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CHAPTER RESOURCES



What is energy?

1

The Nature of Energy

- When an object has energy, it can make things happen.
- **Energy** is the ability to cause change. 



CHAPTER RESOURCES



1

Transferring Energy


- Everything around you has energy, but you notice it only when a change takes place.
- Anytime a change occurs, energy is transferred from one object to another.
- For example, leaves are put into motion when energy in the moving wind is transferred to them.



What is energy?

1

Energy of Motion

- Things that move can cause change.
- **Kinetic energy** is the energy an object has due to its motion. 
- If an object isn't moving, it doesn't have kinetic energy.



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What is energy?

1

Kinetic Energy and Speed

- If you roll a bowling ball so it moves faster, what happens when it hits the pins?
- A faster ball causes more change to occur than a ball that is moving slowly.
- The faster the ball goes, the more kinetic energy it has. This is true for all moving objects.



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1

Kinetic Energy and Mass

- Suppose you roll a volleyball down the alley instead of a bowling ball.
- The volleyball might not knock down any pins.



1


Kinetic Energy and Mass

- An important difference between the volleyball and the bowling ball is that the volleyball has less mass.
- Even though the volleyball is moving at the same speed as the bowling ball, the volleyball has less kinetic energy because it has less mass.
- Kinetic energy also depends on the mass of a moving object. Kinetic energy increases as the mass of the object increases.



1

Energy of Position

- An object can have energy even though it is not moving.
- **Potential energy** is the energy stored in an object because of its position. 



CHAPTER RESOURCES



END

What is energy?

1

Energy of Position

- The potential energy of an object is greater if it is higher above the floor.
- Potential energy also depends on mass. The more mass an object has, the more potential energy it has.



CHAPTER RESOURCES




END

What is energy?

1

Forms of Energy—Thermal Energy

- All objects have **thermal energy** that increases as its temperature increases. 
- A cup of hot chocolate has more thermal energy than a cup of cold water.
- Many chemical reactions that take place inside your cells produce thermal energy.
- Thermal energy released by chemical reactions comes from another form of energy called chemical energy.



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END

What is energy?

1

Chemical Energy

- **Chemical energy** is the energy stored in chemical bonds. 
- When chemicals are broken apart and new chemicals are formed, some of this energy is released.
- The flame of a candle is the result of chemical energy stored in the wax.




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END

1


Light Energy

- When the light is absorbed by an object, the object can become warmer.
- The object absorbs energy from the light and this energy is transformed into thermal energy.
- The energy carried by light is called **radiant energy**. 



1


Electrical Energy

- The electric current that comes out of batteries and wall sockets carries **electrical energy**. 
- The amount of electrical energy depends on the voltage.
- To produce the enormous quantities of electrical energy consumed each day, large power plants are needed.



1

Nuclear Energy

- Nuclear power plants use the energy stored in the nucleus of an atom to generate electricity.
- Every atomic nucleus contains energy—**nuclear energy**—that can be transformed into other forms of energy. 



CHAPTER RESOURCES



END

1

Question 1

Energy is the ability to cause _____.

- A. change
- B. chemical energy
- C. kinetic energy
- D. potential energy



Section Check

1

Answer

The answer is A. An object that has energy can do something or make something happen.



CHAPTER RESOURCES



1

Question 2

Whenever a change occurs _____ is transferred from one place to another.

- A. electricity
- B. energy
- C. motion
- D. waves



Section Check

1

Answer

The answer is B. Clap your hands; energy has been transferred from your hands through the air to your ear.



CHAPTER RESOURCES



END

1

Question 3

The energy an object has due to its motion is called _____ energy.

- A. chemical
- B. electrical
- C. kinetic
- D. potential



Section Check

1

Answer

The answer is C.
Anything that is moving,
from a rocket to a falling
leaf, has kinetic energy.



