *Uses: heating, manufacturing, electricity*	**26.6%**	**HYDROPOWER** *Uses: electricity*	**2.6%**
COAL *Uses: electricity, manufacturing*	**18.5%**	**WIND** *Uses: electricity*	**1.6%**
URANIUM *Uses: electricity*	**8.5%**	**SOLAR** *Uses: heating, electricity*	**0.3%**
PROPANE *Uses: heating, manufacturing*	**1.7%**	**GEOTHERMAL** *Uses: heating, electricity*	**0.2%**

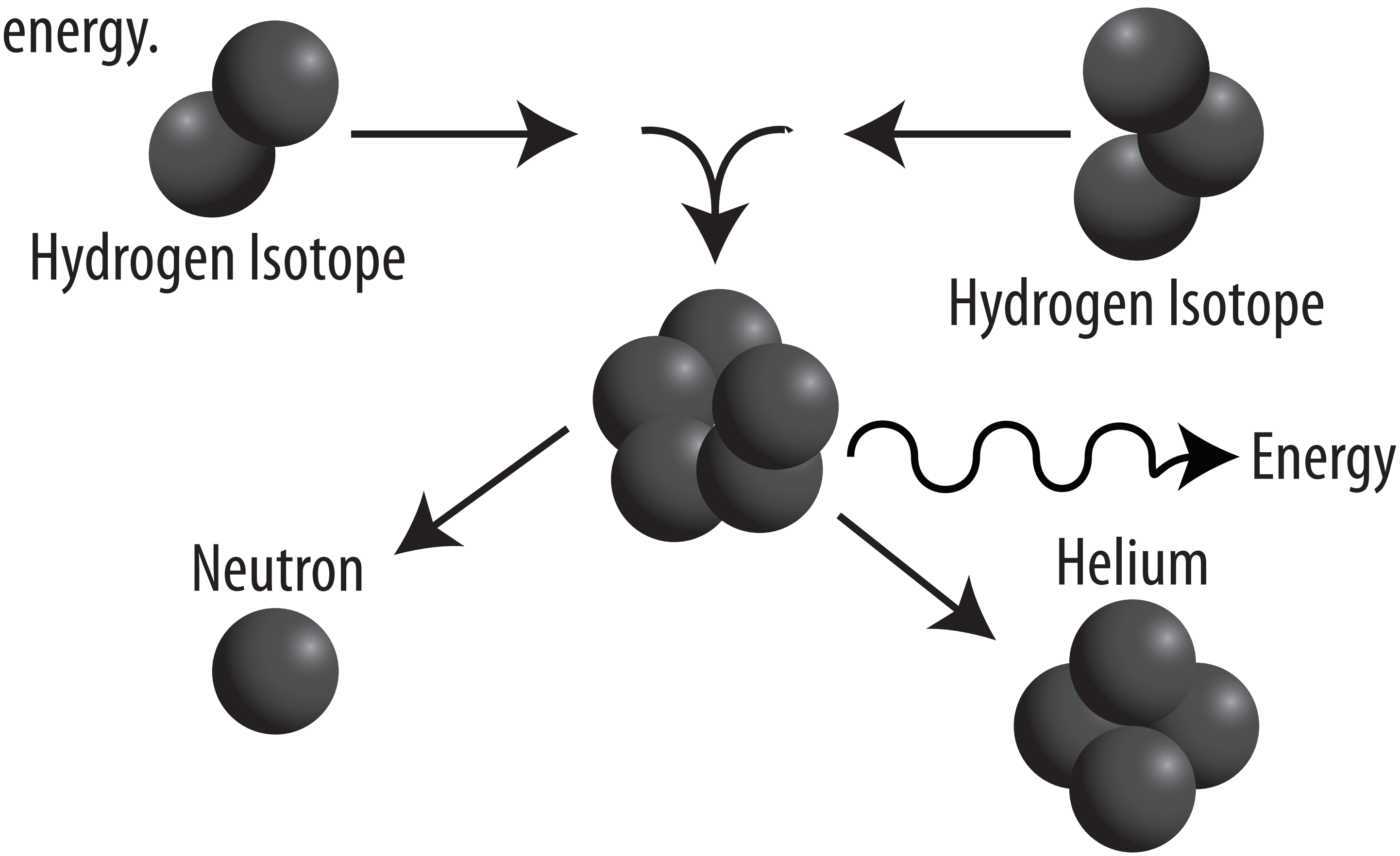
*Total does not add to 100% due to independent rounding.
Data: Energy Information Administration

Energy Transformations in a Hand Generated Flashlight

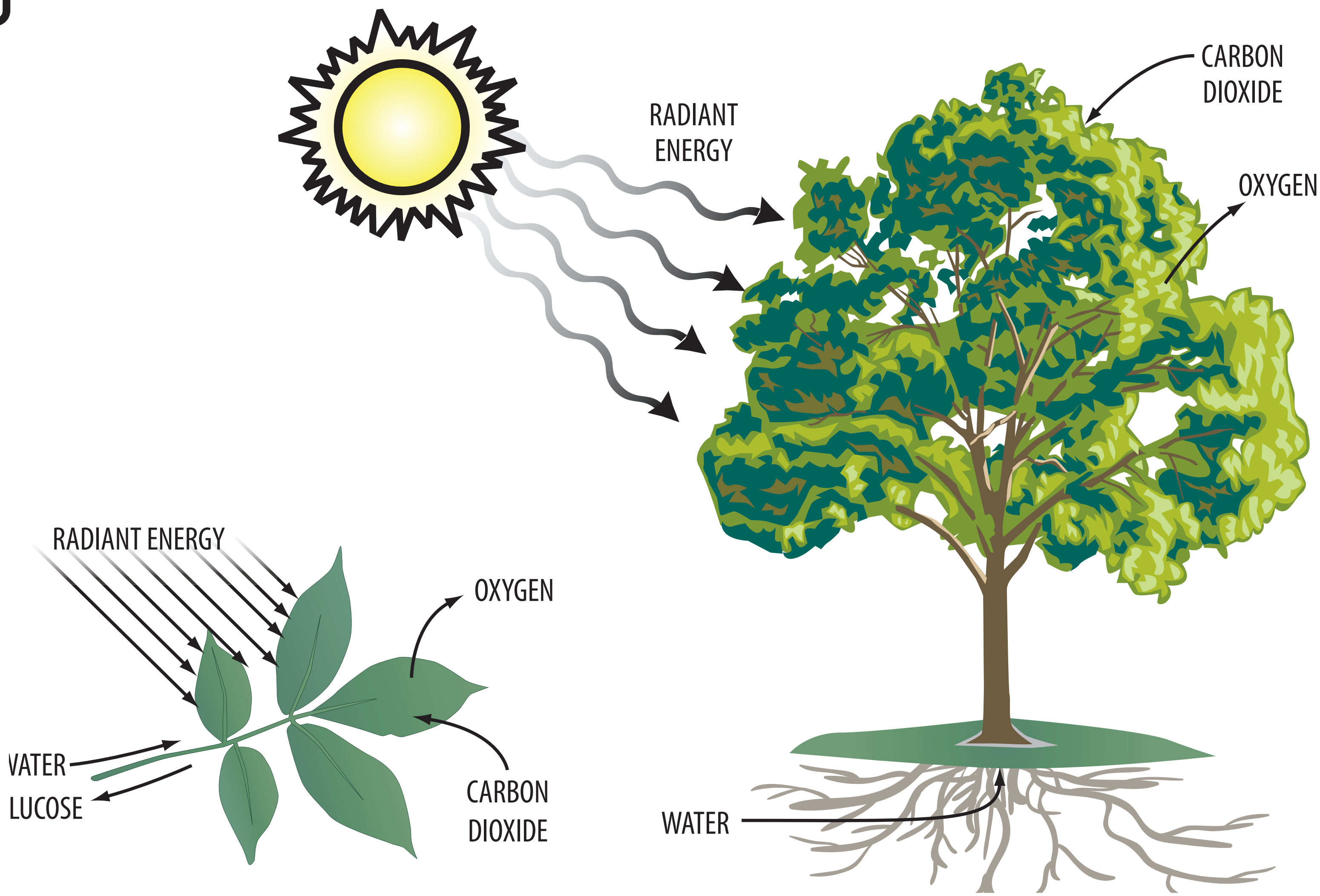


Fusion

The process of fusion most commonly involves hydrogen isotopes combining to form a helium atom with a transformation of matter. This matter is emitted as radiant energy.



