

# How to Use This Presentation



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# Resources



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### Objectives

- **List** five factors that influence the value of a fuel.
- **Explain** how fuels are used to generate electricity in an electric power plant.
- **Identify** patterns of energy consumption and production in the world and in the United States.
- **Explain** how fossil fuels form and how they are used.
- **Compare** the advantages and disadvantages of fossil-fuel use.
- **List** three factors that influence predictions of fossil-fuel production.





### Energy Resources and Fossil Fuels

- A **fossil fuel** is a nonrenewable energy resource formed from the remains of organisms that lived long ago; examples include oil, coal, and natural gas.
- Most of the energy we use comes from this group of natural resources called fossil fuels.
- We use fossil fuels to run cars, ships, planes, and factories and to produce electricity.





### Energy Resources and Fossil Fuels

- Fossil fuels are central to life in modern societies, but there are two main problems with fossil fuels.
  - The supply of fossil fuels is limited.
  - Obtaining and using them has environmental consequences.
- In the 21st century, societies will continue to explore alternatives to fossil fuels but will also focus on developing more-efficient ways to use these fuels.





### Fuels for Different Uses

- Fuel is used for four main purposes:
  - Transportation
  - Manufacturing
  - Heating and cooling buildings
  - Generating electricity to run machines and appliances
- Different fuels are used for different purposes.
- The suitability of a fuel for each application depends on the fuel's energy content, cost, availability, safety, and byproducts.





### Electricity—Power on Demand

- Because electricity is more convenient to use, the energy in fuel is often converted before used.
- Electricity can be transported quickly across great distances.
- This makes it a good source of power for computers, light switches, and more.
- Two disadvantages of electricity are that it is difficult to store and other energy sources have to be used to generate it.







### How Is Electricity Generated?

- An **electric generator** is a device that converts mechanical energy into electrical energy.
- Generators produce electrical energy by moving an electrically conductive material within a magnetic field.
- Most commercial electric generators convert the movement of a turbine into electrical energy. A *turbine* is a wheel that changes the force of a moving gas or a liquid into energy that can do work.
- The turbine spins a generator to produce electricity.





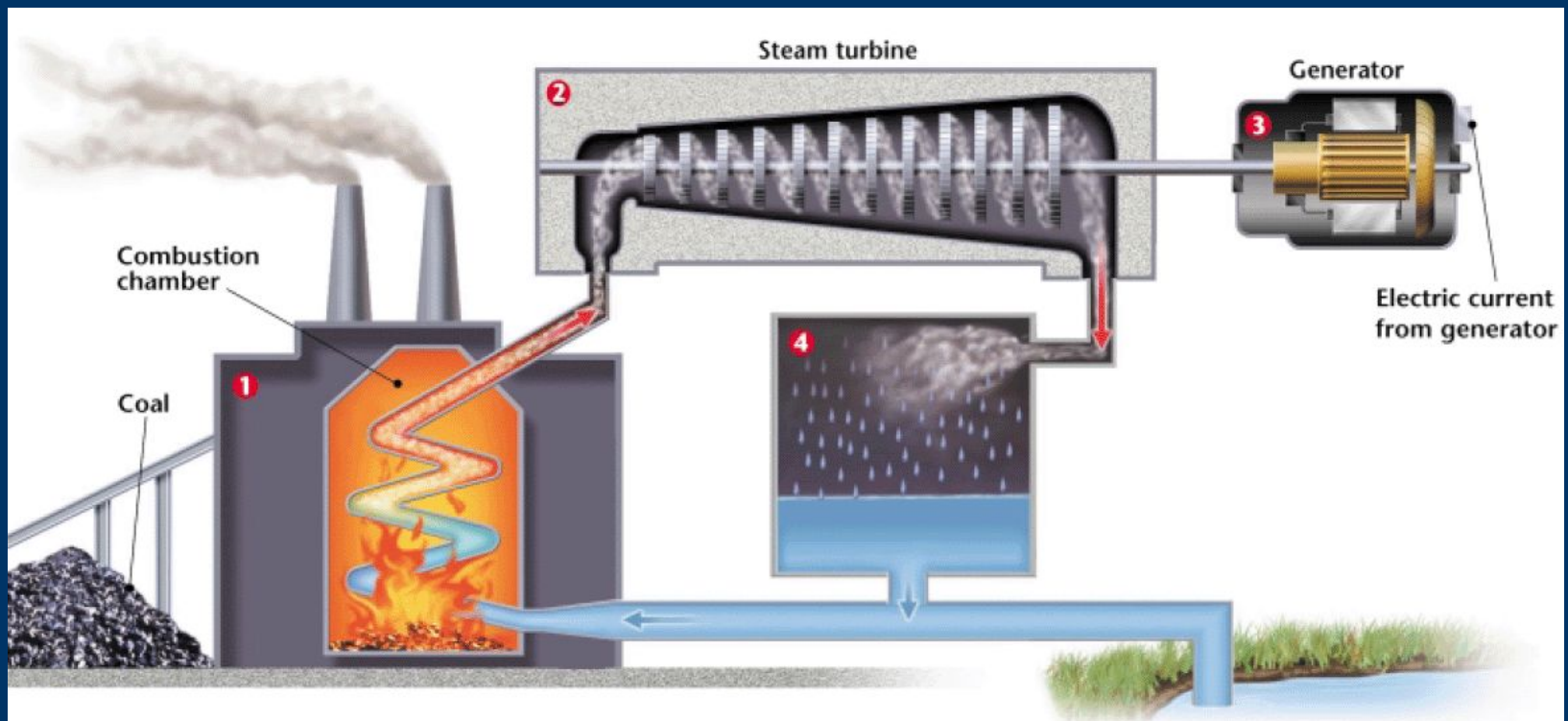
### How Is Electricity Generated?

- The turbine spins because of the steam released from boiling water.
- The water is heated using a coal-fired or gas-fired plant, or is heated from the fission of uranium in nuclear plants.





### How Is Electricity Generated



**1** Burning fossil fuels release energy in the form of heat, which is used to boil water and produce high-pressure steam.

**2** The steam is directed against the blades of a turbine, which is set into motion.

**3** The turbine is connected to an electric generator. The turbine sets the generator in motion, generating electricity.

**4** Steam from the turbine is directed to a condenser where it cools and becomes liquid water to be cycled again.



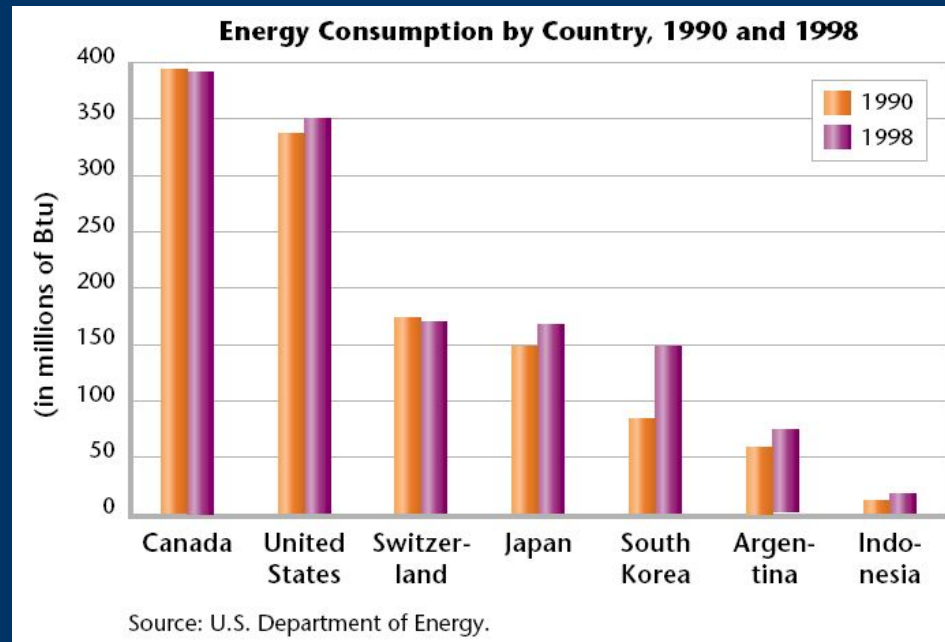
### World Energy Use

- Everything you do, from the food you eat to the clothes you wear requires energy.
- There are dramatic differences in fuel use and efficiency throughout the world.
- People in developed societies use more energy than people in developing countries do.
- And within developed societies, there are differences in energy consumption.



### World Energy Use

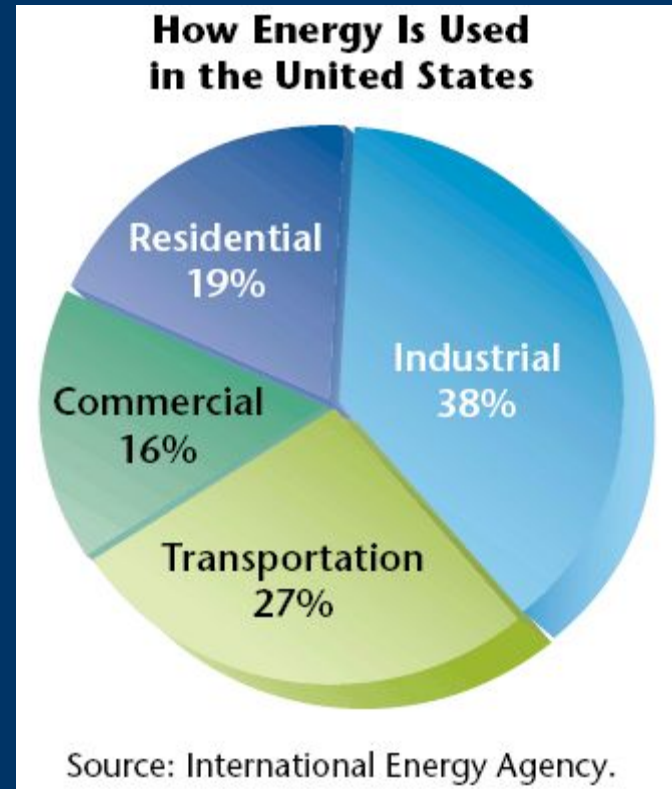
- The difference in energy use among developed countries depends on how energy is generated and used in those countries.





### Energy Use in the United States

- The United States uses more energy per person than any other country except Canada and the United Arab Emirates.
- The U.S. uses more than 25% of its energy to transport goods and people.





### Energy Use in the United States

- Other countries, such as Japan and Switzerland, depend on extensive rail systems and are smaller, compact countries
- Residents of the United States and Canada enjoy some of the lowest gasoline taxes in the world. There is little incentive to conserve gasoline when its cost is so low.
- Countries with limited fossil-fuel resources supplement a greater percentage of their energy needs with other energy sources, such as hydroelectric or nuclear power.





### How Fossil-Fuel Deposits Form

- Fossil fuel deposits are not distributed evenly.
- There is an abundance of oil in Texas and Alaska, but very little in Maine.
- The eastern United States produces more coal than other areas.
- The reason for this difference lies in the geologic history of the areas.