CHAPTER RESOURCES



Changing Forms of Energy

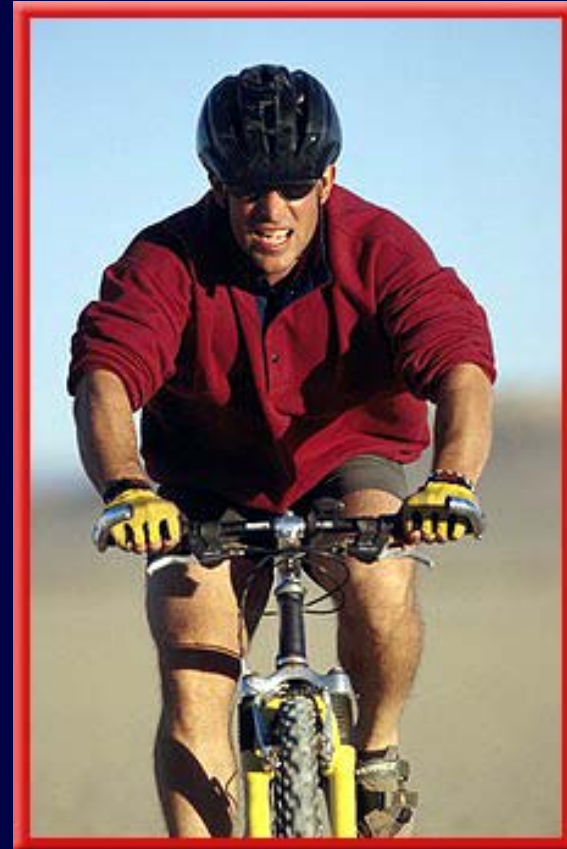
- In the world around you, energy is transforming continually between one form and another. You observe some of these transformations by noticing a change in your environment.
- Forest fires are a dramatic example of an environmental change that can occur naturally as a result of lightning strikes.



2

Tracking Energy Transformations

- As a mountain biker pedals, leg muscles transform chemical energy into kinetic energy.
- The kinetic energy of his leg muscles transforms into kinetic energy of the bicycle as he pedals.




Tracking Energy Transformations

- Some energy is transformed into thermal energy.
- Energy in the form of heat is almost always one of the products of an energy transformation.



The Law of Conservation of Energy

- According to the **law of conservation** of energy, energy is never created or destroyed. 
- The only thing that changes is the form in which energy appears.



2

Changing Kinetic and Potential Energy

- The law of conservation of energy can be used to identify the energy changes in a system.
- Tossing a ball into the air and catching it is a simple system.
- As the ball leaves your hand, most of its energy is kinetic.



2

Changing Kinetic and Potential Energy

- As the ball rises, it slows and loses kinetic energy.
- The loss of kinetic energy equals the gain of potential energy as the ball flies higher in the air.
- The total amount of energy always remains constant.



2

Energy Changes Form

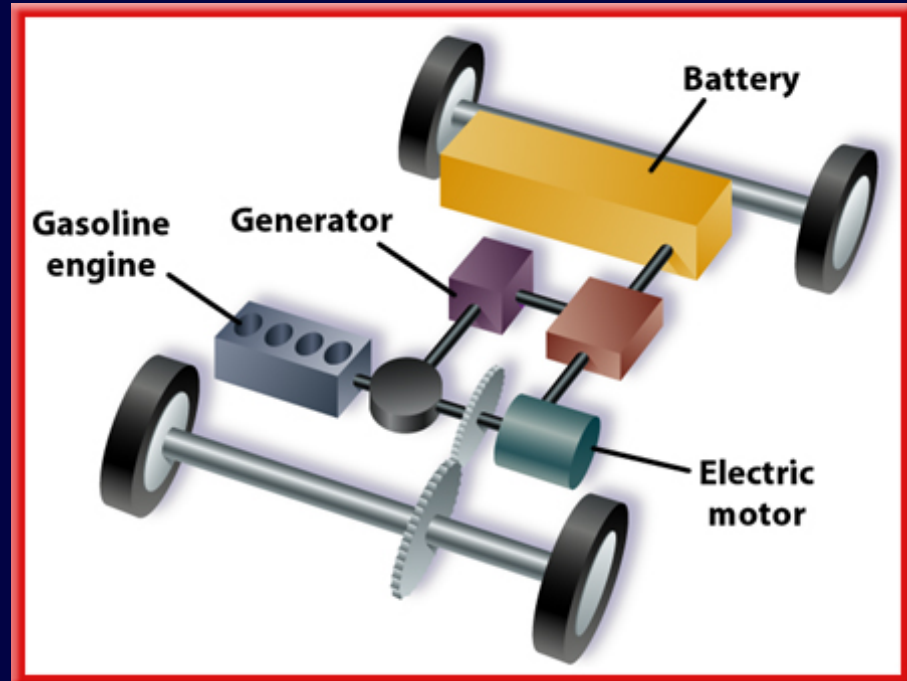
- Many machines are devices that transform energy from one form to another.
- For example, an automobile engine transforms the chemical energy in gasoline into energy of motion.
- An engine that converts chemical energy into more kinetic energy is a more efficient engine.