Photosynthesis

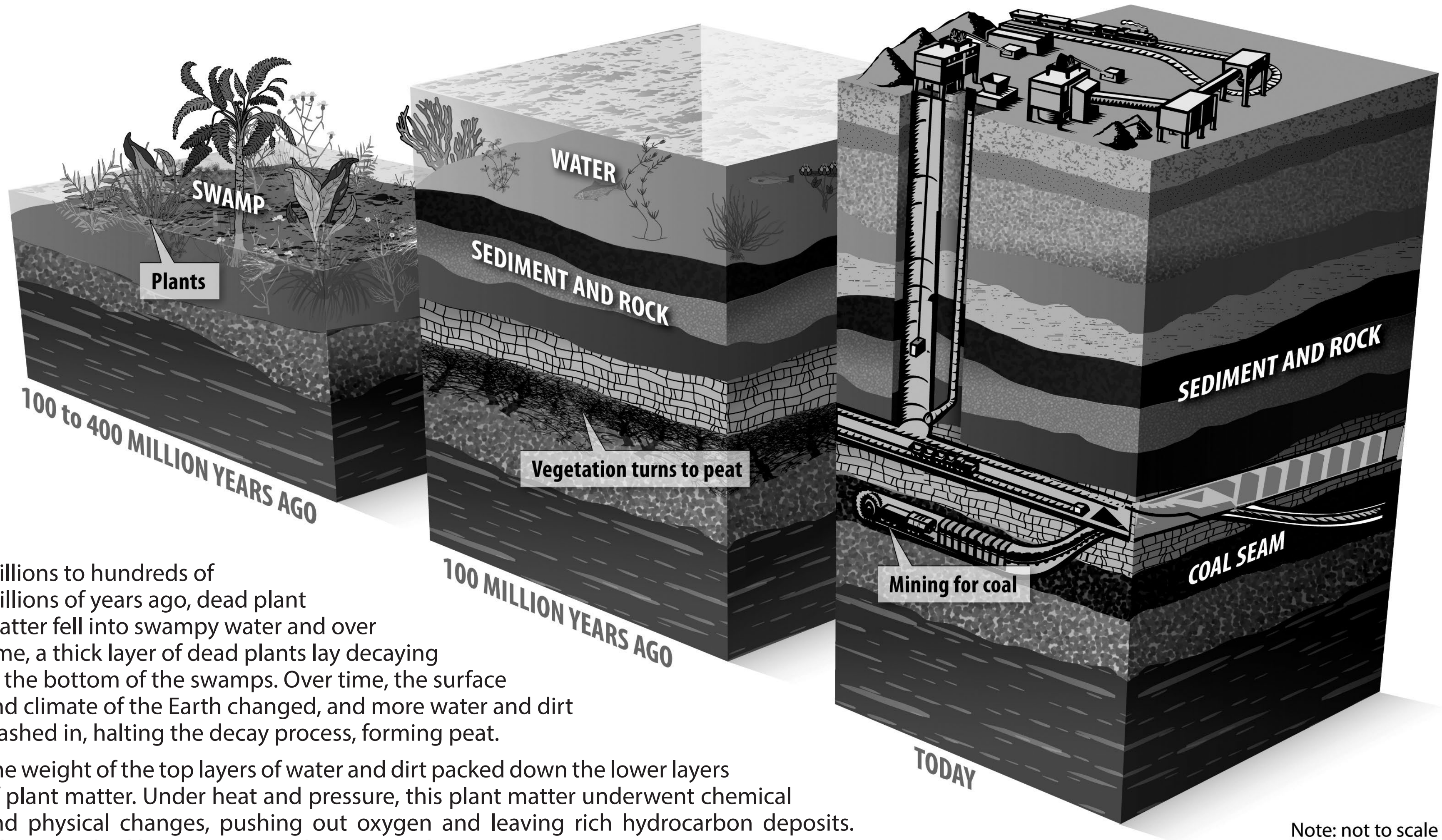


In the process of photosynthesis, plants convert radiant energy from the sun into chemical energy in the form of glucose (or sugar).

water + carbon dioxide + sunlight → glucose + oxygen

$$6\,H_2O + 6\,CO_2 + \text{radiant energy} \longrightarrow C_6H_{12}O_6 + 6\,O_2$$

How Coal Was Formed



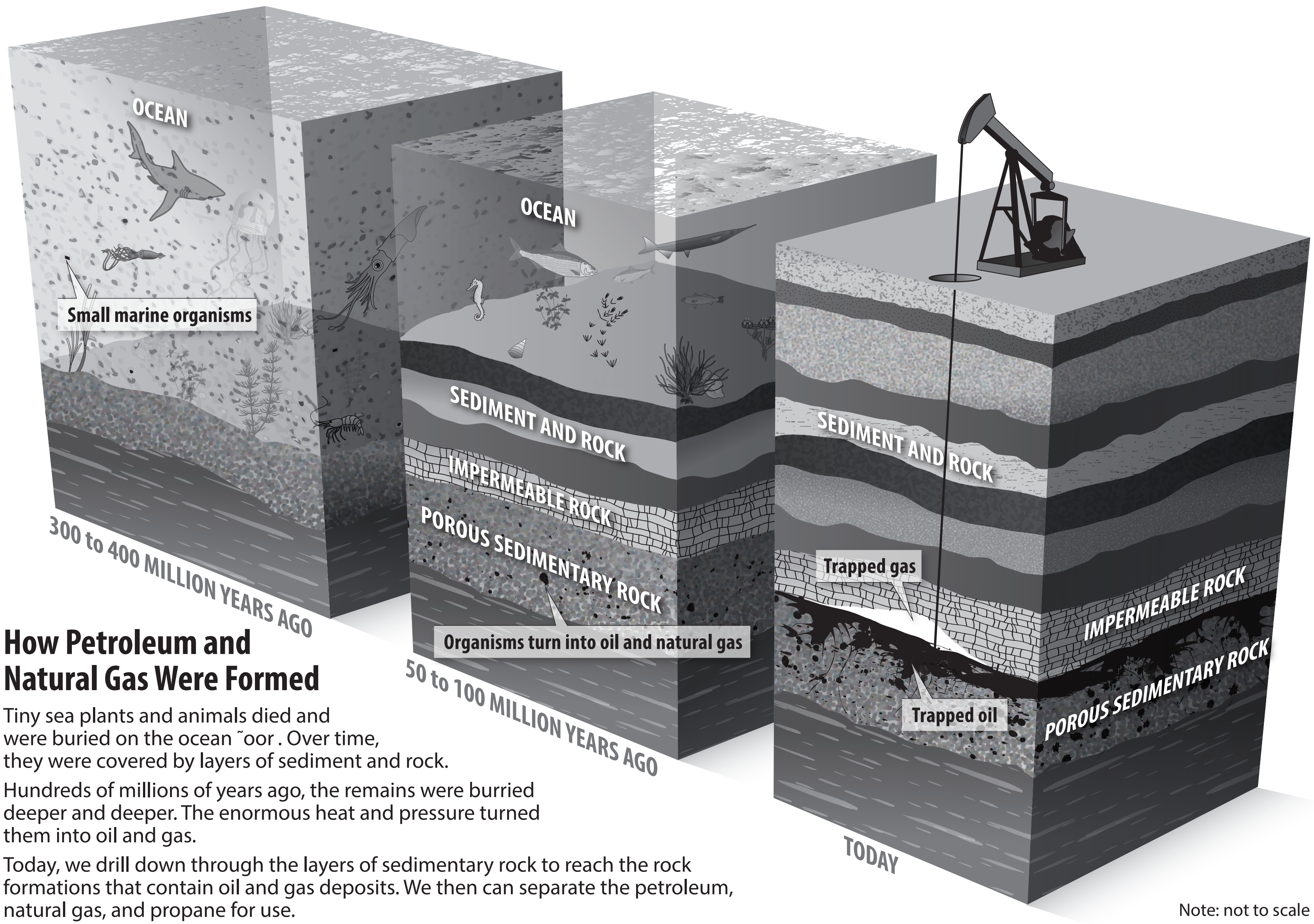
Note: not to scale

Millions to hundreds of millions of years ago, dead plant matter fell into swampy water and over time, a thick layer of dead plants lay decaying at the bottom of the swamps. Over time, the surface and climate of the Earth changed, and more water and dirt washed in, halting the decay process, forming peat.

The weight of the top layers of water and dirt packed down the lower layers of plant matter. Under heat and pressure, this plant matter underwent chemical and physical changes, pushing out oxygen and leaving rich hydrocarbon deposits. What once had been plants gradually turned into coal.

Coal can be found deep underground (as shown in this graphic), or it can be found near the surface.

Oil and Natural Gas Formation



How Petroleum and Natural Gas Were Formed

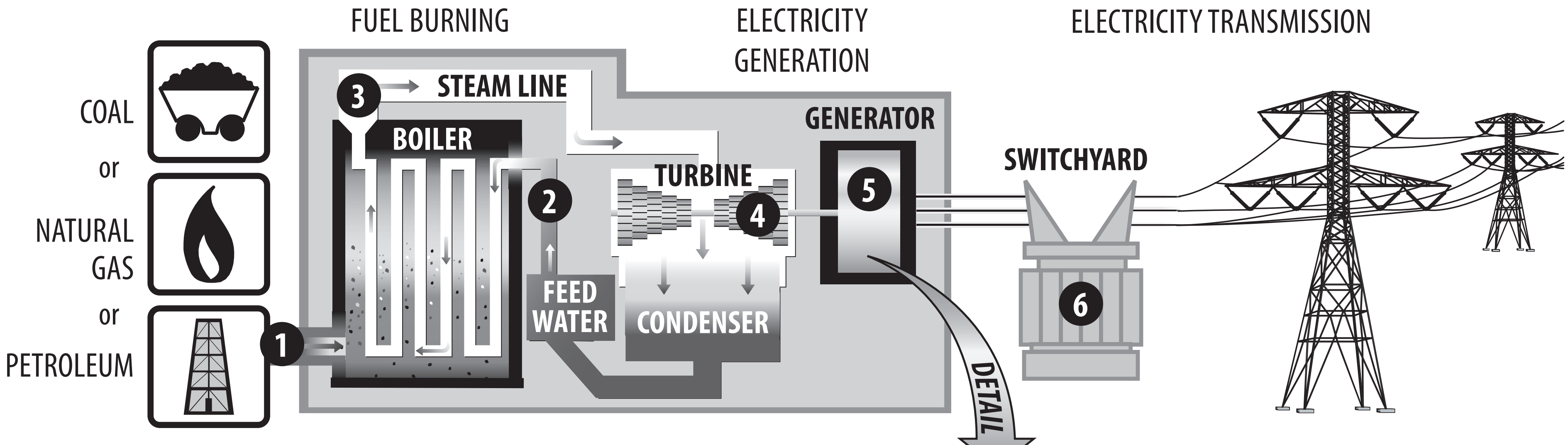
Tiny sea plants and animals died and were buried on the ocean ˜oor . Over time, they were covered by layers of sediment and rock.

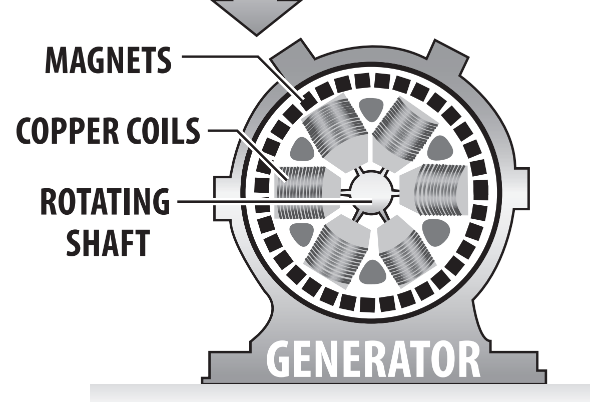
Hundreds of millions of years ago, the remains were burried deeper and deeper. The enormous heat and pressure turned them into oil and gas.

Today, we drill down through the layers of sedimentary rock to reach the rock formations that contain oil and gas deposits. We then can separate the petroleum, natural gas, and propane for use.