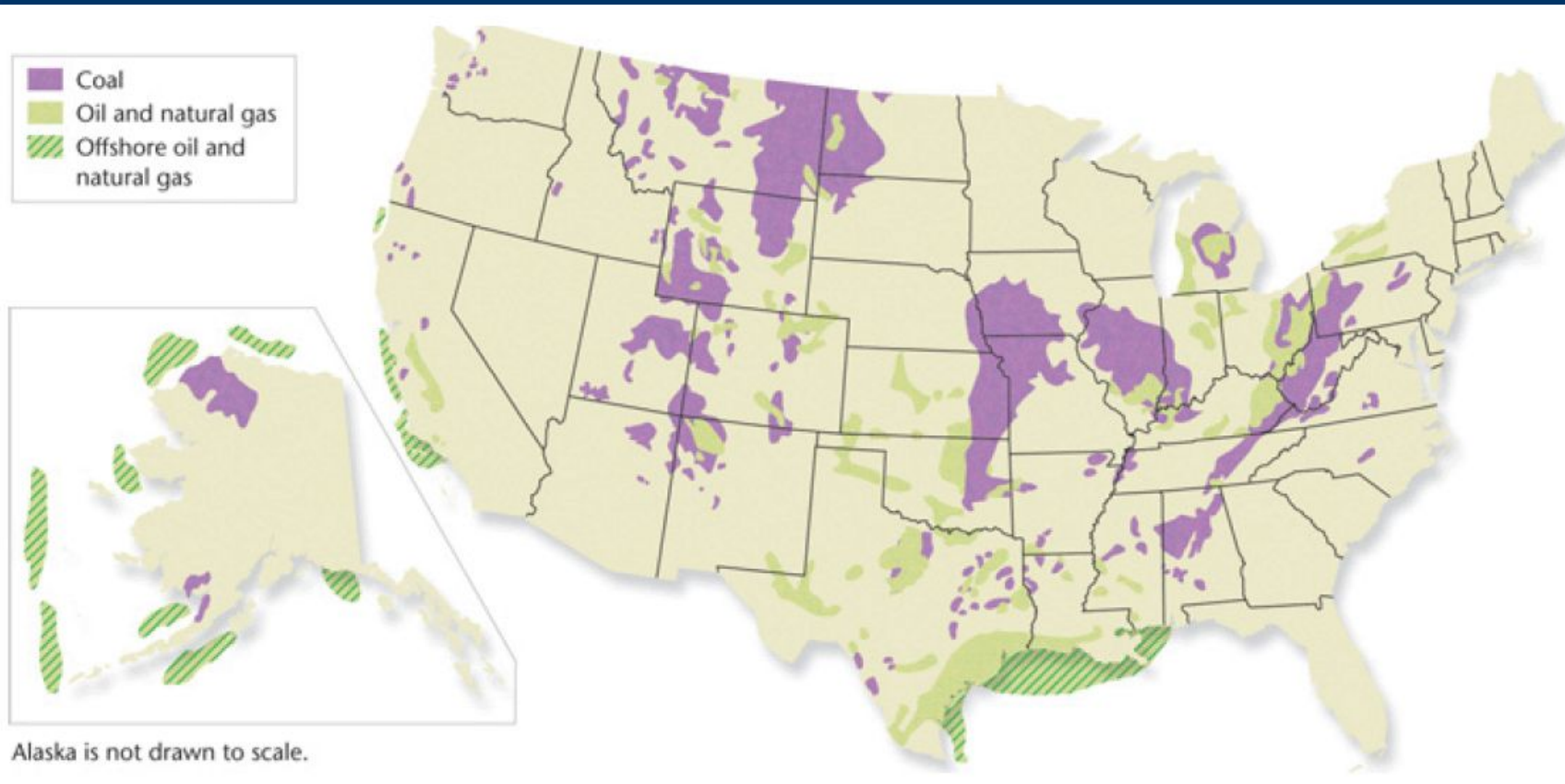


# Chapter 17

## Section 1 Energy Resources and Fossil Fuels



### Oil and Gas Deposits in the United States



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### Coal Formation

- Coal forms from the remains of plants that lived in swamps hundreds of millions of years ago.
- As ocean levels rose and fell, swamps were repeatedly covered with sediment.
- Layers of sediment compressed the plant remains, and heat and pressure within the Earth's crust caused coal to form.
- Much of the coal in the United States formed about 300 to 250 million years ago. Deposits in western states, however, formed between 100 and 40 million years ago.





### Oil and Natural Gas Formation

- Oil and natural gas result from the decay of tiny marine organisms that accumulated on the bottom of the ocean millions of years ago.
- These remains were buried by sediments and then heated until they became complex energy-rich carbon molecules.
- These molecules, over time, migrated into the porous rock formations that now contain them.





### Coal

- Most of the world's fossil-fuel reserves are made up of coal.
- Coal is relatively inexpensive and it needs little refining after being mined.
- Asia and North America are particularly rich in coal deposits.

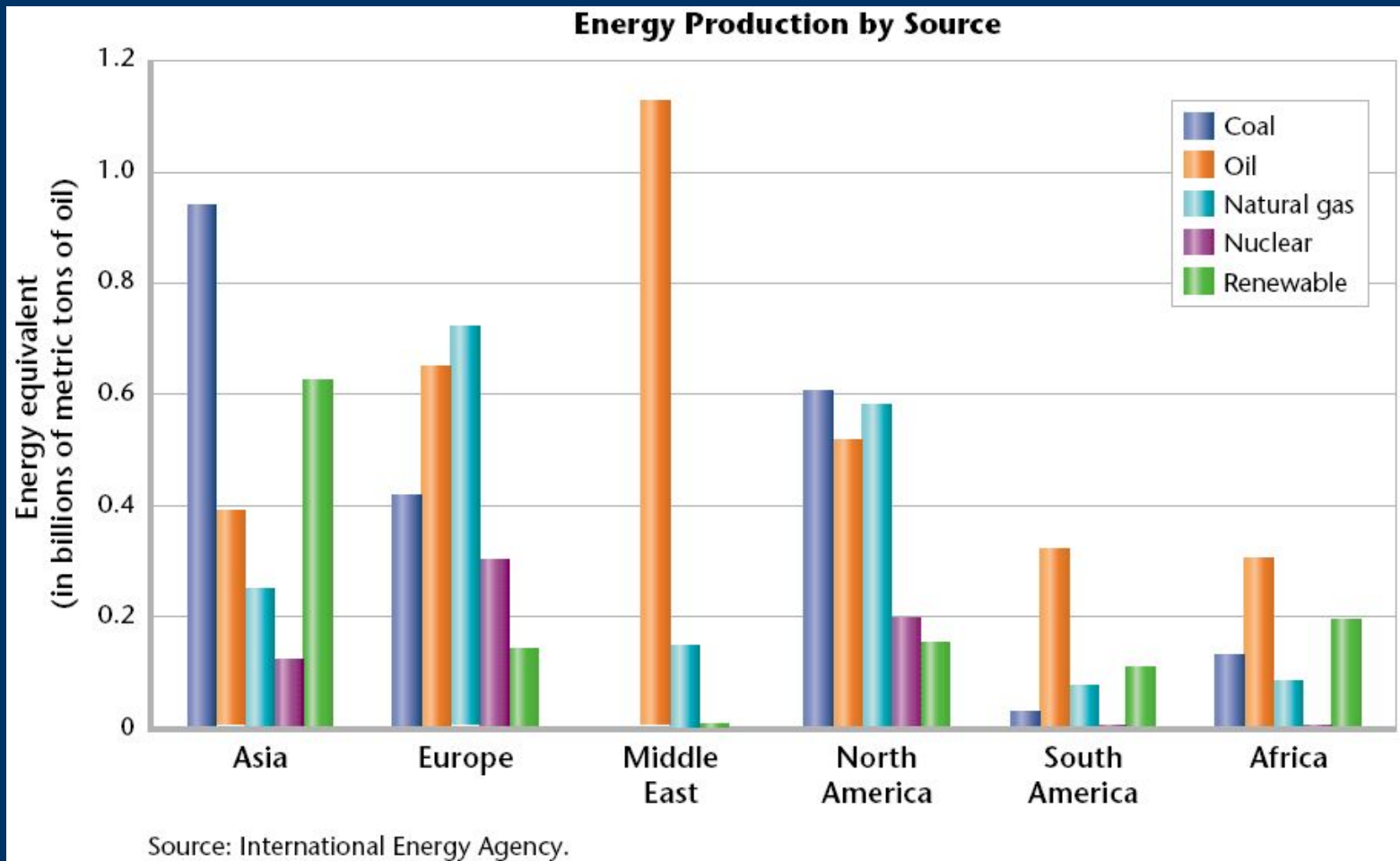


# Chapter 17

## Section 1 Energy Resources and Fossil Fuels



### Coal



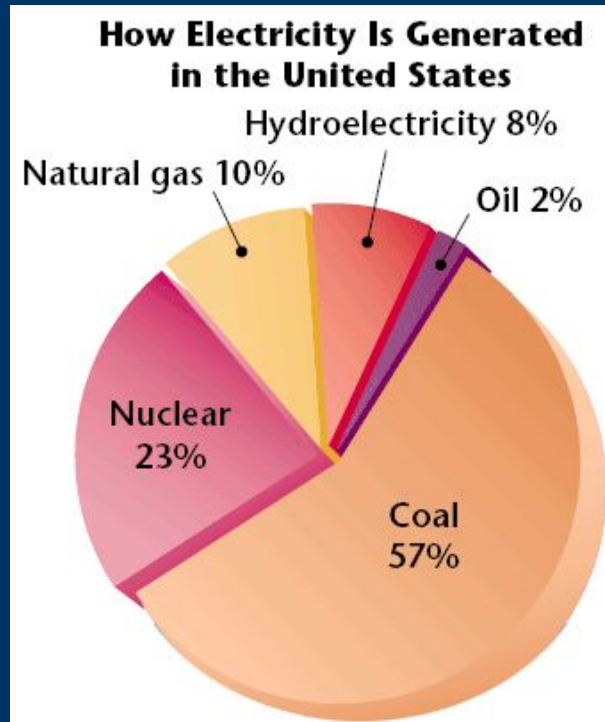
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### Coal

- Over half the electricity generated in the United States comes from coal-fired power plants.





### Coal Mining and the Environment

- The environmental effects of coal mining vary.
- Underground mining may have minimal effect on the environment at the surface, but surface coal-mining operations sometimes remove the top of an entire mountain to reach the coal deposit.
- A lot of research focuses on locating the most productive, clean-burning coal deposits and finding less damaging methods of mining coal.





### Air Pollution

- The quality of coal varies. Higher-grade coals, such as bituminous coal, produce more heat and less pollution than lower-grade coal, such as lignite.
- Sulfur, found in all grades of coal, can be a major source of pollution when coal is burned.
- The air pollution and acid precipitation that result from burning high-sulfur coal without adequate pollution controls are serious problems in countries such as China.
- However, clean-burning coal technology has dramatically reduced air pollution in countries such as the United States.







### Petroleum

- **Petroleum** is a liquid mixture of complex hydrocarbon compounds that is used widely as a fuel source.
- Petroleum, also known as **crude oil**.
- Anything that is made from crude oil, such as fuels, chemicals, and plastics, is called a petroleum product.
- Petroleum accounts for 45% of the world's commercial energy use.





### Locating Oil Deposits

- Oil is found in and around major geologic features, such as folds, faults, and salt domes, that tend to trap oil as it moves in the Earth's crust.
- Most of the world's oil reserves are in the Middle East. Large deposits also exist in the United States, Venezuela, the North Sea, Siberia, and Nigeria.
- Geologists use many different methods to locate the rock formations that could contain oil.





### Locating Oil Deposits

- When geologists have gathered all of the data that they can from the Earth's surface, exploration wells are drilled to determine the volume and availability of the oil deposit.
- If oil can be extracted at a profitable rate, wells are drilled and oil is pumped or flows to the surface.
- After petroleum is removed from a well, it is transported to a refinery to be converted into fuels and other petroleum products.





### The Environmental Effects of Using Oil

- Petroleum fuel releases pollutants when burned.
- These pollutants contribute to smog and cause health problems.
- Many scientists think that the carbon dioxide released from burning petroleum fuels contributes to global warming.