2

Energy Changes Form

- New types of cars use an electric motor along with a gasoline engine.
- These engines are more efficient so the car can travel farther on a gallon of gas.



Transforming Chemical Energy

- Inside your body, chemical energy also is transformed into kinetic energy.
- The transformation of chemical to kinetic energy occurs in muscle cells.



2

Transforming Chemical Energy

- The matter contained in living organisms, also called biomass, contains chemical energy.
- Bacteria, fungi, and other organisms help convert these chemical compounds to simpler chemicals that can be used by other living things.
- Thermal energy also is released as these changes occur.



2


How Thermal Energy Moves

- Thermal energy can move from one place to another.
- Thermal energy only moves from something at a higher temperature to something at a lower temperature.



2

Generating Electrical Energy


- Every power plant works on the same principle—energy is used to turn a large generator.
- A **generator** is a device that transforms kinetic energy into electrical energy. 
- In fossil fuel power plants, coal, oil, or natural gas is burned to boil water.

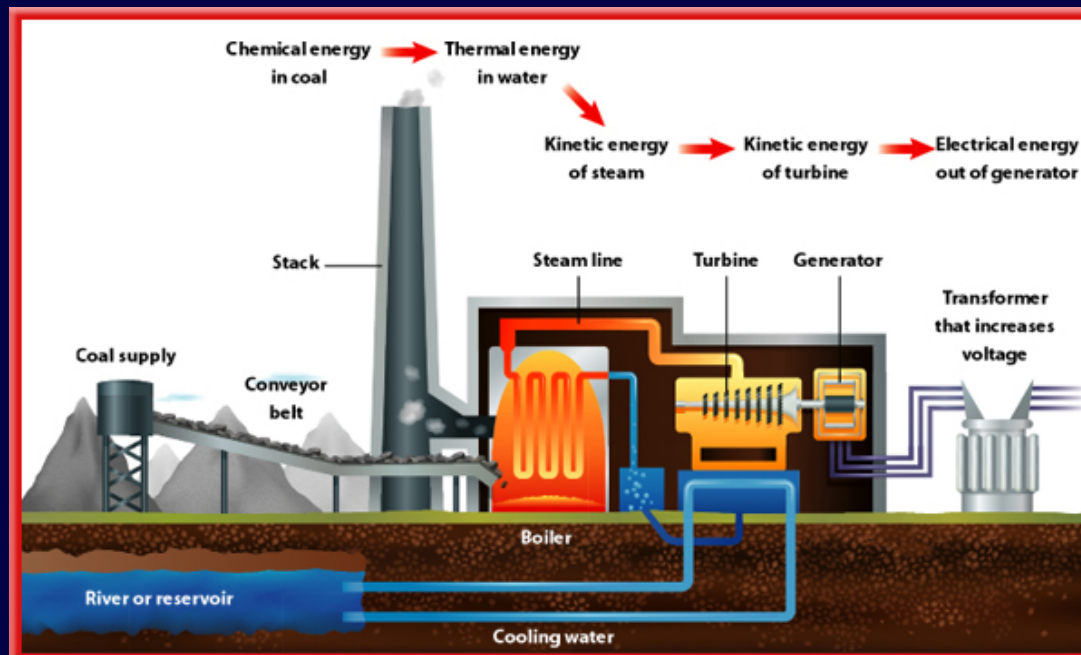


Energy Transformations

2

Generating Electrical Energy

- As the hot water boils, the steam rushes through a **turbine**, which contains a set of narrowly spaced fan blades. 