Note: not to scale

Burning Fossil Fuels to Generate Electricity





1. A fossil fuel is fed into a boiler, where it is burned to release thermal energy.

2. Water is piped into the boiler and heated, turning it into steam.

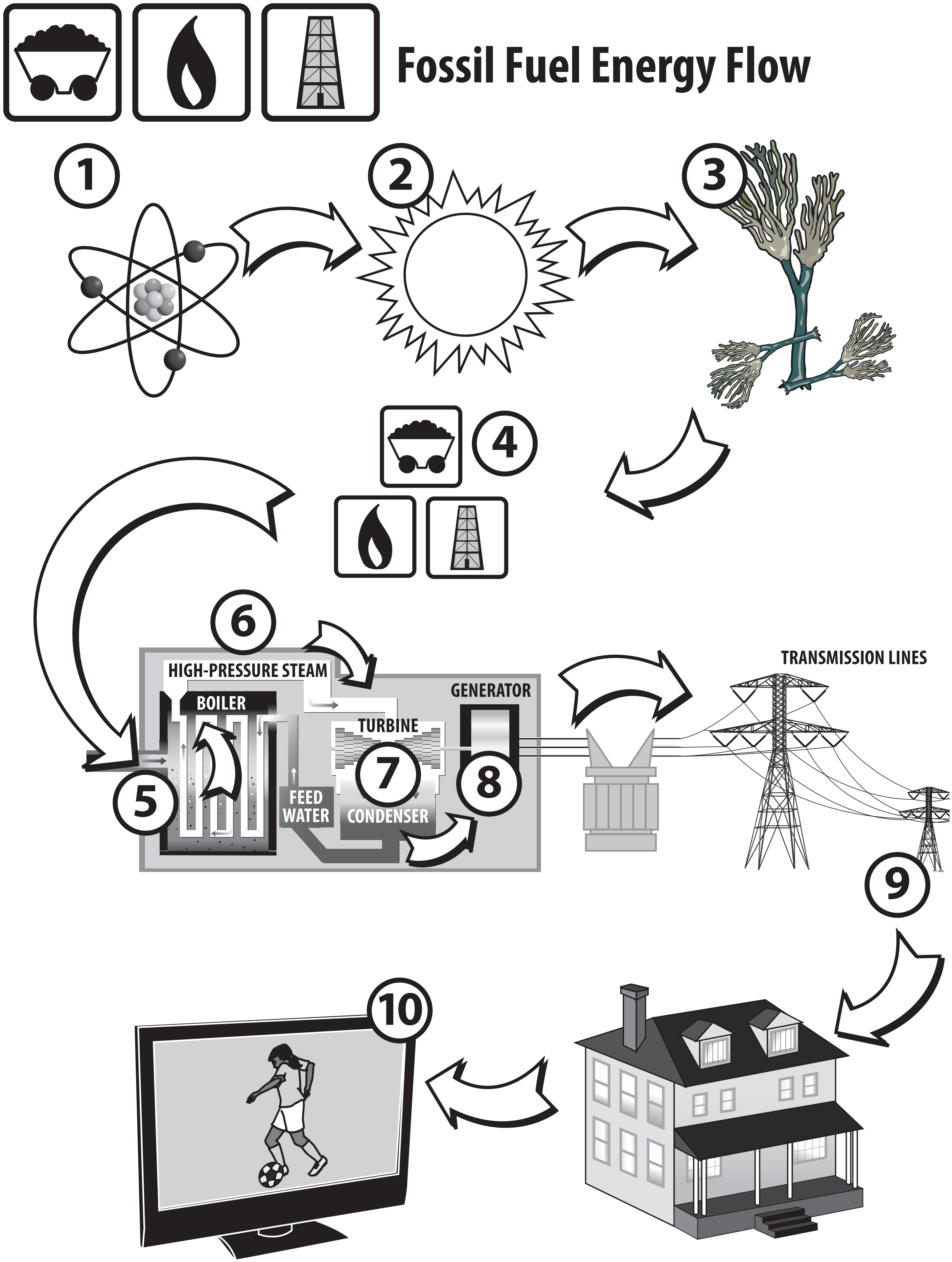
3. The steam travels at high pressure through a steam line.

4. The high pressure steam turns a turbine, which spins a shaft.

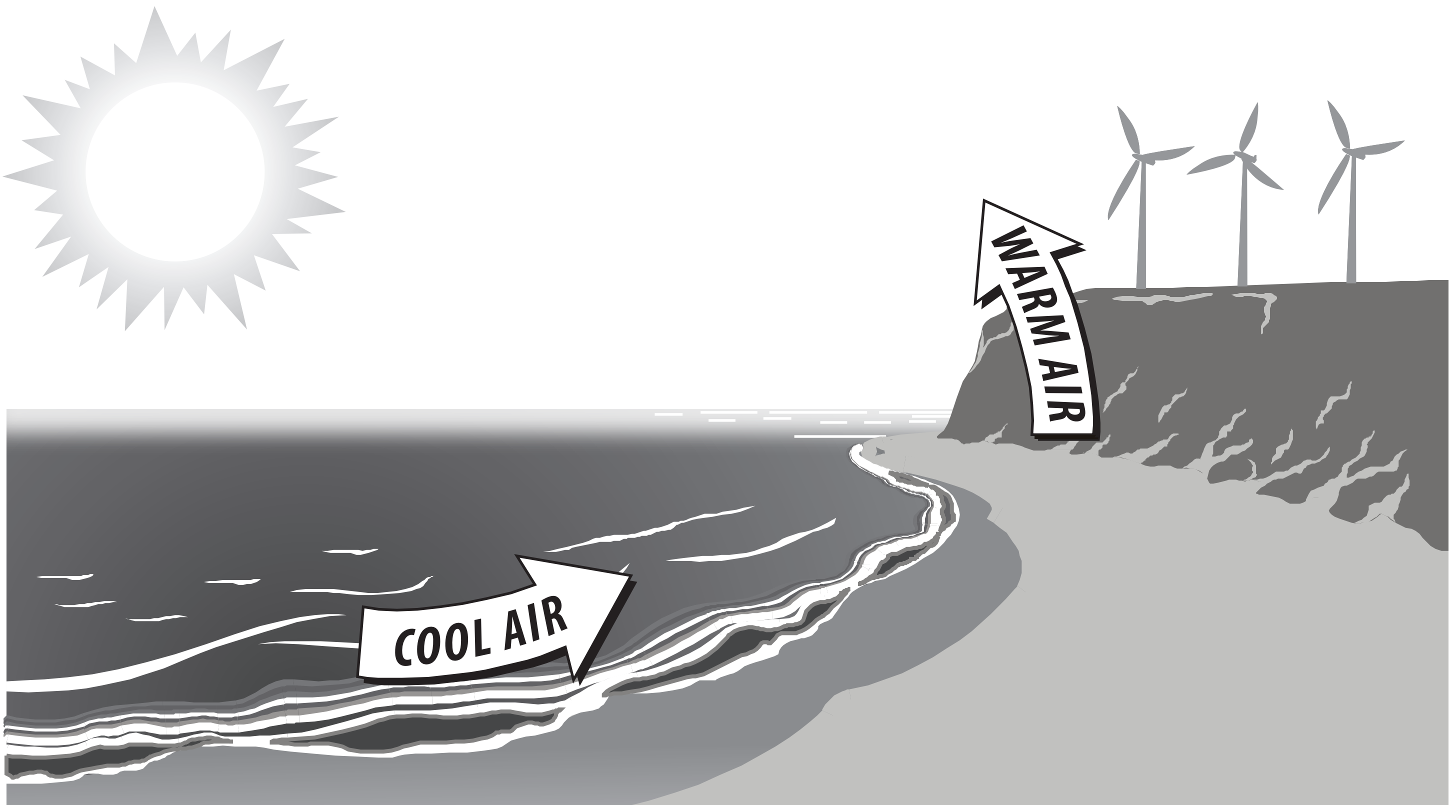
5. Inside the generator, the shaft spins coils of copper wire inside a ring of magnets. This creates an electric field, producing electricity.

6. Electricity is sent to a switchyard, where a transformer increases the voltage, allowing it to travel through the electric grid.

Fossil Fuel Energy Flow

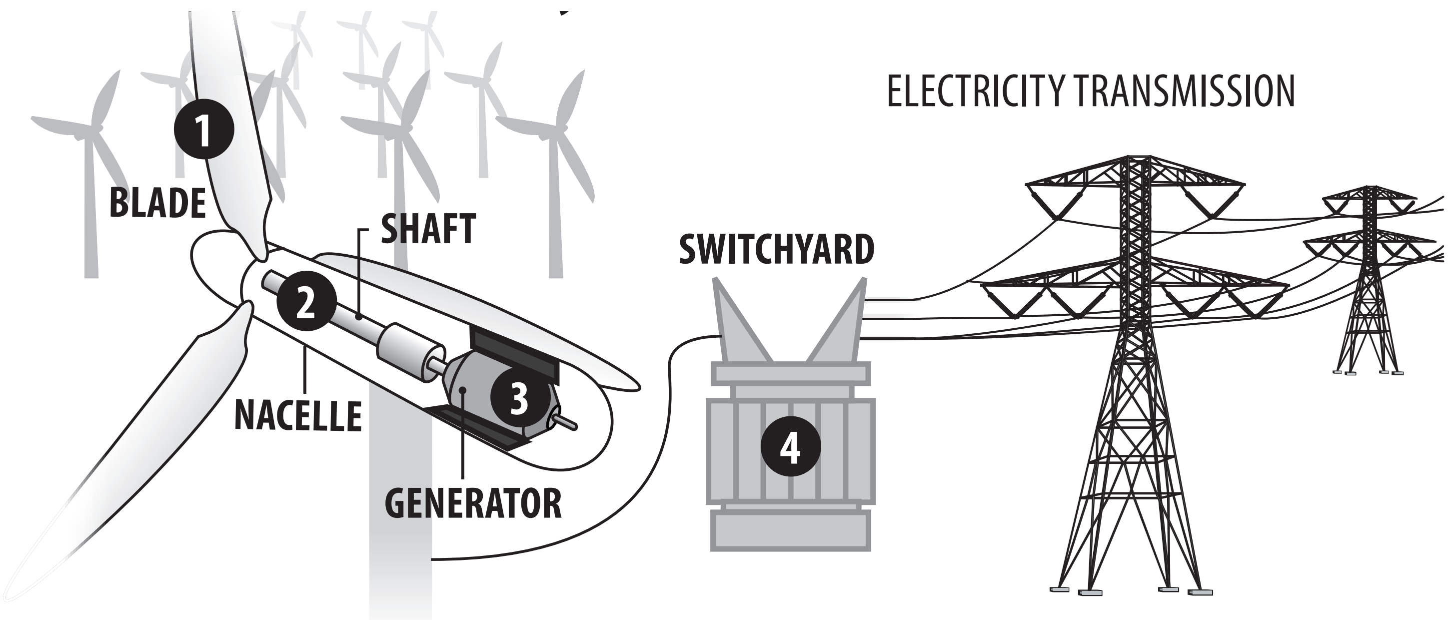


How Wind is Formed



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.