### The Environmental Effects of Using Oil

- Oil spills from tanker ships are another potential environmental problem of oil use .
- While oil spills are dramatic, much more oil pollution comes from everyday sources, like leaking cars.





### The Environmental Effects of Using Oil

- Emissions regulations and technologies have helped reduce the air pollution in many areas.
- New measures have recently been taken to prevent oils spills from tankers.
- Unfortunately, measures to reduce everyday contamination of our waterways from oil lag far behind the efforts to prevent large spills.





### Natural Gas

- About 20% of the world's nonrenewable energy comes from natural gas.
- Natural gas, or methane (CH<sub>4</sub>), produces fewer pollutants than other fossil fuels when burned.
- Vehicles that run on natural gas require fewer pollution controls.
- Electric power plants can also use this clean-burning fuel.





### Fossil Fuels and the Future

- Fossil fuels supply about 90% of the energy used in developed countries.
- As the demand for energy resources increases, the cost of fossil fuels will likely increase.
- This will make other energy sources more attractive.
- Planning for the energy we will use in the future is important because it takes many years for a new source of energy to make a significant contribution to our energy supply.

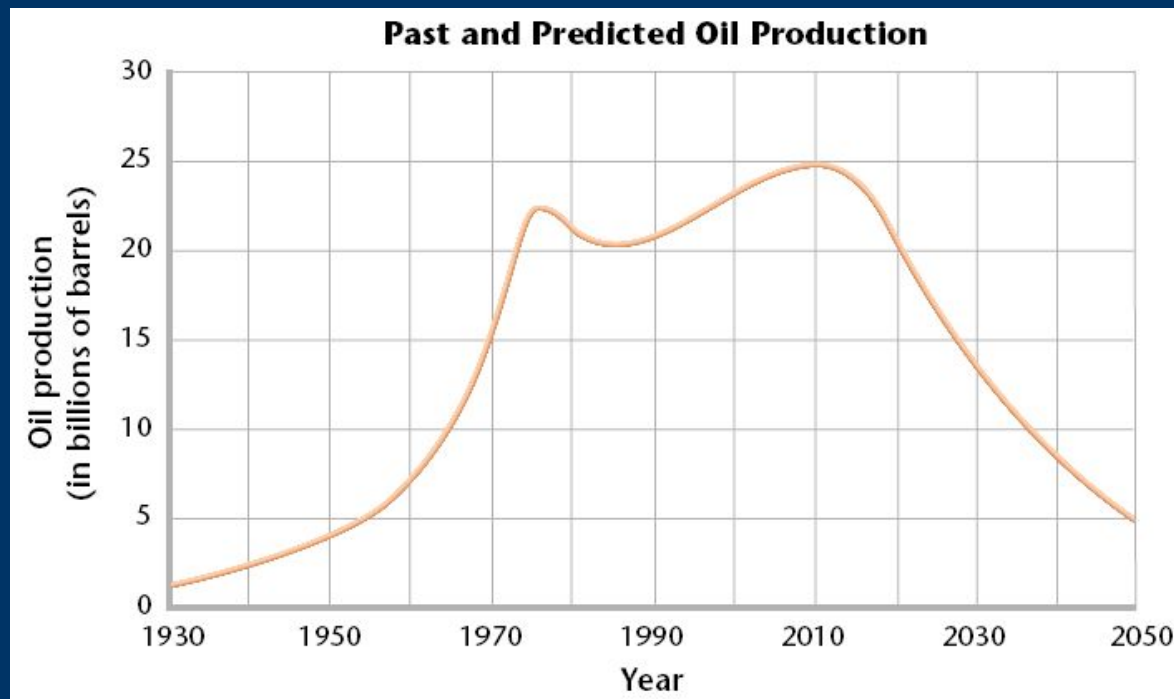






### Predicting Oil Prediction

- Oil production is still increasing, but it is increasing much more slowly than it has in the past.





### Predicting Oil Production

- Many different factors must be considered when predicting oil production.
- **Oil reserves** are oil deposits that are discovered and are in commercial production.
- Oil reserves can be extracted profitably at current prices using current technologies.
- In contrast, some oil deposits are yet to be discovered or to become commercial.





### Predicting Oil Production

- Prediction must also take into account the changes in technology that will allow more oil to be extracted in the future.
- All predictions of future oil production are guided by an important principle: the relative cost of obtaining fuels influences the amount of fossil fuels we extract from the Earth.
- As supplies decrease, oil may be used more selectively.
- Also, we may begin to rely on other energy sources to power items like cars and power plants.





### Future Oil Reserves

- No large oil reserves have been discovered in the past decade.
- Geologists predict that oil production from fields accessible from land will peak in about 2010.
- Additional oil reserves exist under the ocean, but it is expensive to drill for oil in the deep ocean.
- Currently, oil platforms can be built to drill for oil in the ocean, but much of the oil in the deep ocean is currently inaccessible.





### Objectives

- **Describe** nuclear fission.
- **Describe** how a nuclear power plant works.
- **List** three advantages and three disadvantages of nuclear energy.





### Nuclear Energy

- In the 1950s and 1960s, nuclear power plants were seen as the power source of the future because the fuel they use is clean and plentiful.
- In the 1970s and 1980s, however, many planned nuclear power plants were cancelled and others under construction were abandoned.
- Today, nuclear power accounts for 17% of the world's electricity.





### Fission: Splitting Atoms

- Nuclear power plants get their power from *nuclear energy*.
- **Nuclear energy** is the energy released by a fission or fusion reaction. It represents the binding energy of the atomic nucleus.
- The forces that hold together a nucleus of an atom are more than 1 million times stronger than the chemical bonds between atoms.
- In nuclear power plants, atoms of the element uranium are used as the fuel.





### Fission: Splitting Atoms

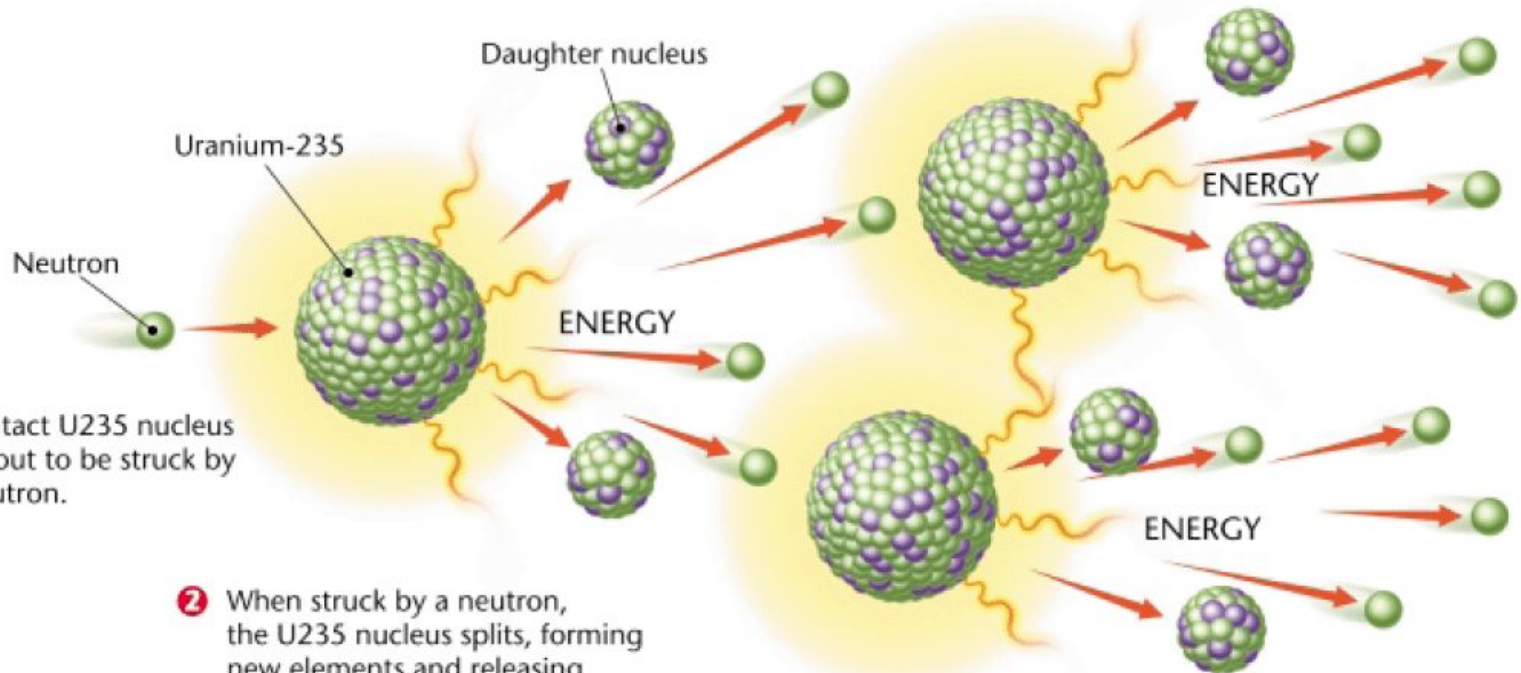
- The nuclei of uranium atoms are bombarded with atomic particles called **neutrons**. These collisions cause the nuclei to split in a process called nuclear fission.
- **Nuclear fission** is the splitting of the nucleus of a large atom into two or more fragments.
- Nuclear fission releases a tremendous amount of energy and more neutrons, which in turn collide with more uranium nuclei.







### Fission: Splitting Atoms



1 An intact U235 nucleus is about to be struck by a neutron.

2 When struck by a neutron, the U235 nucleus splits, forming new elements and releasing several neutrons plus energy.

3 The released neutrons strike other U235 nuclei.

4 The nuclei split and release neutrons and energy.



### How Nuclear Energy Works

- The heat released during nuclear reactions is used to generate electricity in the same way that power plants burn fossil fuels to generate electricity.
- The energy released from the fission reactions heats a closed loop of water that heats another body of water.
- As the water boils, it produces steam that drives a turbine, which is used to generate electricity.