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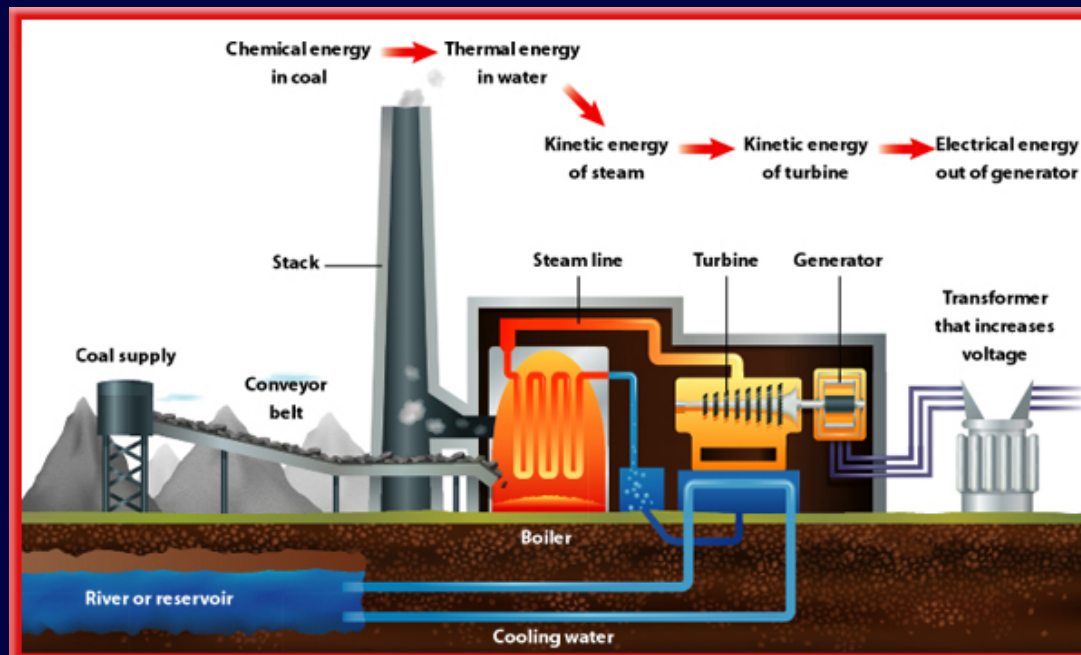
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Energy Transformations

2

Generating Electrical Energy

- The steam pushes on the blades and turns the turbine, which in turn rotates a shaft in the generator to produce the electrical energy.