Harnessing the Wind to Generate Electricity



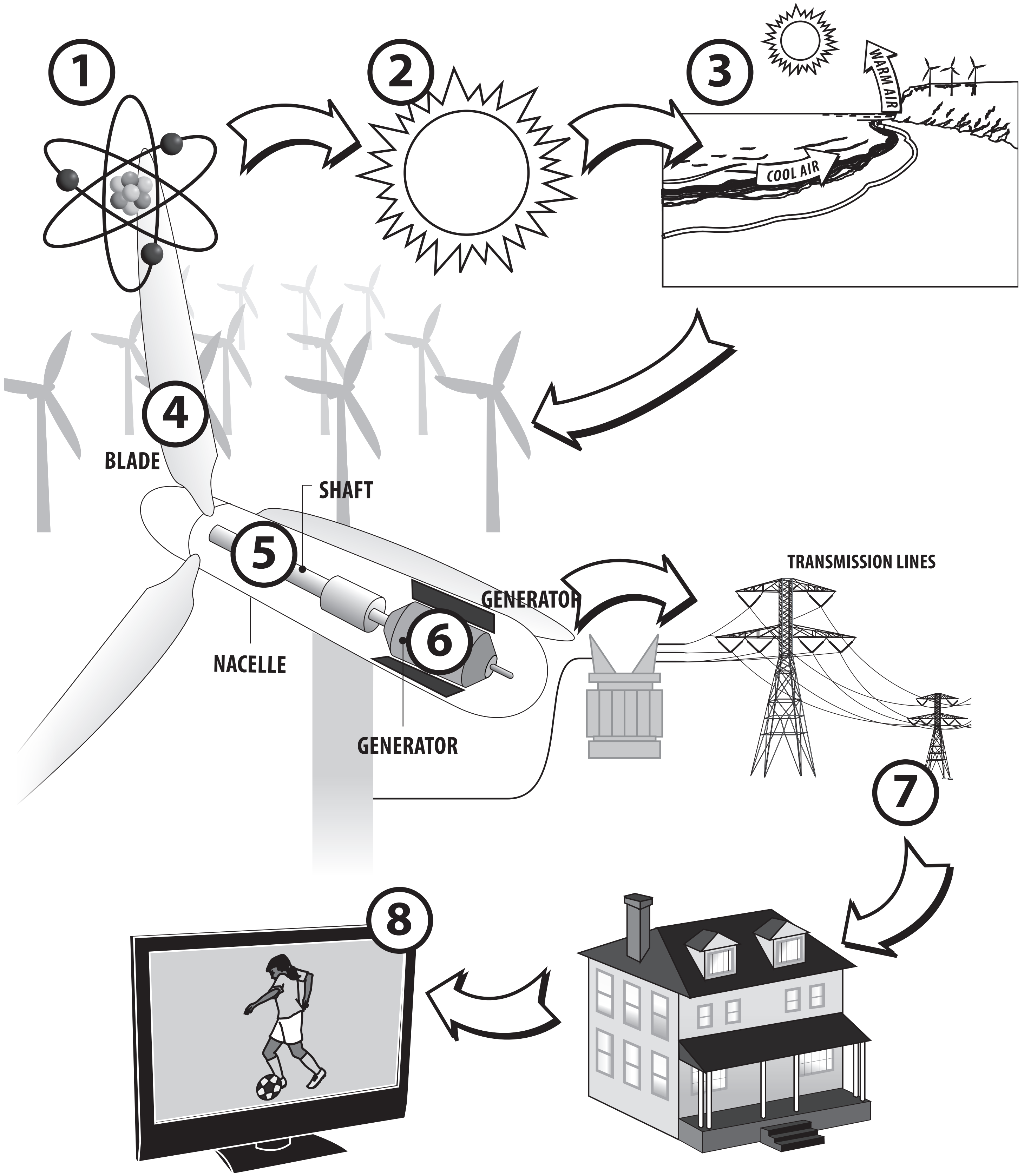
1. Wind turns the blades of the turbine.

2. The blades spin a shaft inside the nacelle.

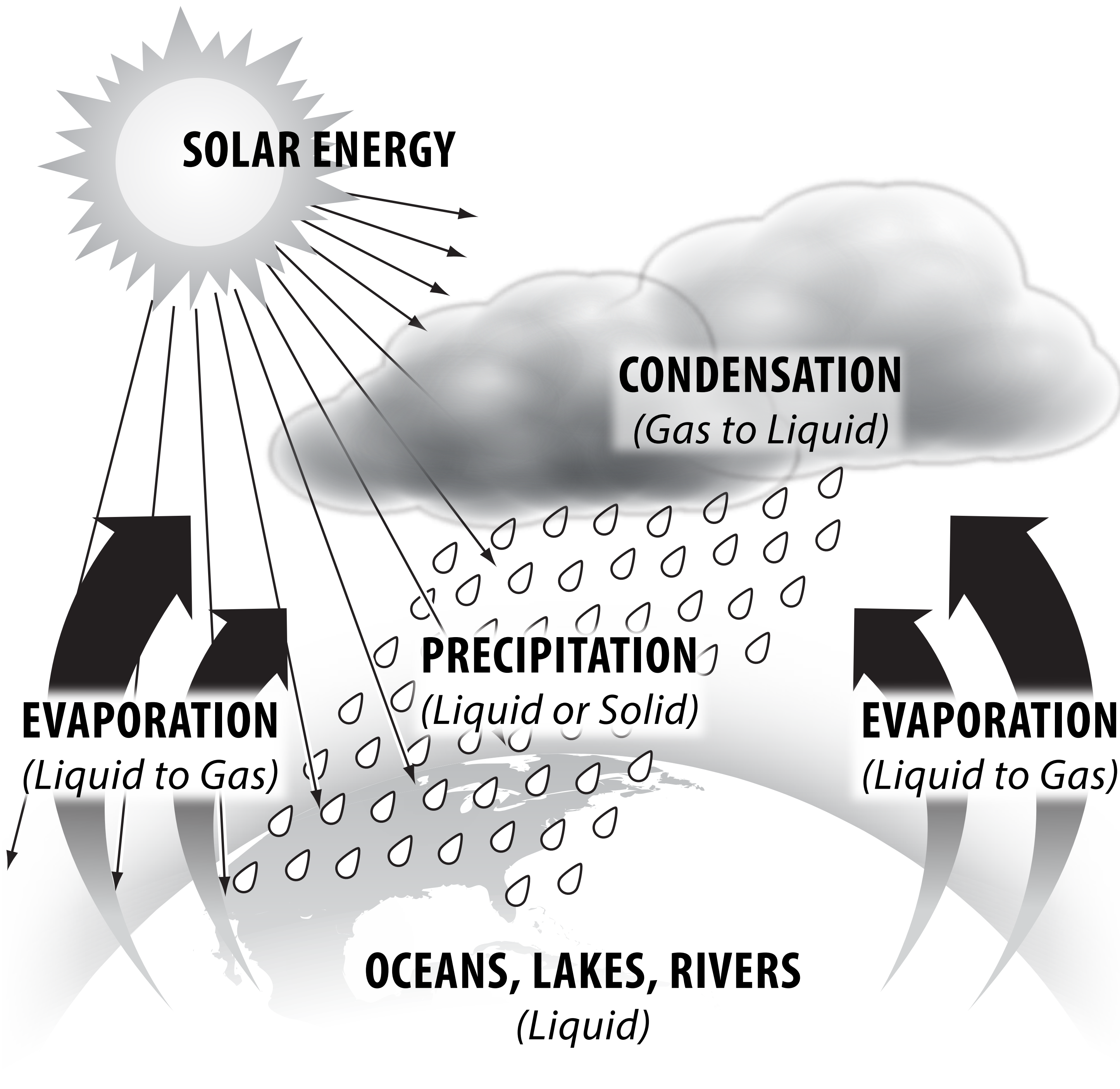
3. Inside the generator, the shaft spins coils of copper wire inside a ring of magnets. This creates an electric field, producing electricity.

4. Electricity is sent to a switchyard, where a transformer increases the voltage, allowing it to travel through the electric grid.

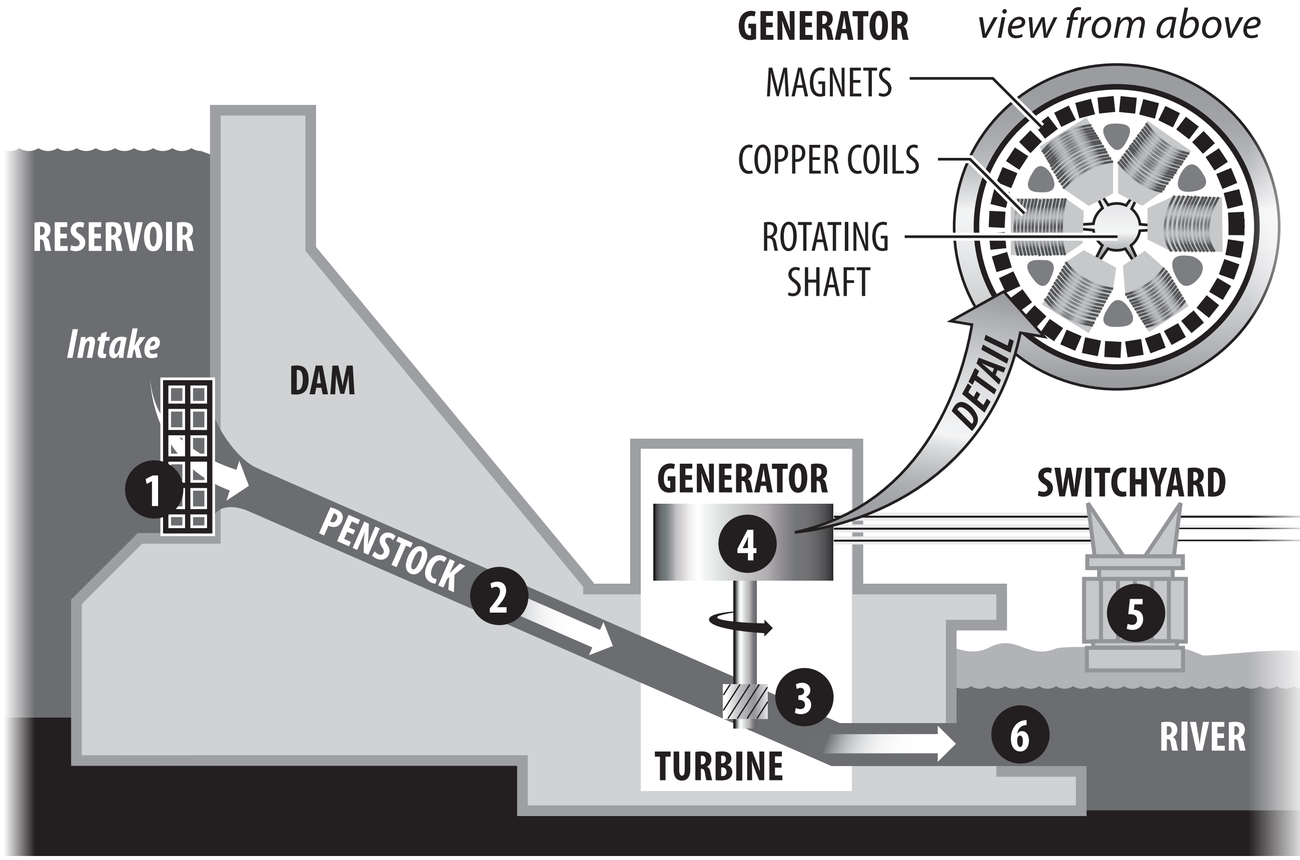
Wind Energy Flow



The Water Cycle



Harnessing Hydropower to Generate Electricity



1. Water in a reservoir behind a hydropower dam flows through an intake screen, which filters out large debris, but allows fish to pass through.