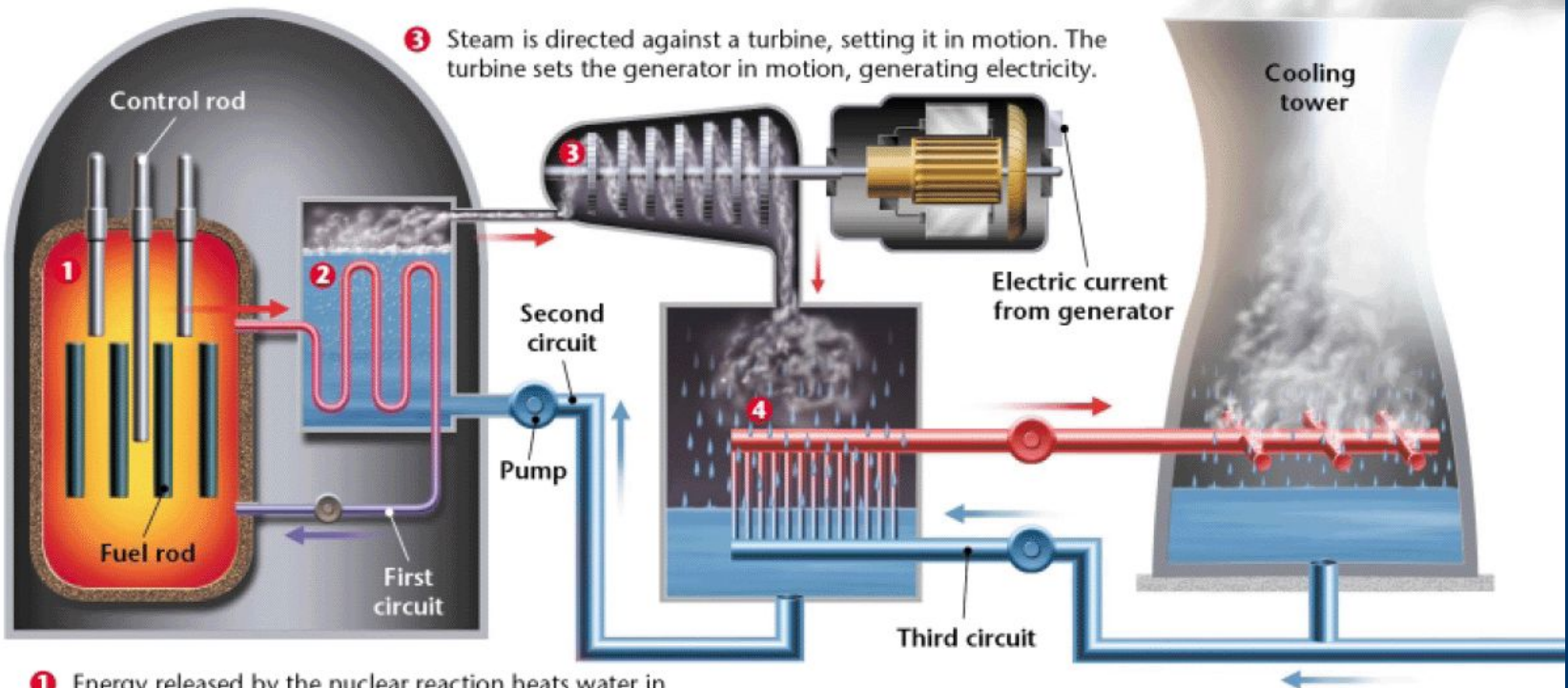




### How Nuclear Energy Works

**2** The superheated water is pumped to a heat exchanger, which transfers the heat of the first circuit to the second circuit. Water in the second circuit flashes into high-pressure steam.

**3** Steam is directed against a turbine, setting it in motion. The turbine sets the generator in motion, generating electricity.



**1** Energy released by the nuclear reaction heats water in the pressurized first circuit to a very high temperature.

**4** A third circuit cools the steam from the turbine and the waste heat is released from the cooling tower in the form of steam.



### The Advantages of Nuclear Energy

- Nuclear fuel is a very concentrated energy source.
- Nuclear power plants do not produce air-polluting gases.
- Nuclear power plants release less radioactivity than coal-fired power plants do, when operated properly.
- Countries with limited fossil-fuel resources rely heavily on nuclear plants to supply electricity.





### Why Aren't We Using More Nuclear Energy?

- Building and maintaining a safe reactor is very expensive.
- This makes nuclear plants no longer competitive with other energy sources in many countries.
- The actual cost of new nuclear power plants is uncertain, so it is difficult to predict whether investors will build new plants in the United States.





### Storing Waste

- The greatest disadvantage of nuclear power is the difficulty in finding a safe place to store nuclear waste.
- The fission products produced can remain dangerously radioactive for thousands of years.
- Storage sites for nuclear wastes must be located in areas that are geologically stable for tens of thousands of years.
- Scientists are researching a process called *transmutation*, that would recycle the radioactive elements in nuclear fuel.





### Safety Concerns

- In a poorly designed nuclear plant, the fission process can potentially get out of control.
- The Chernobyl reactor was destroyed in 1986 when an unauthorized test caused explosions and blasted radioactive materials into the air.
- Hundreds of people in the Ukraine died from radioactive exposure from this explosion.
- Even today, parts of northern Europe and the Ukraine remain contaminated from this disaster.





### Safety Concerns

- The most serious nuclear accident in the United States occurred in 1979 at the Three Mile Island nuclear power plant in Pennsylvania.
- Human error, along with blocked valves and broken pumps, was responsible for this accident.
- Fortunately, only a small amount of radioactive gas escaped.
- Since that accident, the U.S. Nuclear Regulatory Commission has required more than 300 safety improvements to nuclear plants.







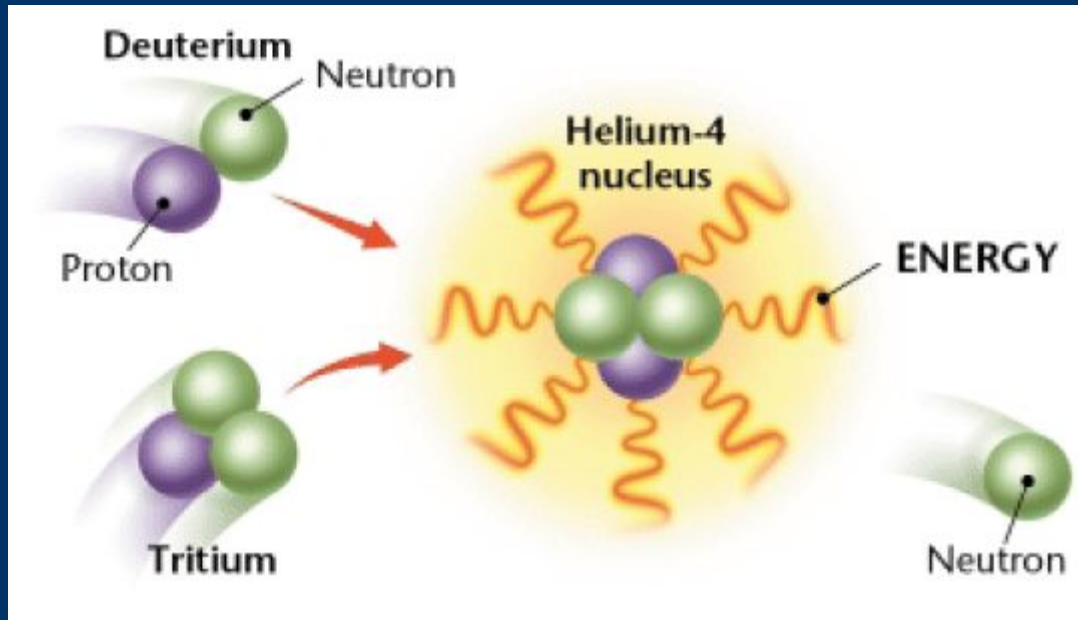
### The Future of Nuclear Power

- One possible future energy source is *nuclear fusion*.
- **Nuclear fusion** is the combination of the nuclei of small atoms to form a larger nucleus. Fusion releases tremendous amounts of energy.
- It is potentially a safer energy source than nuclear fission is because it creates less dangerous radioactive byproducts.





### The Future of Nuclear Power





### The Future of Nuclear Power

- Although the potential for nuclear fusion is great, so is the technical difficulty of achieving that potential.
- For fusion to occur, three things must occur simultaneously:
  - Atomic nuclei must be heated to extremely high temperatures (about 100,000,000°C or 180,000,000 °F).
  - The nuclei must be maintained at very high conditions.
  - The nuclei must be properly confined.
- The technical problems are so complex that building a nuclear fusion plant may take decades or may never happen.





### Bellringer

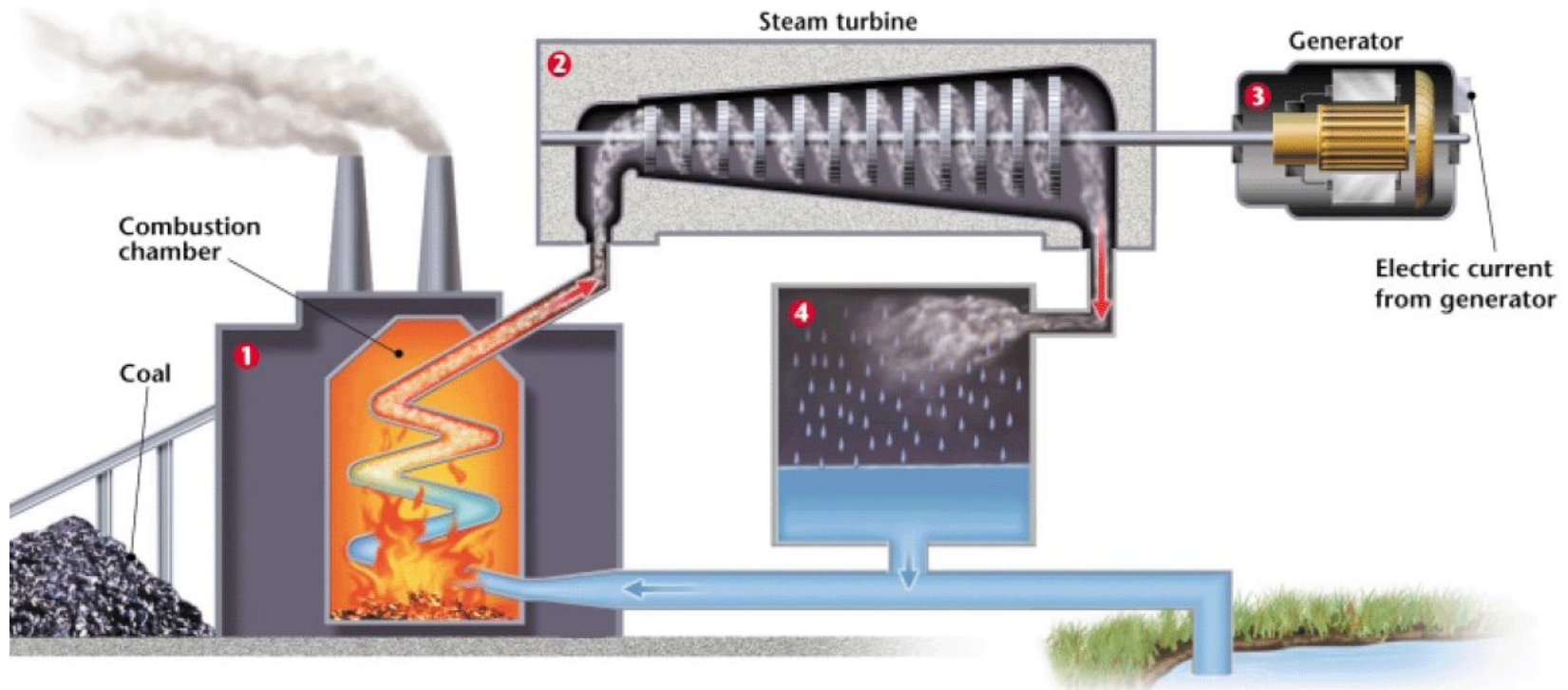
#### **Section: Energy Resources and Fossil Fuels**

Describe the photos in **Figure 1**. List five characteristics of each fuel shown.

Write your responses in your *EcoLog*.