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END

2

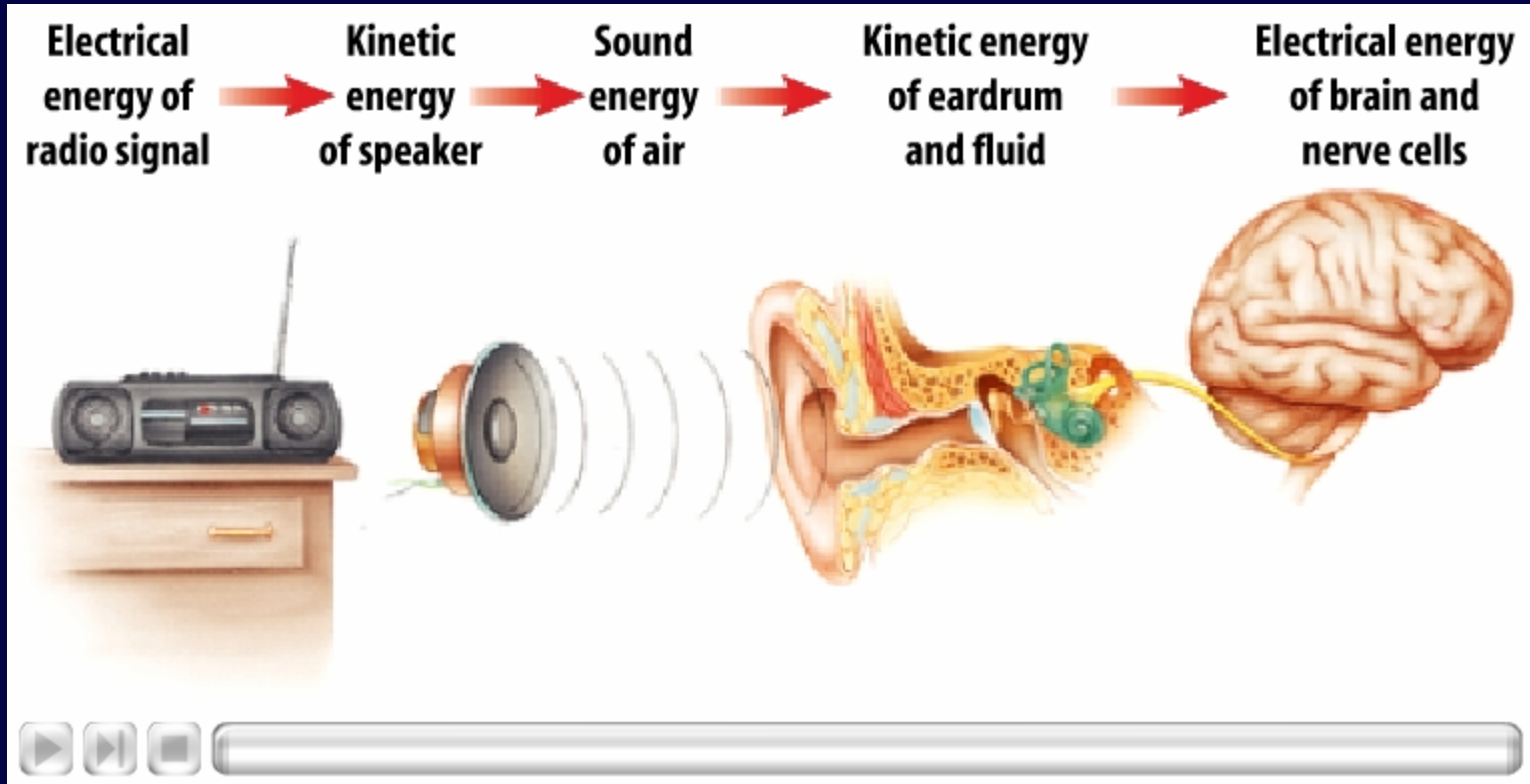
Transforming Electrical Energy

- Every time you plug something into a wall outlet, or use a battery, you are using electrical energy.
- This figure shows how electrical energy is transformed into other forms of energy when you listen to the radio.



Transforming Electrical Energy

X MAC OS X users click here to view.



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2

Transforming Thermal Energy

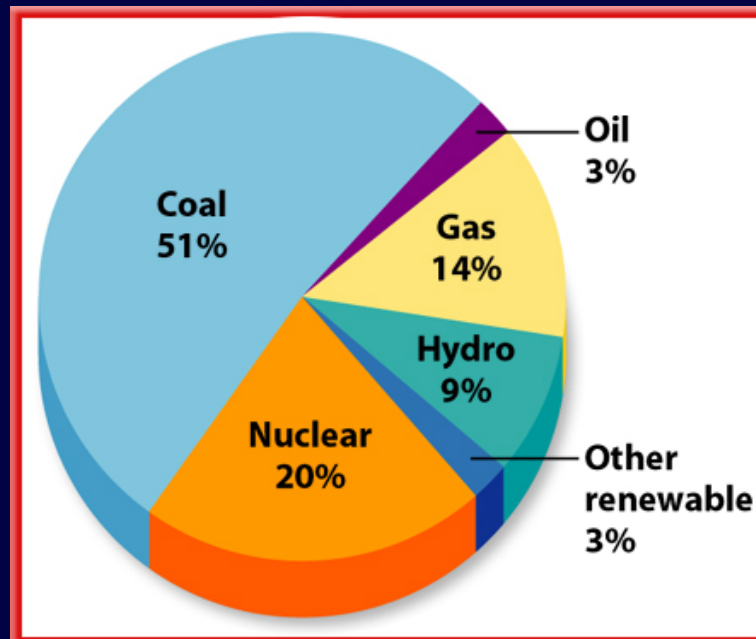
- Different forms of energy can be transformed into thermal energy.
- Chemical energy changes into thermal energy when something burns.
- Electrical energy changes into thermal energy when a wire that is carrying an electric current gets hot.
- Thermal energy also can be transformed into radiant energy.