2. The water travels through a large pipe, called a penstock.

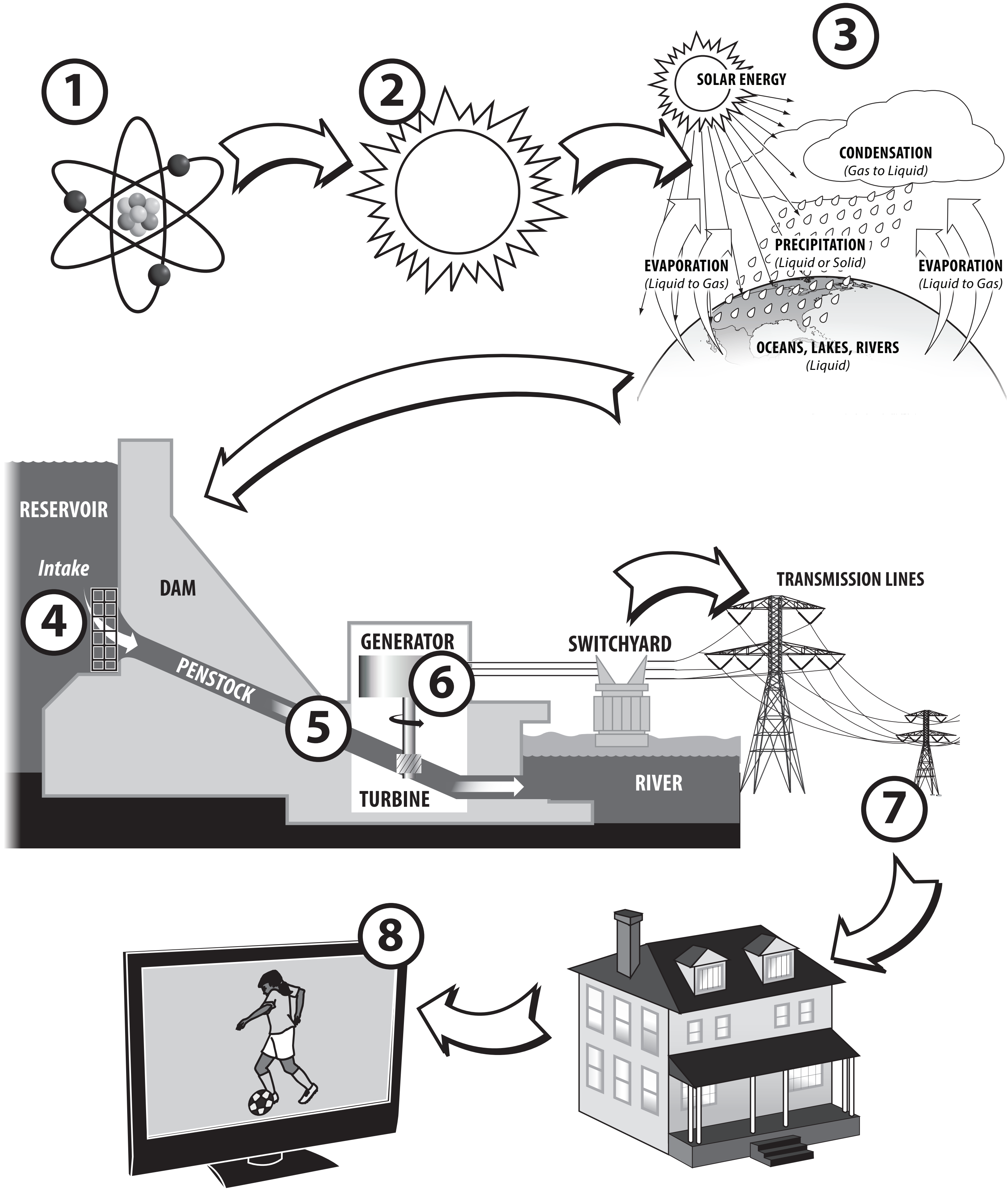
3. The force of the water spins a turbine at a low speed, allowing fish to pass through unharmed.

4. Inside the generator, the shaft spins coils of copper wire inside a ring of magnets. This creates an electric field, producing electricity.

5. Electricity is sent to a switchyard, where a transformer increases the voltage, allowing it to travel through the electric grid.

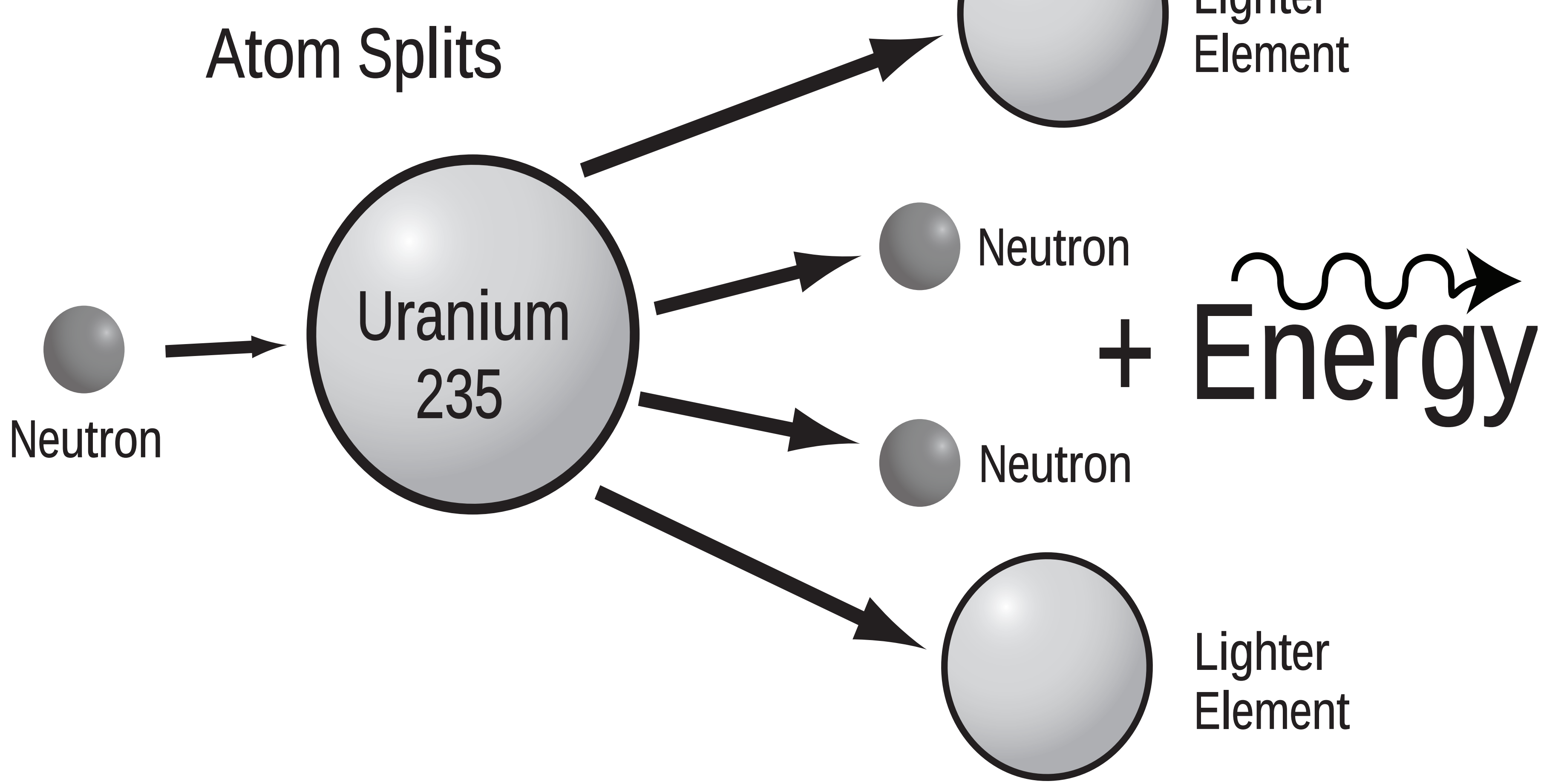
6. Water flows out of the penstock into the downstream river.