### How a Coal-Fired Power Plant Works



- 1** Burning fossil fuels release energy in the form of heat, which is used to boil water and produce high-pressure steam.
- 2** The steam is directed against the blades of a turbine, which is set into motion.
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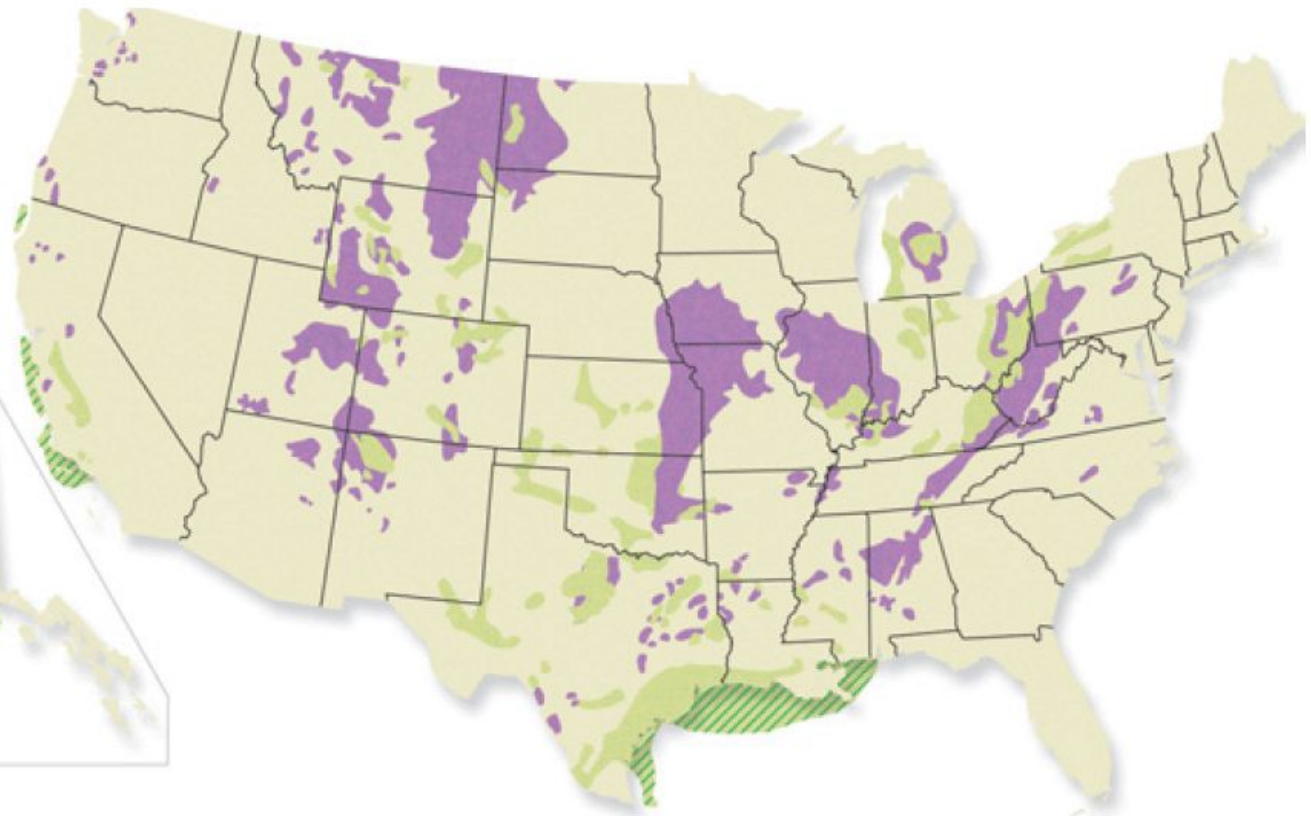


### Fossil Fuels in the United States

- Coal
- Oil and natural gas
- Offshore oil and natural gas



Alaska is not drawn to scale.





### Bellringer

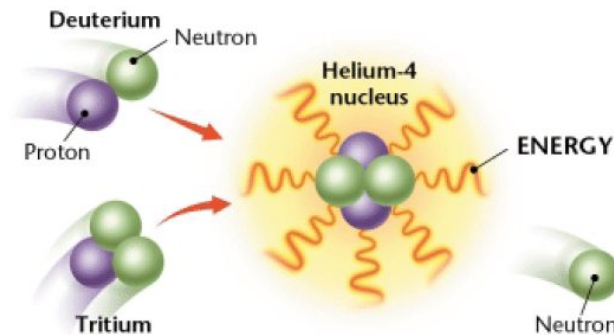
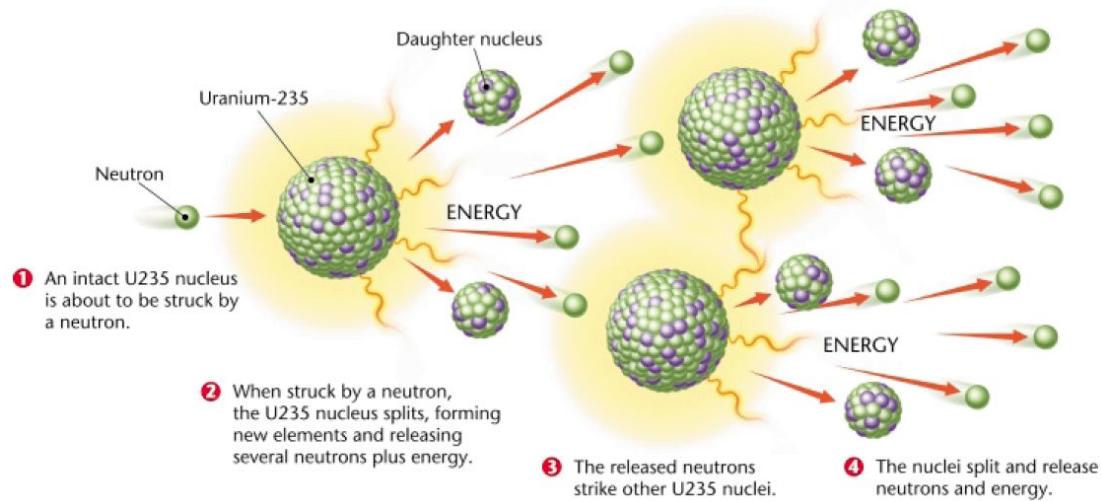
#### Section: Nuclear Energy

Think about how nuclear energy and nuclear power plants are portrayed in the media. Write about what you have seen on TV or in the movies. Write several questions about nuclear power that you would like to answer.

Write your responses in your *EcoLog*.



### Fission and Fusion



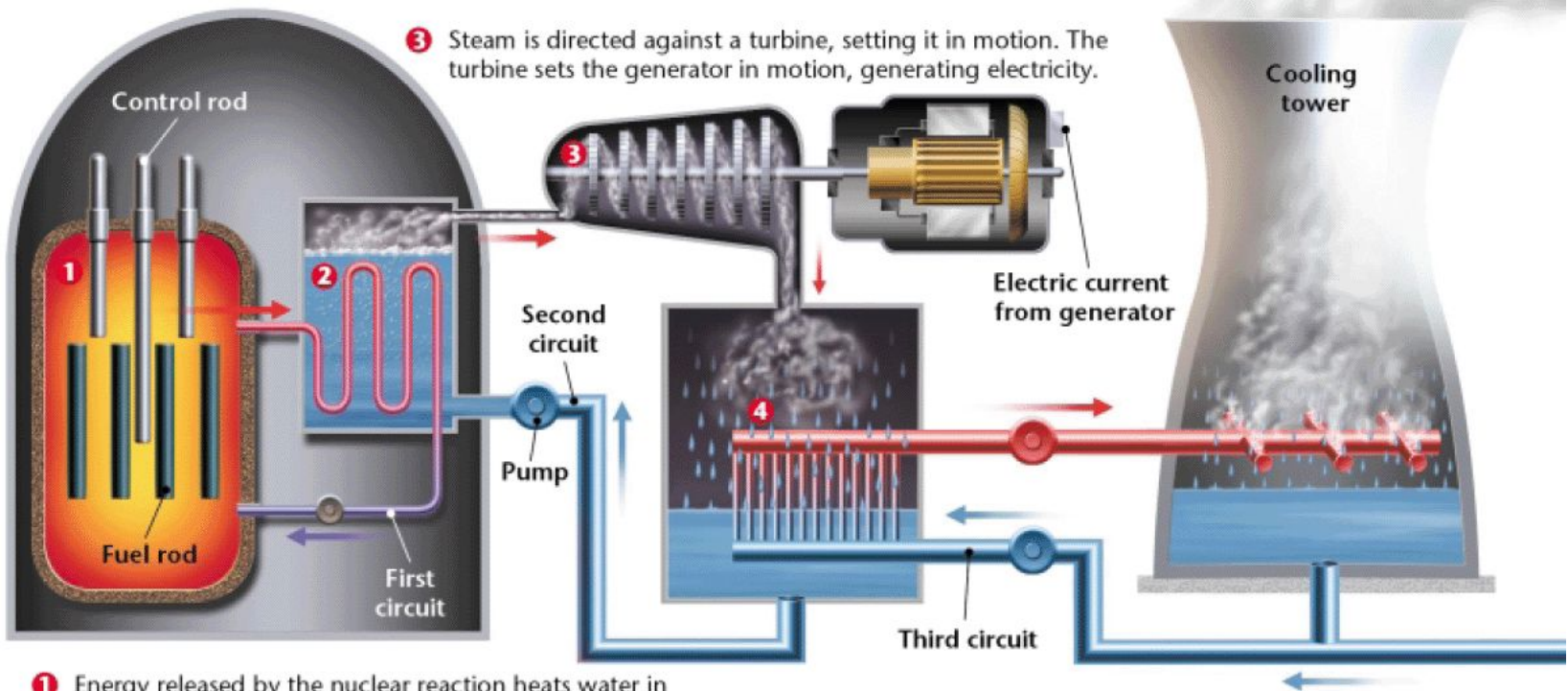




# How a Nuclear Power Plant Works

**2** The superheated water is pumped to a heat exchanger, which transfers the heat of the first circuit to the second circuit. Water in the second circuit flashes into high-pressure steam.

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**1** Energy released by the nuclear reaction heats water in the pressurized first circuit to a very high temperature.

**4** A third circuit cools the steam from the turbine and the waste heat is released from the cooling tower in the form of steam.



### Multiple Choice

1. Where do coal, oil and natural gas come from?
  - A. the melting of polar ice packs
  - B. the remains of organisms
  - C. the residue of volcanic eruptions
  - D. the understory of forests



### Multiple Choice

1. Where do coal, oil and natural gas come from?
  - A. the melting of polar ice packs
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### Multiple Choice, *continued*

2. Where fossil fuels are burned and converted to electricity, how does the total amount of usable energy change?
- F. The amount of usable energy remains the same.
  - G. The amount of usable energy decreases during conversion.
  - H. The amount of usable energy doubles during conversion.
  - I. The amount of usable energy depends on how well the power plant is maintained.



### Multiple Choice, *continued*

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### Multiple Choice, *continued*

3. Which of the following statements describes energy consumption trends today?
- A. Developed nations are using less energy per person.
  - B. Undeveloped nations are using less energy per person.
  - C. Developed nations are using more energy than undeveloped nations.
  - D. Undeveloped nations are using more energy than developed nations.