2

Power Plants

- Almost 90 percent of the electrical energy generated in the United States is produced by nuclear and fossil fuel power plants.



2

Power Plants

- To analyze the energy transformations in a power plant, you can diagram the energy changes using arrows.
- A coal-burning power plant generates electrical energy through the following series of energy transformations.

chemical energy of coal → thermal energy of water → kinetic energy of steam → kinetic energy of turbine → electric energy out of generator



2

Question 1

Explain the law of the conservation of energy.

Answer

This law states that energy is never created nor destroyed, but just changes forms. No new energy can come out of nowhere, and all the energy that exists in a system must be accounted for.



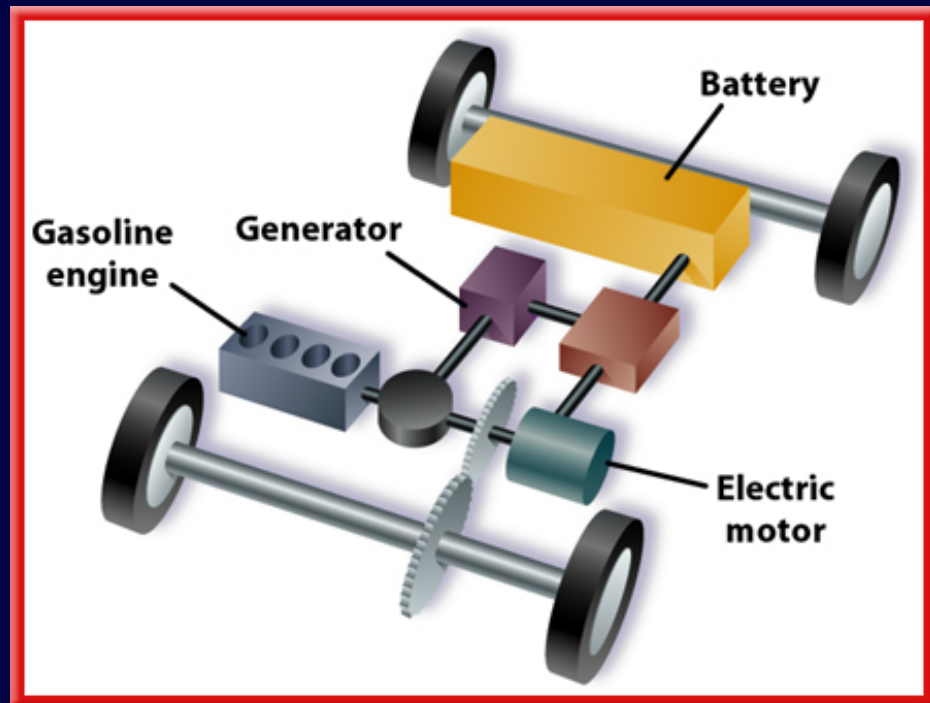
Section Check

2

Question 2

Which object makes this car more efficient?

- A. battery
- B. electric motor
- C. gasoline engine
- D. generator



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END

Section Check

2

Answer

The answer is B. Some new types of cars use an electric motor as well as the standard gasoline engine. These engines are more efficient so the car can travel farther on a gallon of gas.