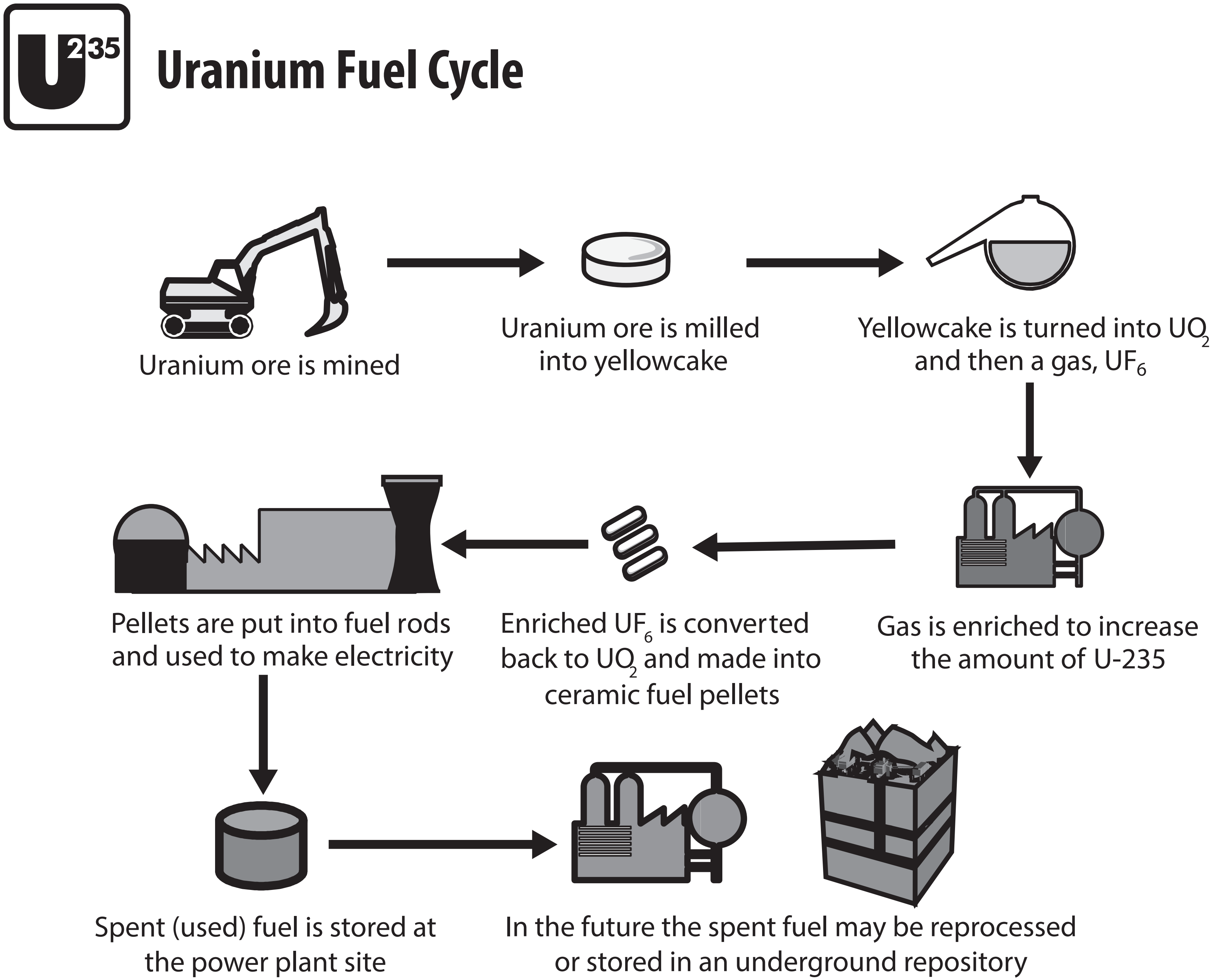
Hydropower Energy Flow



Fission

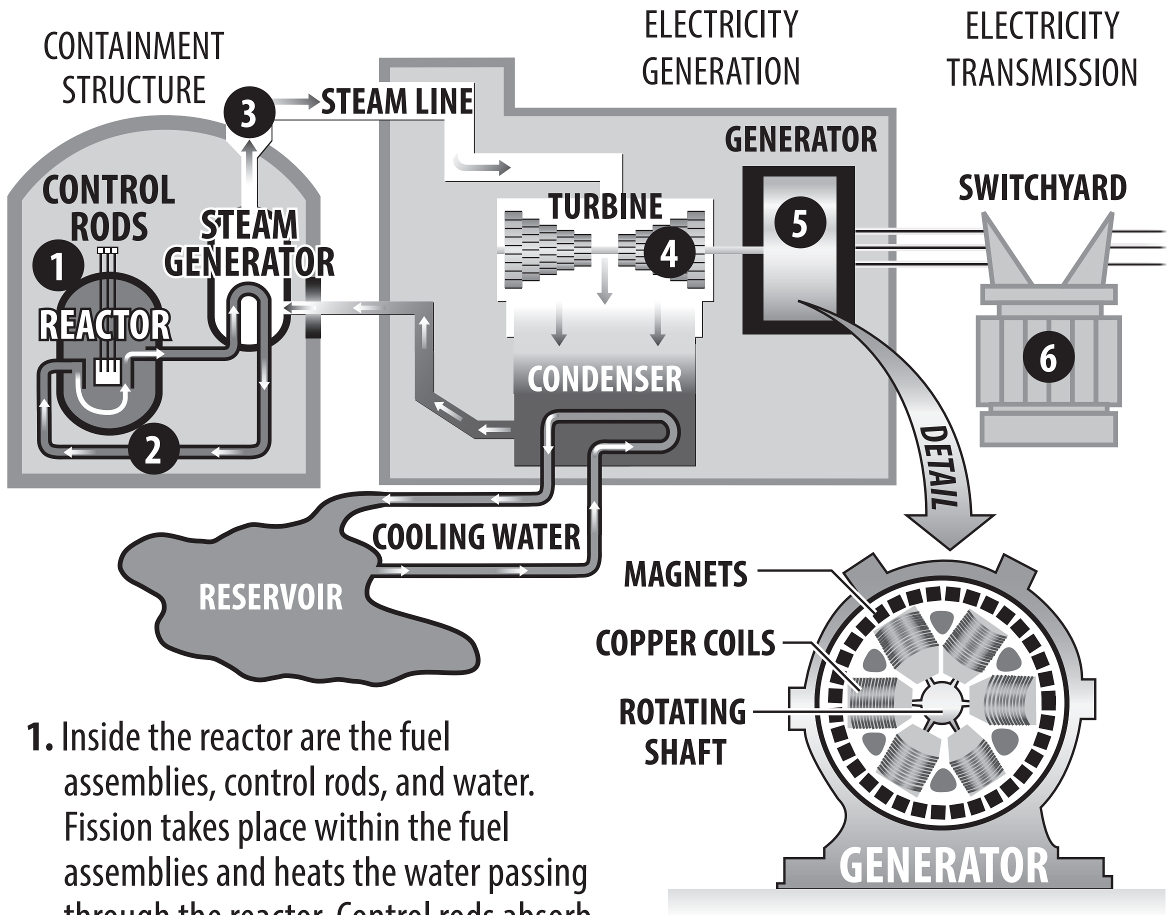
The splitting of the nucleus of an atom into nuclei of lighter atoms, accompanied by the release of energy.




U 235
Uranium Fuel Cycle
Uranium ore is mined
Uranium ore is milled into yellowcake
Yellowcake is turned into UO_2 and then a gas, UF_6
Gas is enriched to increase the amount of U-235
Enriched UF_6 is converted back to UO_2 and made into ceramic fuel pellets
Pellets are put into fuel rods and used to make electricity
Spent (used) fuel is stored at the power plant site
In the future the spent fuel may be reprocessed or stored in an underground repository

Using Nuclear Energy to Generate Electricity

in a Pressurized Water Reactor



1. Inside the reactor are the fuel assemblies, control rods, and water. Fission takes place within the fuel assemblies and heats the water passing through the reactor. Control rods absorb neutrons to control fission.

2. Water is piped through the reactor where it is heated. It then travels to the steam generator where the hot water in pipes heats a secondary system of water.

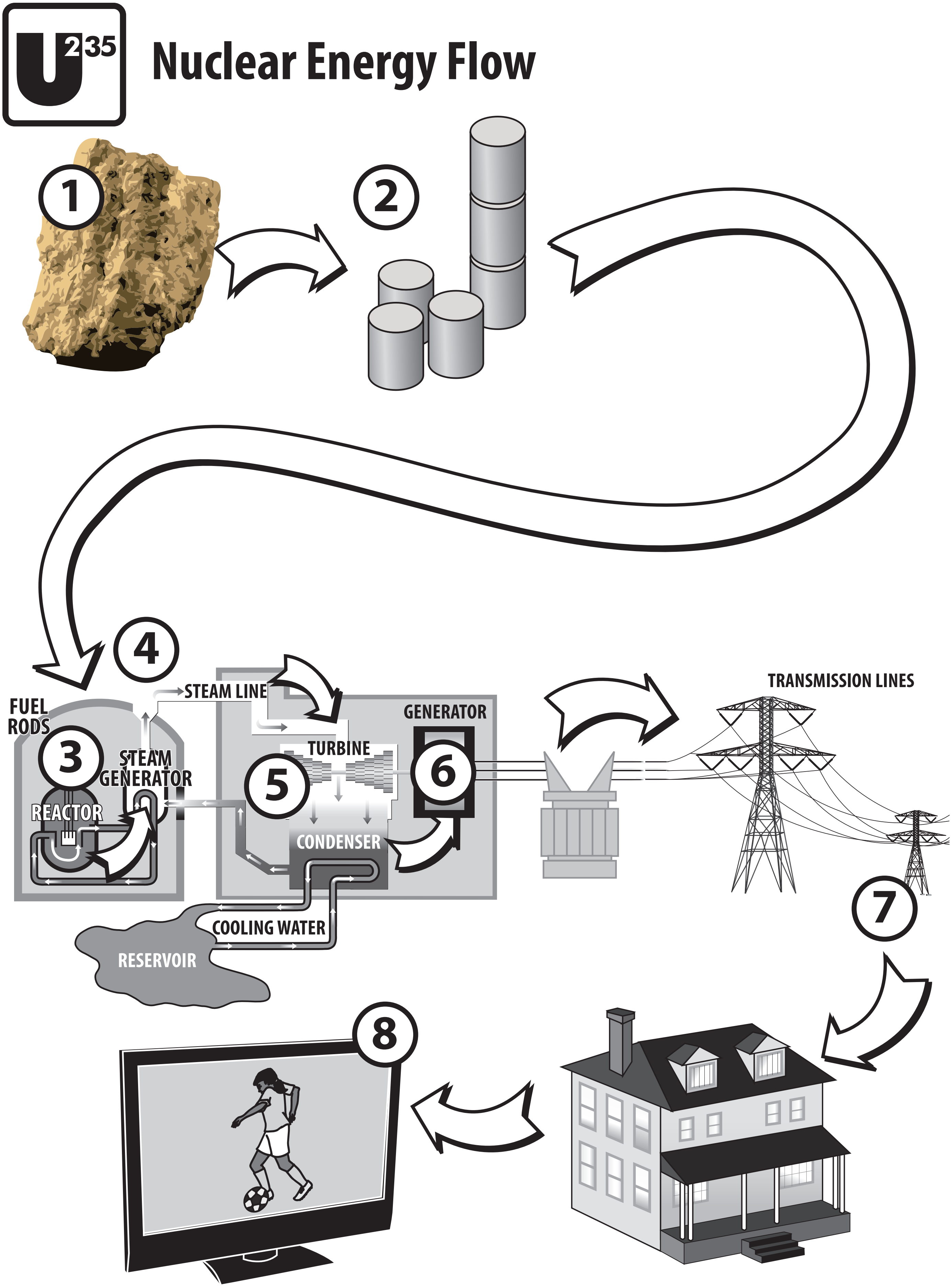
3. The steam generator keeps the steam at a high pressure. The steam travels through a steam line to the turbine.