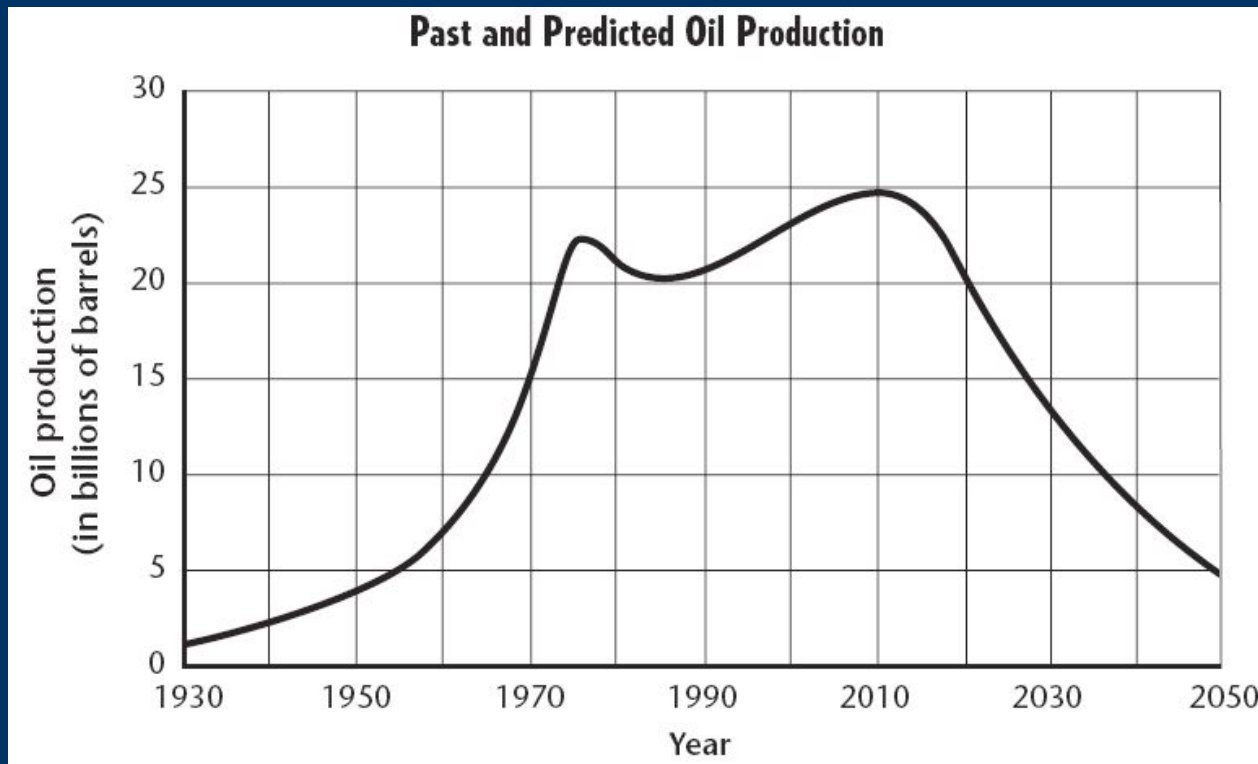
### Multiple Choice, *continued*

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  - D. Undeveloped nations are using more energy than developed nations.



### Multiple Choice, *continued*

Use this graph to answer questions 4 through 7.







### Multiple Choice, *continued*

4. If oil production after 2010 continues at the predicted rate, when will the oil reserves run out?
- F. 2040
  - G. 2050
  - H. 2060
  - I. 2070



### Multiple Choice, *continued*

4. If oil production after 2010 continues at the predicted rate, when will the oil reserves run out?
- F. 2040
  - G. 2050
  - H. 2060
  - I. 2070



### Multiple Choice, *continued*

5. What can be concluded about oil production from the graph?
- A. Oil production hit its peak in the mid 2th century.
  - B. Oil production saw a dramatic increase during the 1980s.
  - C. Oil production continued to increase throughout the 1900s.
  - D. Oil production more than doubled between 1965 and 1975.



### Multiple Choice, *continued*

5. What can be concluded about oil production from the graph?
- A. Oil production hit its peak in the mid 2th century.
  - B. Oil production saw a dramatic increase during the 1980s.
  - C. Oil production continued to increase throughout the 1900s.
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### Multiple Choice, *continued*

6. What can be inferred about the cost of oil after 2010?
- F. It will increase.
  - G. It will decrease steadily.
  - H. It will remain unchanged.
  - I. It will increase until 2030, then decrease.



### Multiple Choice, *continued*

6. What can be inferred about the cost of oil after 2010?
- F. It will increase.
  - G. It will decrease steadily.
  - H. It will remain unchanged.
  - I. It will increase until 2030, then decrease.



### Multiple Choice, *continued*

7. What is the difference in billions of barrels produced in 1990 compared to 1970?
- A. Production doubled.
  - B. Production fell by half.
  - C. Production hit a new low.
  - D. Production was up six billion barrels.



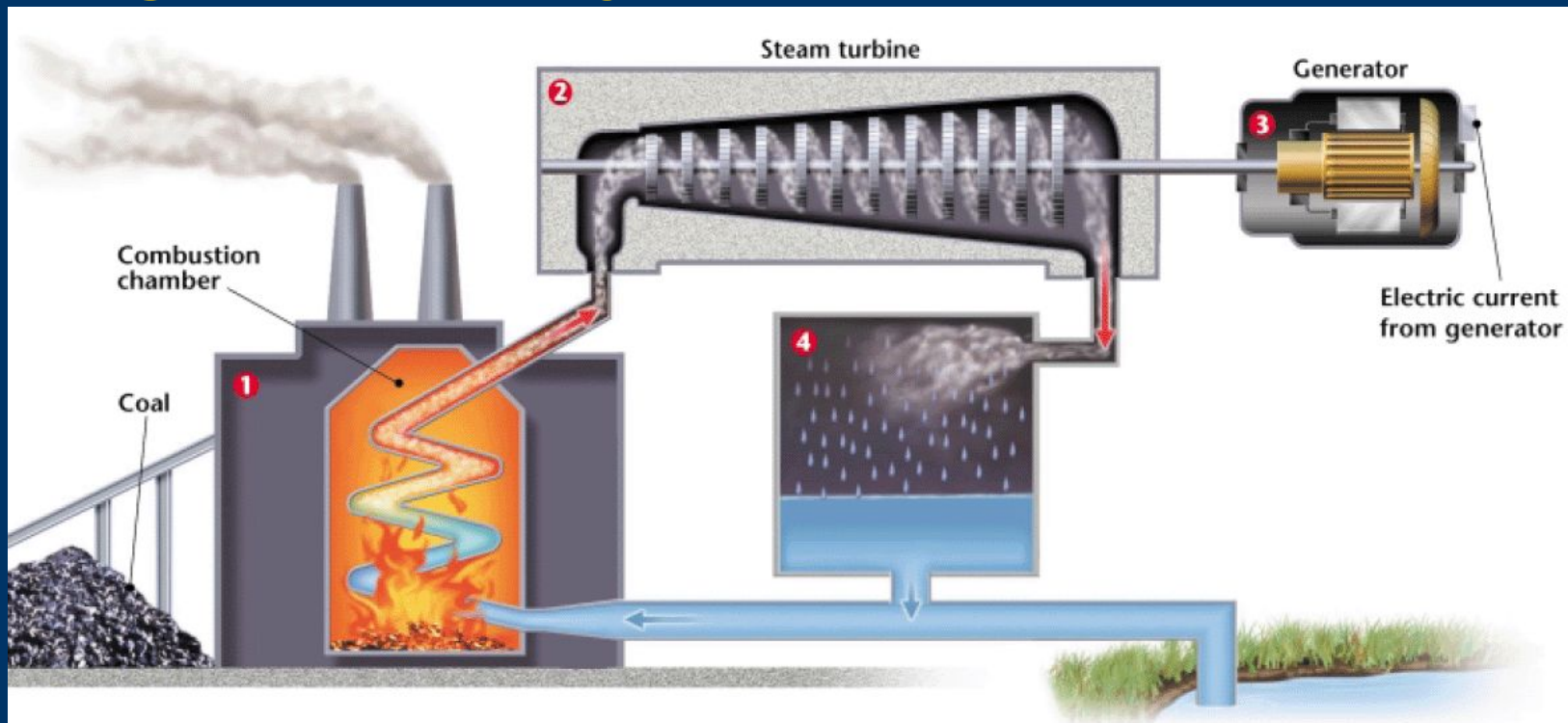
### Multiple Choice, *continued*

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### Image and Activity Bank

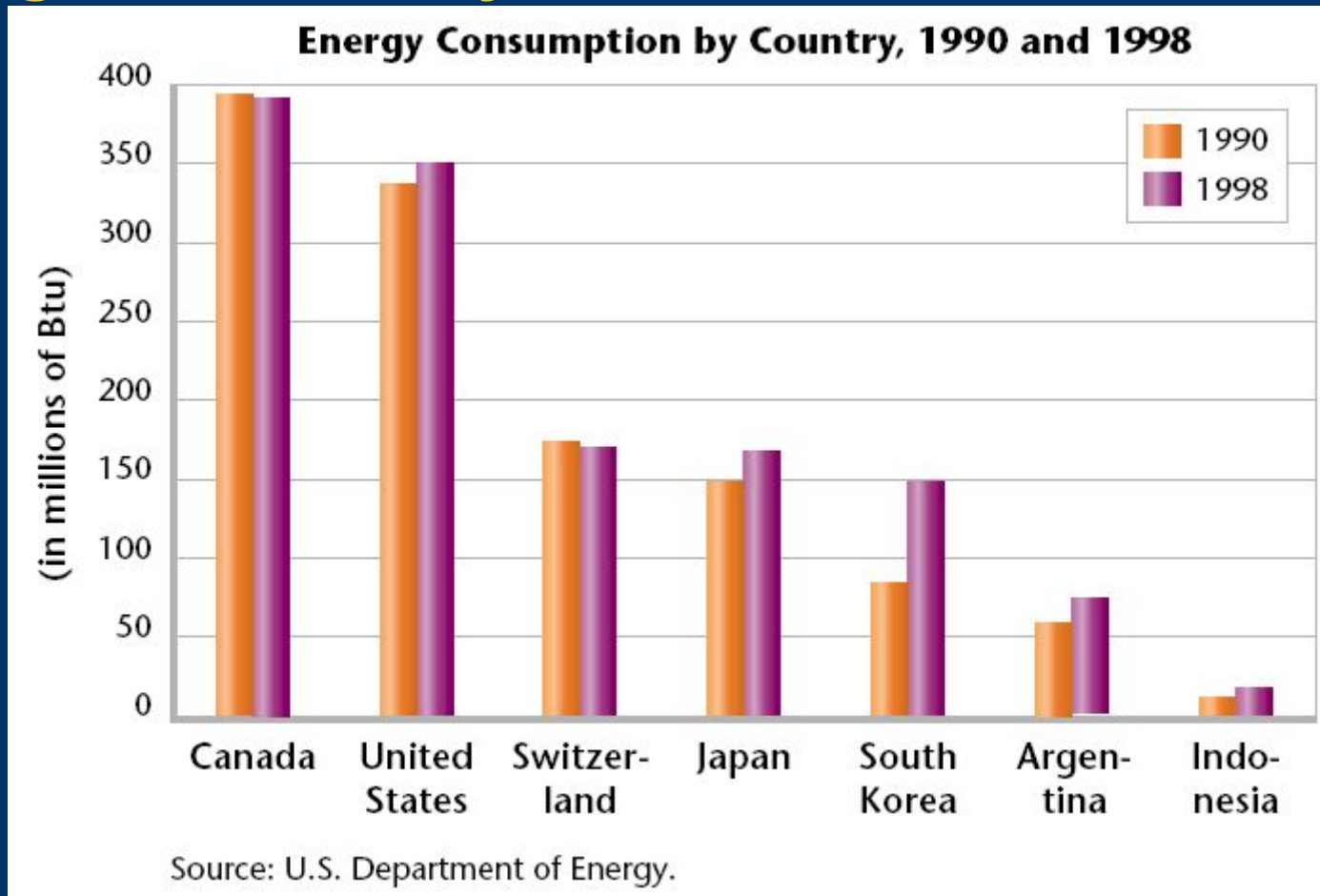


- 1** Burning fossil fuels release energy in the form of heat, which is used to boil water and produce high-pressure steam.
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# Chapter 17

## Section 1 Nonrenewable Energy Today

### Image and Activity Bank



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### Image and Activity Bank

#### QuickLAB



#### Generating Electricity



##### Procedure

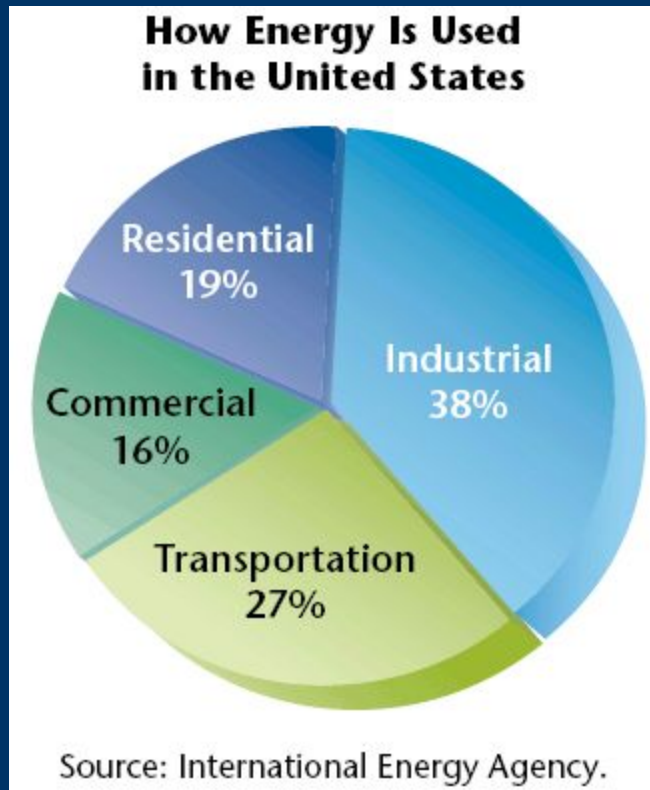
1. Tightly wrap 100 cm of fine-gauge copper wire around a small cardboard tube.
2. Attach a galvanometer or a battery tester to the ends of the wire.
3. Pass a bar magnet through the cardboard tube, and observe the galvanometer.

##### Analysis

1. What did you observe?
2. How could you increase the current you detected?
3. How does this lab model an electric power plant?



### Image and Activity Bank





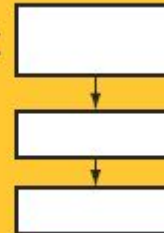
### Image and Activity Bank

#### Graphic

#### Organizer

#### Chain-of-Events Chart

Create the **Graphic Organizer** entitled "Chain-of-Events Chart" described in the Appendix. Then, fill in the chart with details about each step of the formation of fossil fuels.

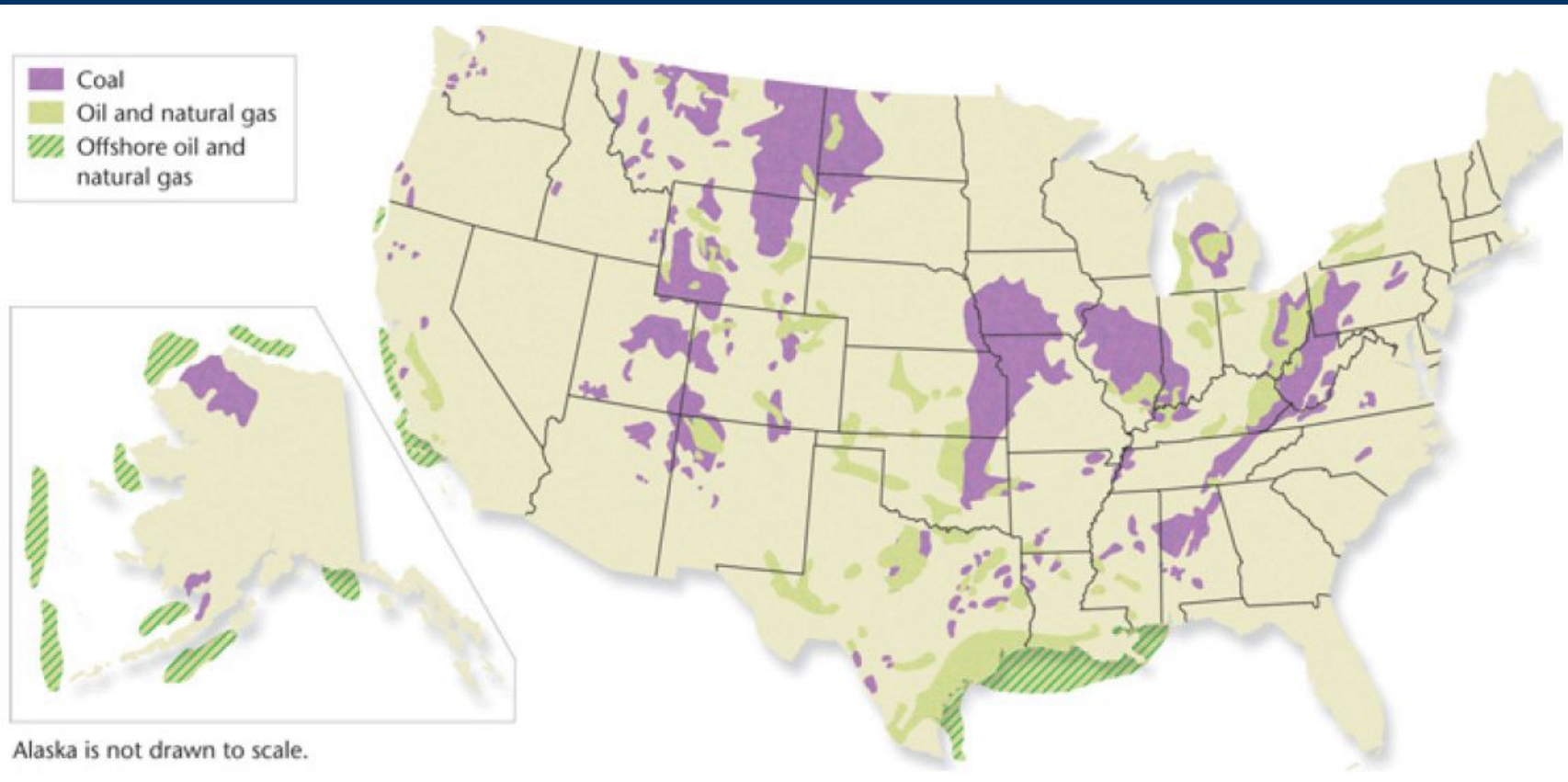


# Chapter 17

## Section 1 Nonrenewable Energy Today



### Image and Activity Bank



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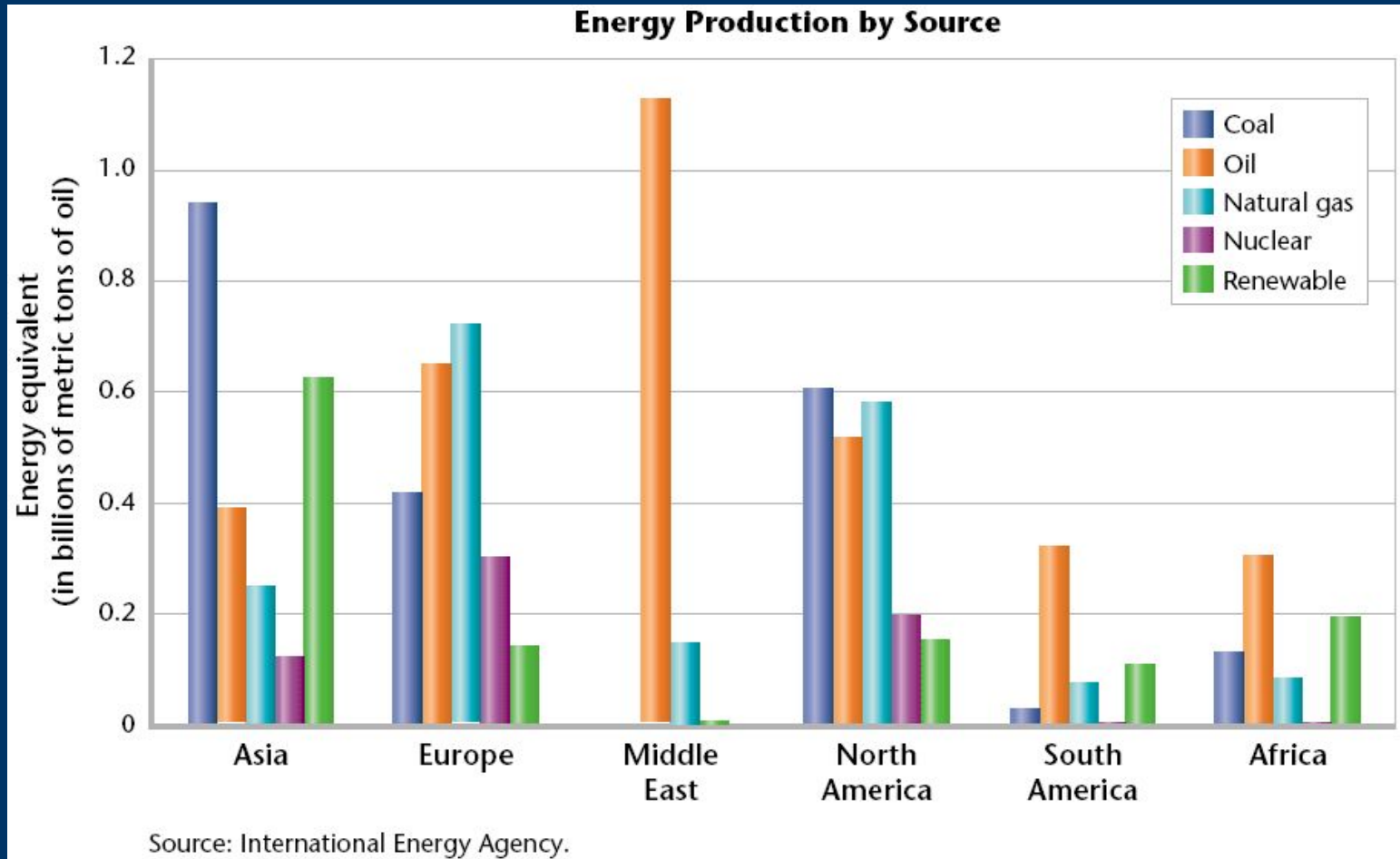
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# Chapter 17