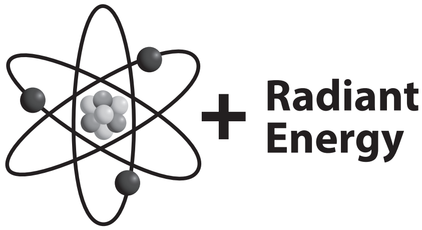
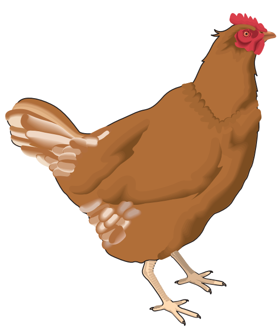
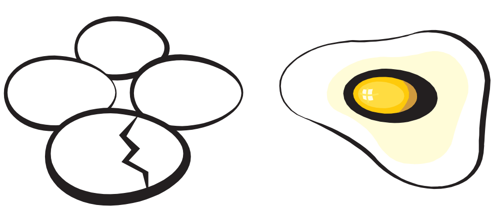
4. The high pressure steam turns the turbine as it passes through, which spins a shaft. The steam then travels through the condenser where it is condensed by cooling water and is pumped back into the steam generator to repeat its cycle.

5. The turbine spins a shaft, which travels into the generator. Inside the generator, the shaft spins coils of copper wire inside a ring of magnets. This generates electricity.

6. Electricity is sent to a switchyard, where a transformer increases the voltage, allowing it to travel through the electric grid.

Nuclear Energy Flow



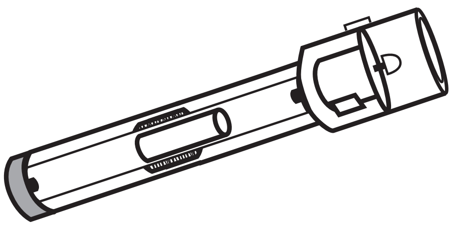
1  **Sun**	**Through the process of fusion, I convert nuclear energy into radiant energy.**
1  **Green Plant**	**Through the process of photosynthesis, I convert radiant energy into chemical energy and store it in my cells.**
1  **Chicken**	**I store energy from food in my cells and turn some of it into other forms of energy.**
1  **Eggs**	**I have chemical energy stored in my cells.**

1

Human Being

I store chemical energy from food in my cells and turn some of it into other forms of energy.

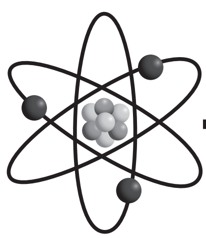
1



Flashlight

I convert motion energy into electrical energy and electrical energy into light when I'm shaken or cranked.

2



+ Radiant Energy

Sun

Through the process of fusion, I convert nuclear energy into radiant energy.

2

Green Plant

Through the process of photosynthesis, I convert radiant energy into chemical energy and store it in my cells.

2

Rabbit

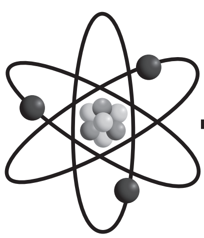
I store energy from food in my cells and turn some of it into other forms of energy.

2

Fox

I store energy from food in my cells and turn some of it into other forms of energy.

3



+ Radiant Energy

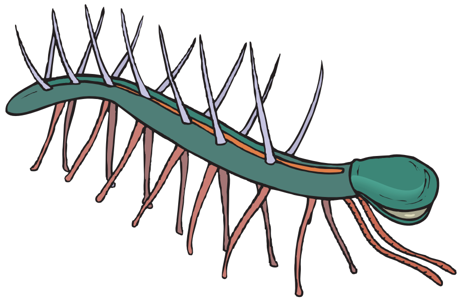
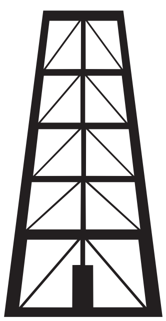
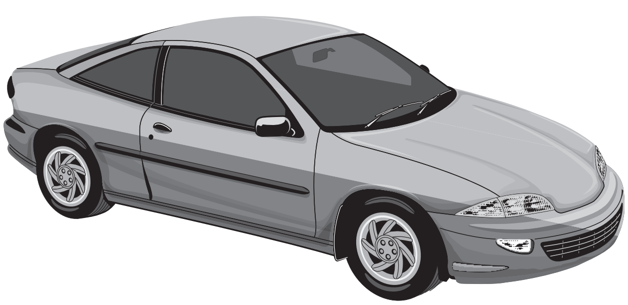
Sun

Through the process of fusion, I convert nuclear energy into radiant energy.

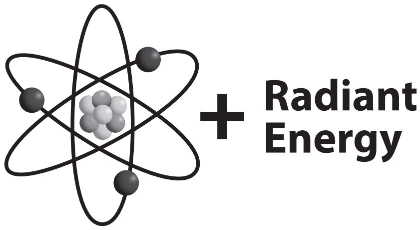
3

Ancient Sea Plant

Through the process of photosynthesis, I converted radiant energy into chemical energy and stored it in my cells.

3  **Ancient Sea Animal**	**I stored chemical energy from food—ancient sea plants—in my cells.**
3 **HEAT AND PRESSURE**	**I turned ancient plants and animals into fossil fuels.**
3  **Petroleum**	**I am a fossil fuel. The chemical energy stored in me came from the remains of ancient sea plants and animals.**
3  **Automobile**	**I convert chemical energy in petroleum into motion, sound, and heat.**

4



Sun

Through the process of fusion, I convert nuclear energy into radiant energy.

4

Ancient Fern

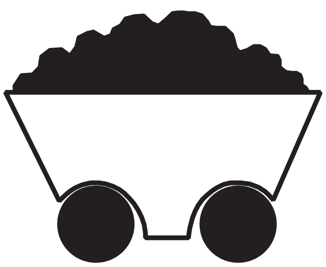
Through the process of photosynthesis, I converted radiant energy into chemical energy and stored it in my cells.

4

HEAT AND PRESSURE

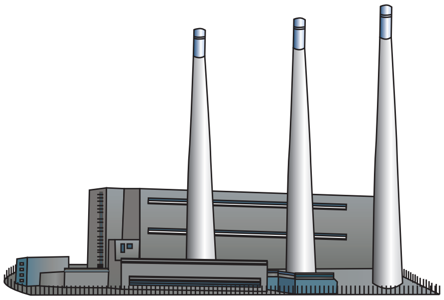
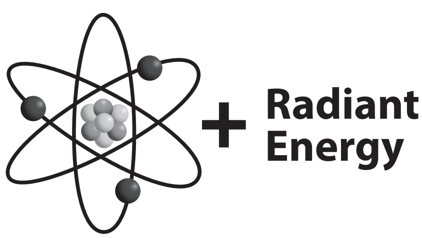
I turned ancient plants into fossil fuels.

4

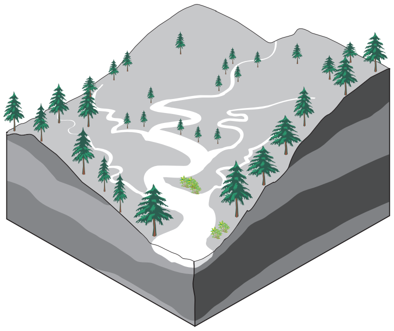


Coal

I am a fossil fuel. The chemical energy stored in me came from the remains of ancient ferns.

4  **Thermal Power Plant**	**I convert chemical or nuclear energy in fuels into thermal energy then into electrical energy.**
4  **Television**	**I convert electrical energy into light, heat, and sound.**
5  **Sun**	**Through the process of fusion, I convert nuclear energy into radiant energy.**
5  **Water**	**I am a renewable energy source. The sun drives the water cycle and keeps me replenished in lakes, rivers, and oceans.**

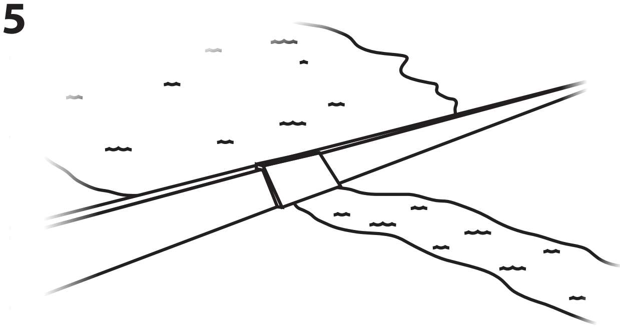
5



River

Through the water cycle I am always fl wing and am fed by smaller streams and creeks.

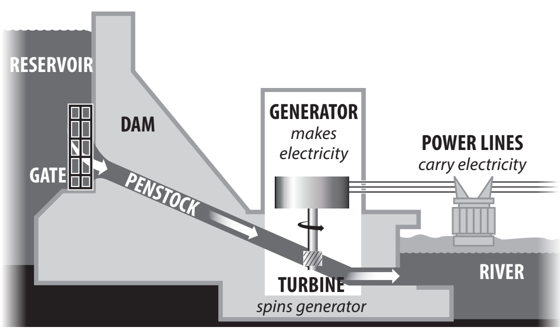
5



Reservoir

I stay full because of the water cycle. I hold water as gravitational potential energy.

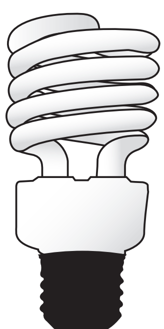
5



Hydropower Plant

I convert the kinetic energy of moving water into electrical energy.

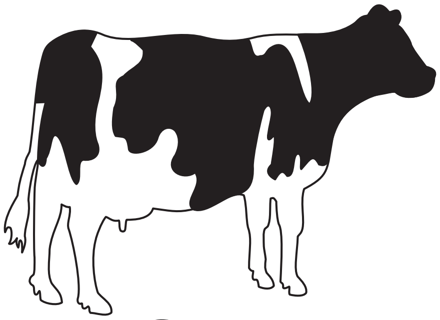
5



Light Bulb

I turn electrical energy into radiant and thermal energy.