## Section 1 Nonrenewable Energy Today



### Image and Activity Bank

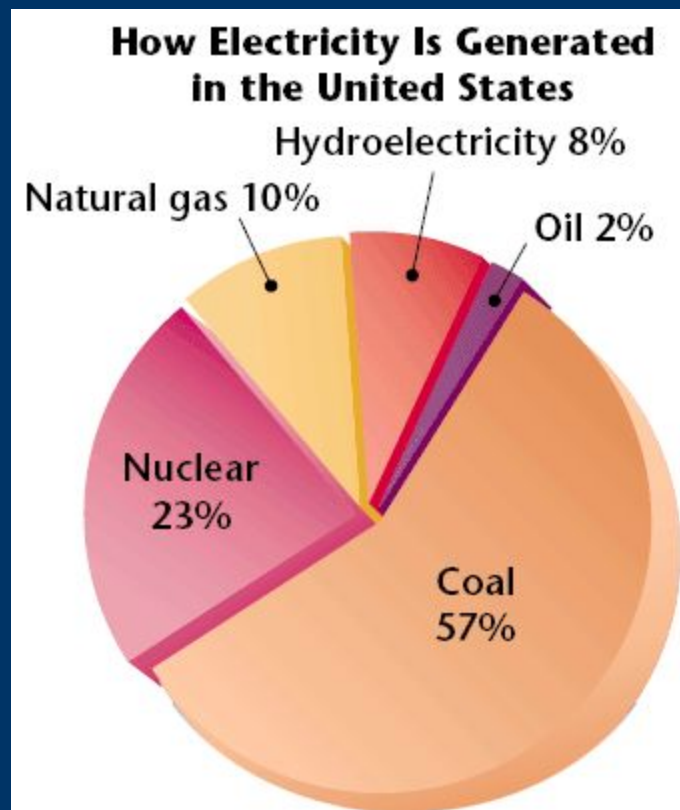


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### Image and Activity Bank







### Image and Activity Bank

#### MATHPRACTICE

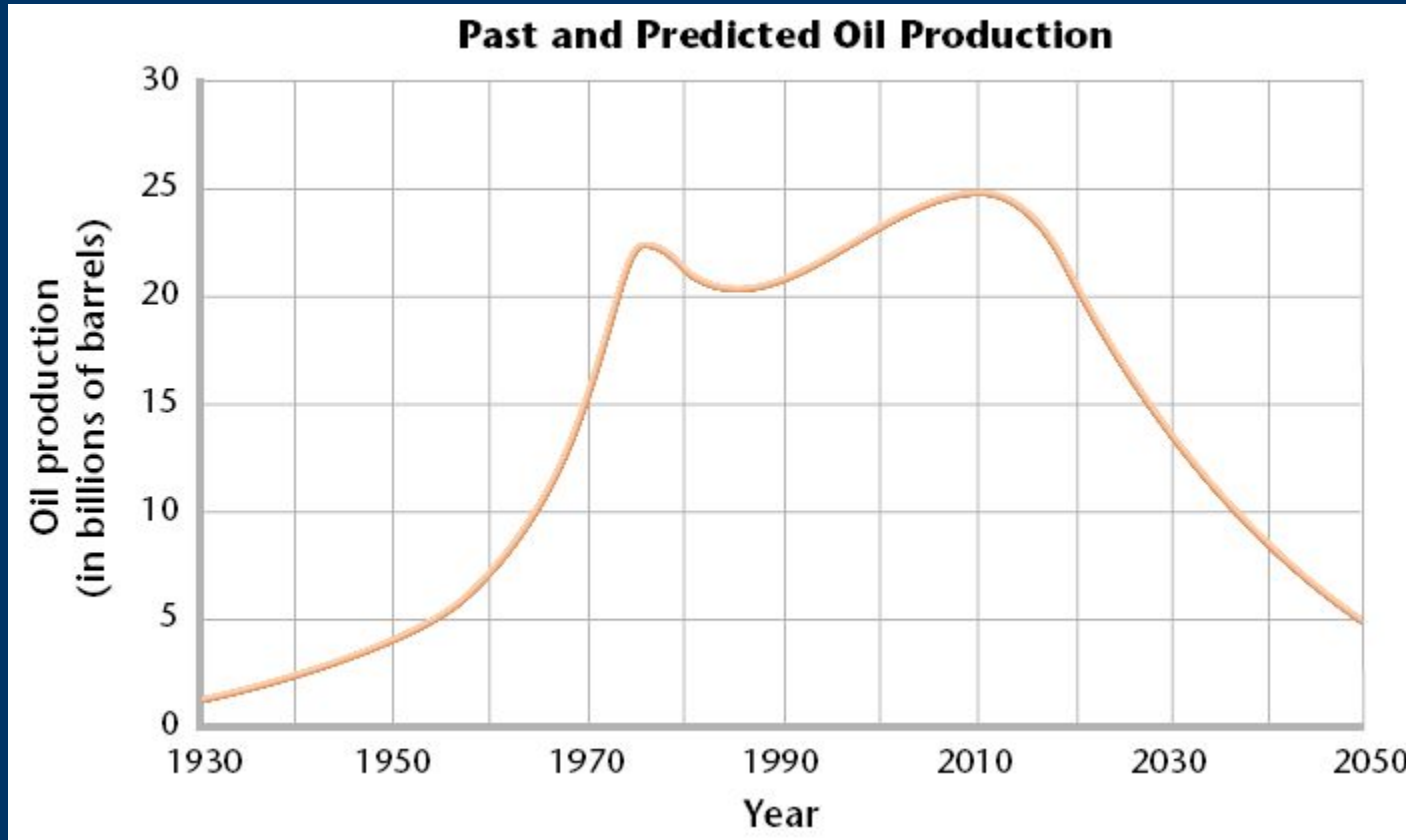


##### World Energy Use

In 1980, worldwide production of petroleum was 59.6 million barrels per day. In 1998, petroleum production was 66.9 million barrels a day. Calculate the percent increase in oil production during this period.

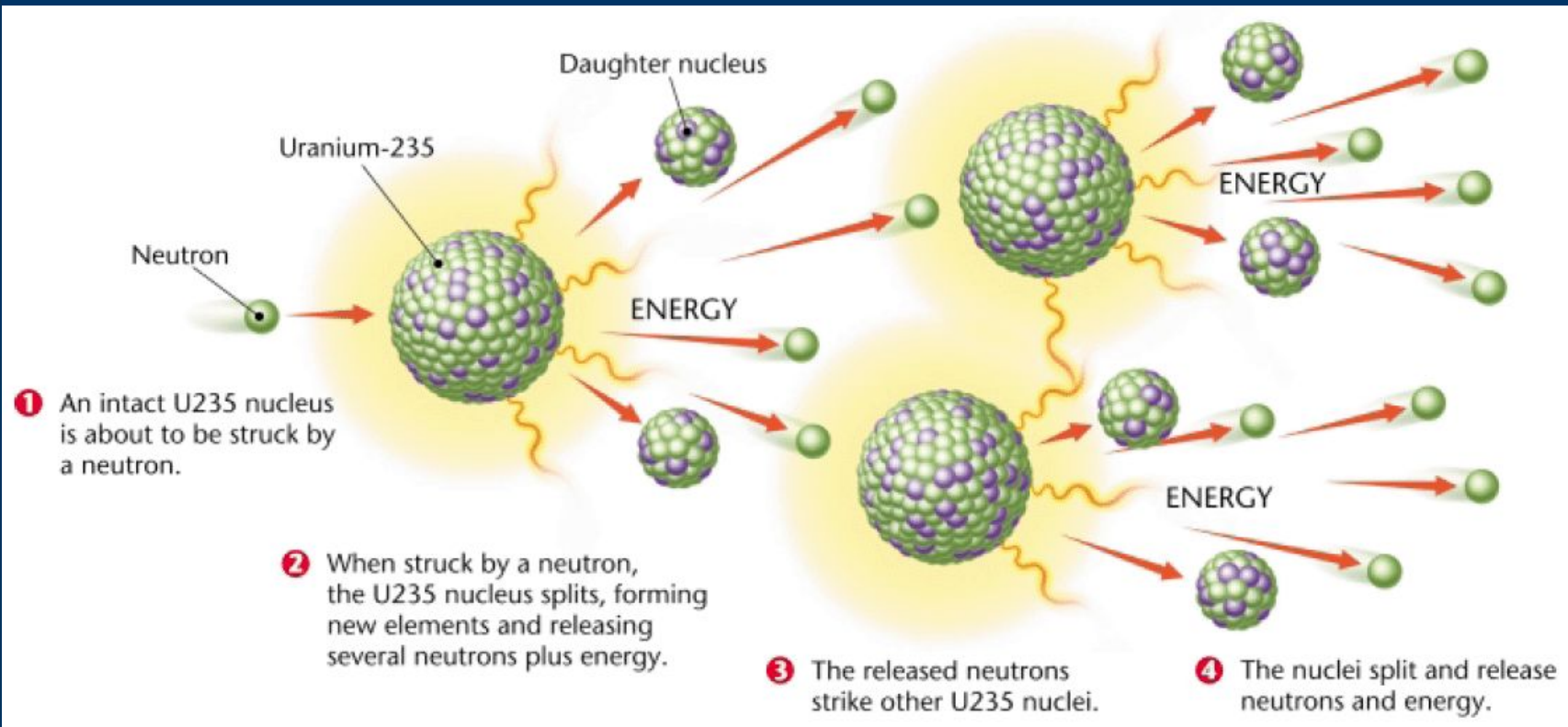


### Image and Activity Bank





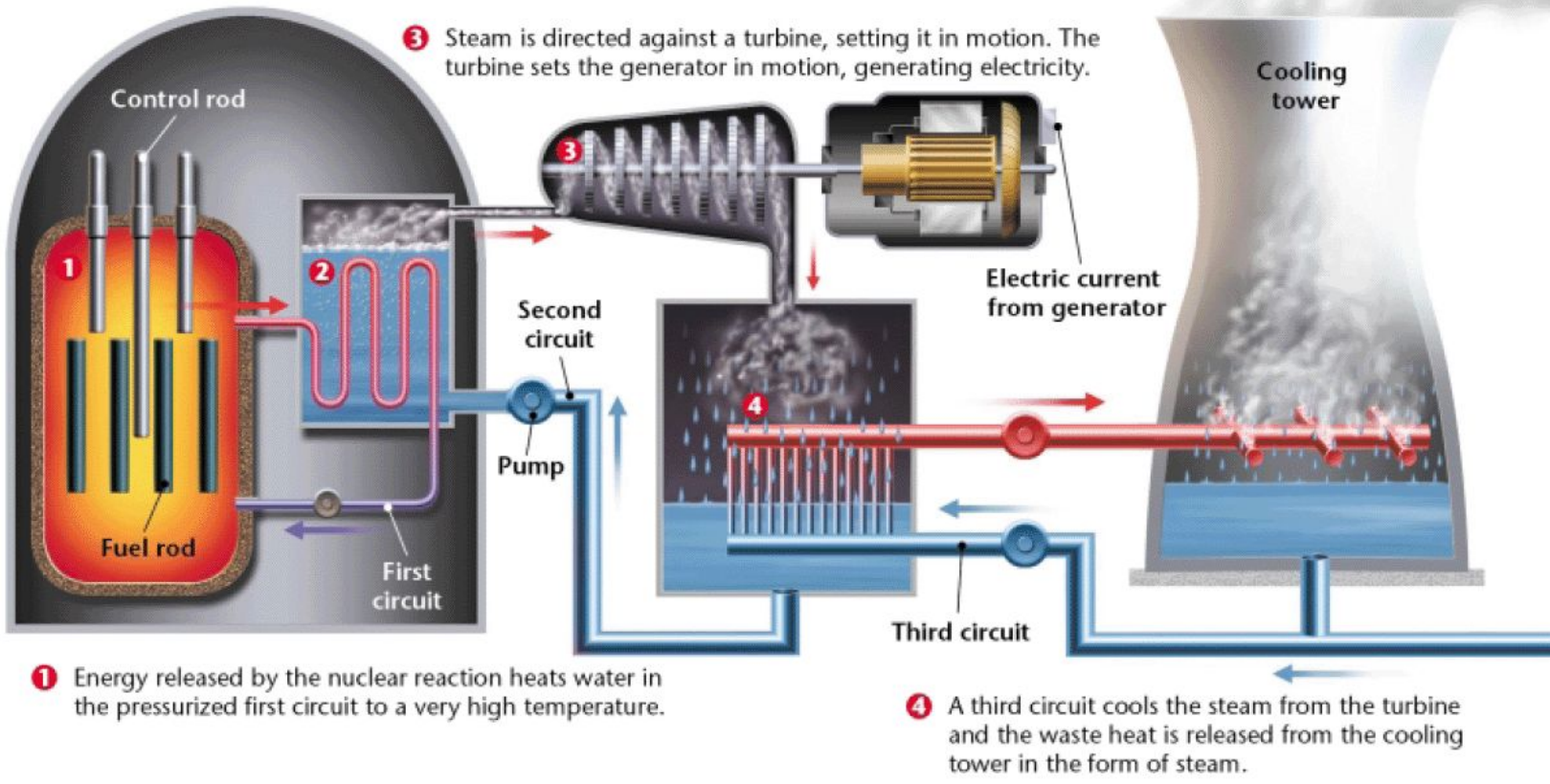
### Image and Activity Bank





### Image and Activity Bank

- 2** The superheated water is pumped to a heat exchanger, which transfers the heat of the first circuit to the second circuit. Water in the second circuit flashes into high-pressure steam.





### Image and Activity Bank