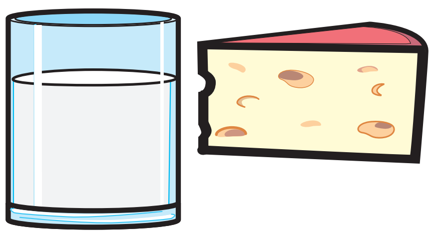
SUB



Cow

I store chemical energy from food in my cells and turn some of it into other forms of energy.

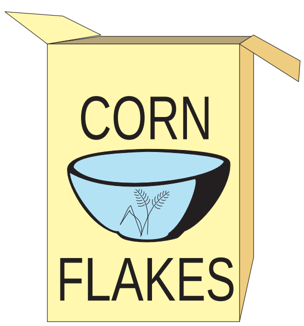
SUB



Milk and Cheese

I have chemical energy stored in my cells.

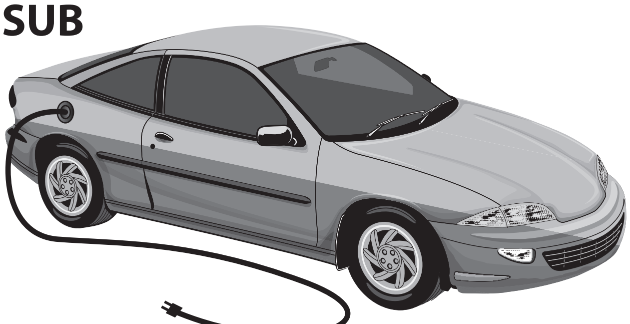
SUB



Corn Flakes

I have chemical energy stored in my cells.

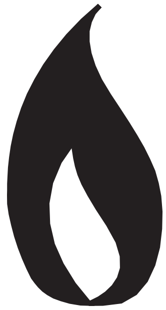
SUB



Electric Car

I convert electrical energy into motion, sound, and heat.

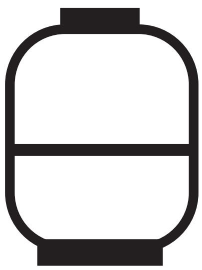
SUB



Natural Gas

I am a fossil fuel. My chemical energy came from the remains of ancient sea plants and animals.

SUB



Propane

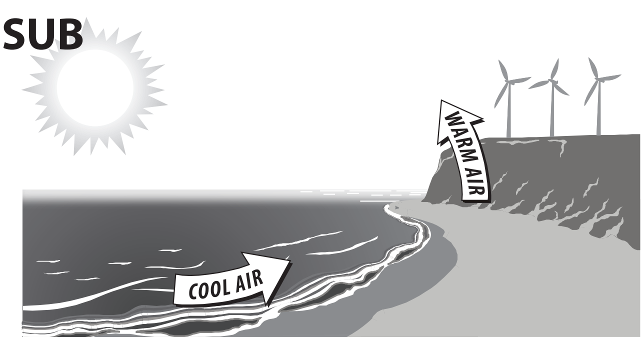
I am a fossil fuel. The chemical energy stored in me came from the remains of ancient sea plants and animals.

SUB

Uranium

I am a common rock found around the world. My nuclear energy comes from the splitting of my atoms.

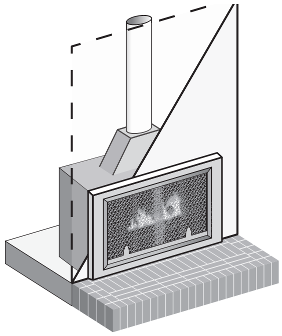
SUB



Wind

I am renewable. The motion energy in me came from the sun's uneven heating of land and water.

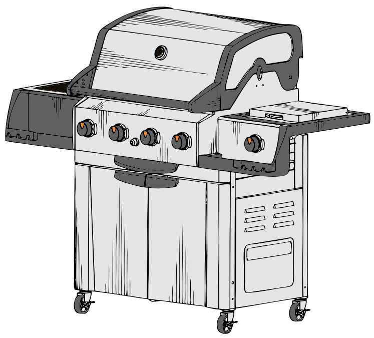
SUB



Gas Fireplace

I convert the chemical energy in natural gas into thermal energy.

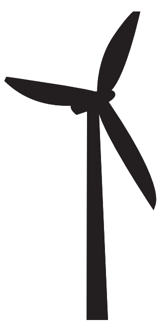
SUB



Propane Grill

I convert the chemical energy in propane into thermal energy.

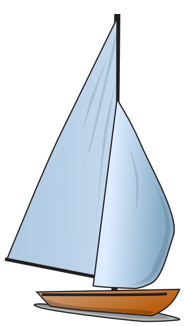
SUB



Wind Turbine

I convert the kinetic energy in wind into electrical energy.

SUB



Sailboat

I harness the wind's kinetic energy to move across water.

A Cool Coal Story

Students will demonstrate the fl w of energy to produce electricity using props. Depending on the audience, signs with the different forms of energy can be used by the students to identify the energy transformations. This activity can also be used to demonstrate other energy fl ws, like biodiesel, ethanol, natural gas, etc.

Sun		Nuclear fusion—produces energy
	Prop & Action	Yellow ball
Radiant Energy		Nuclear energy in the sun is transformed to radiant energy and travels through space to Earth. Radiant energy travels in WAVES.
	Prop & Action	Long pieces of yellow ribbon, several students wave in the air
Chemical Energy		Radiant energy is absorbed by green plans and through photosynthesis converts radiant energy to chemical energy.
	Prop & Action	Green plants or silk plants, students bring up from floo
Stored Chemical Energy		Green plants die and are compressed under extreme pressure over a LONG period of time and become COAL. Chemical energy is stored in the coal.
	Prop & Action	Green plants or silk plants, students step on leaves
Coal		Coal is mined and taken to a power plant. (Additional details may be added if desired.)
	Prop & Action	Pieces of coal OR wads of black construction paper, students pick up coal from ground
Thermal Energy		Coal is burned in the furnace. Stored chemical energy produces thermal energy.
	Prop & Action	Empty box, coal is put into "furnace" box
Thermal Energy		The thermal energy heats the water. Water becomes steam.
	Prop & Action	Hot pot or bottled water, student lifts up hot pot
Steam		Steam travels down pipes (plastic tubing) to the turbine.
	Prop & Action	Plastic hose or tubing, connect tube to hot pot used above
Motion/Mechanical Energy		Steam causes the turbine blades to spin.
	Prop & Action	Student arms, student stands with arms outstretched and bent upwards at the elbow, student spins as steam touches them
Electrical Energy		The turbine is connected to the generator causing the magnets to spin around the copper coils producing electrical energy.
	Prop & Action	Bar magnets, copper ribbons, three students hold bar magnets, one student is 'wrapped' in copper colored ribbon or wire, students with magnets 'spin' around copper wire
Electrical Energy		Electrical energy travels down the power lines to our homes.
	Prop & Action	Twisted rope, start with twisted rope then pull away the smaller pieces to designate the low voltage lines that come into our homes
Electrical Energy		Electrical energy powers our homes.
	Prop & Action	'Magic' light bulb, and extension cord, student pulls chain on light bulb or switches it on
Variations		*Other energy fl ws can be demonstrated, substituting other sources for the coal (corn to ethanol; soybeans to biodiesel; decomposing garbage to methane, etc.)*

A Cool Coal Story

A long, long time ago before even the dinosaurs roamed the Earth, the sun shone in the sky and giant plants grew in swampy forests. Like all living things, these plants died.

And more plants grew and died. This happened over and over for millions of years—plants grew and died and fell into the swamp.

The plants on the bottom got squished—really, really squished. After millions of years of being really squished those plants turned into COAL.

Now the coal is buried in the ground. Big machines—giant bulldozers and steam shovels—dig it up.

The machines load the coal onto trains and barges to take it to the power plant.

Inside the power plant there is a giant tub of water with a big oven in the middle. The coal is put into the big oven and burned.

The smoke from the fi e is cleaned with big scrub brushes before it goes up the smokestack and into the air.

Inside the oven it gets really hot. So hot, the water in the tub boils and turns into steam. The oven is called a boiler because it boils the water and turns it into steam.

That steam comes roaring through a big pipe and turns a giant pinwheel, called a turbine.

The middle of the pinwheel has coils of wire wrapped around it. On the blades of the pinwheel are big magnets. When the magnets spin around the wire, it makes electricity. That is amazing!

Now, we can't go down to the power plant to buy a bag of electricity. So, the electricity comes to us.

A wire from the turbine runs out of the power plant and up a tall, tall pole. The electricity fl ws up the wire to the top of the pole. It fl ws through high-power lines from pole to pole until it gets to our town.

CONTINUED ON NEXT PAGE

Then it fl ws into lots of small wires to our houses. Inside our houses—hidden in the walls—are lots of wires. They go to all the switches and all the outlets all over our house and the electricity fl ws through them.

When we flip on a lig t switch, the electricity fl ws into the light bulb and makes light.

When we plug a radio into an outlet, we get music. The electricity fl ws through the cord to make it work. Electricity runs our washers and dryers, TVs, and video games.

Most of the electricity in our country is made by burning coal. The energy in the coal came from the sun.

Energy Flows Evaluation Form

State: ____________ **Grade Level:** ____________ **Number of Students:** ___________

1. Did you conduct the entire activity?	❑ Yes	❑ No
2. Were the instructions clear and easy to follow?	❑ Yes	❑ No
3. Did the activity meet your academic objectives?	❑ Yes	❑ No
4. Was the activity age appropriate?	❑ Yes	❑ No
5. Were the allotted times suffici t to conduct the activity?	❑ Yes	❑ No
6. Was the activity easy to use?	❑ Yes	❑ No
7. Was the preparation required acceptable for the activity?	❑ Yes	❑ No
8. Were the students interested and motivated?	❑ Yes	❑ No
9. Was the energy knowledge content age appropriate?	❑ Yes	❑ No
10. Would you teach this activity again?	❑ Yes	❑ No

Please explain any 'no' statement below.

How would you rate the activity overall?	❑ excellent	❑ good	❑ fair	❑ poor
How would your students rate the activity overall?	❑ excellent	❑ good	❑ fair	❑ poor

What would make the activity more useful to you?

____

____

____

____

Other Comments:

____

____

____

____

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8408 Kao Circle
Manassas, VA 20110
FAX: 1-800-847-1820

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