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END

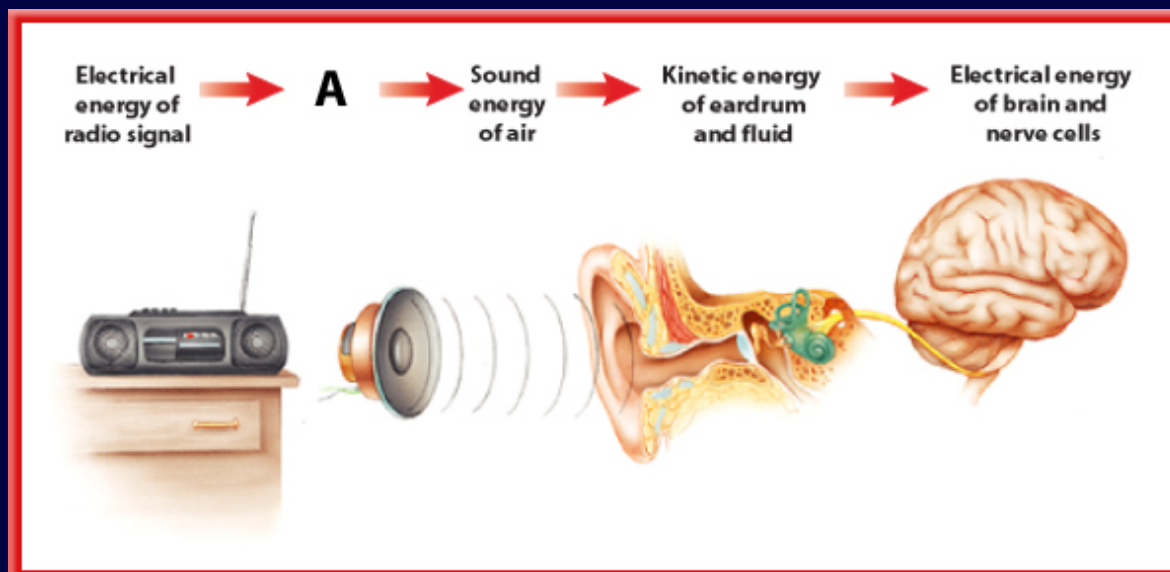
Section Check

2

Question 3

What form of energy is being used at point A in this image?

- A. electrical
- B. chemical
- C. kinetic
- D. potential



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END

Section Check

2

Answer

The answer is C. Kinetic energy of the speaker is transformed into sound energy in air.



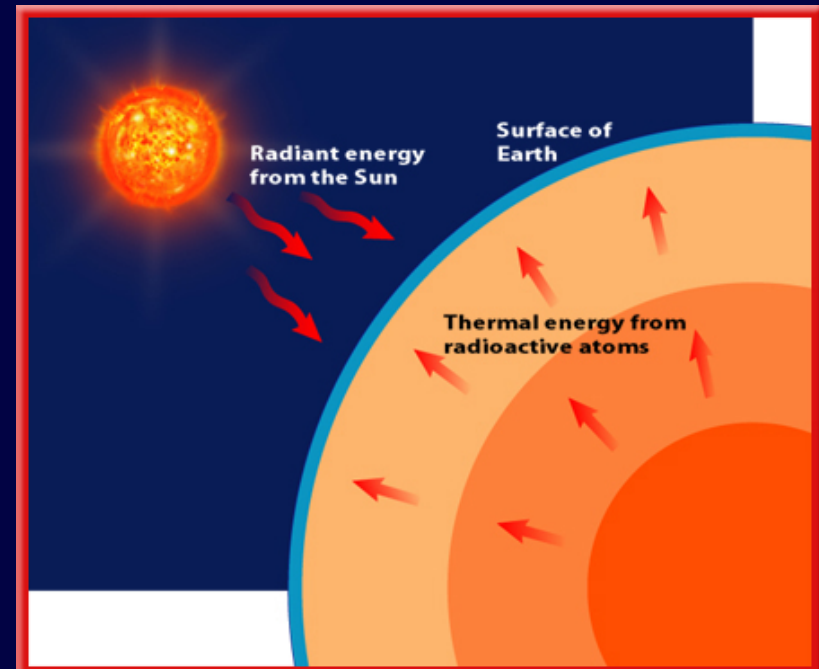
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3

Energy Resources

- The surface of Earth receives energy from two sources—the Sun and radioactive atoms in Earth's interior.
- Nearly all the energy you used today can be traced to the Sun, even the gasoline used to power the car or school bus you came to school in.



3

Fossil Fuels

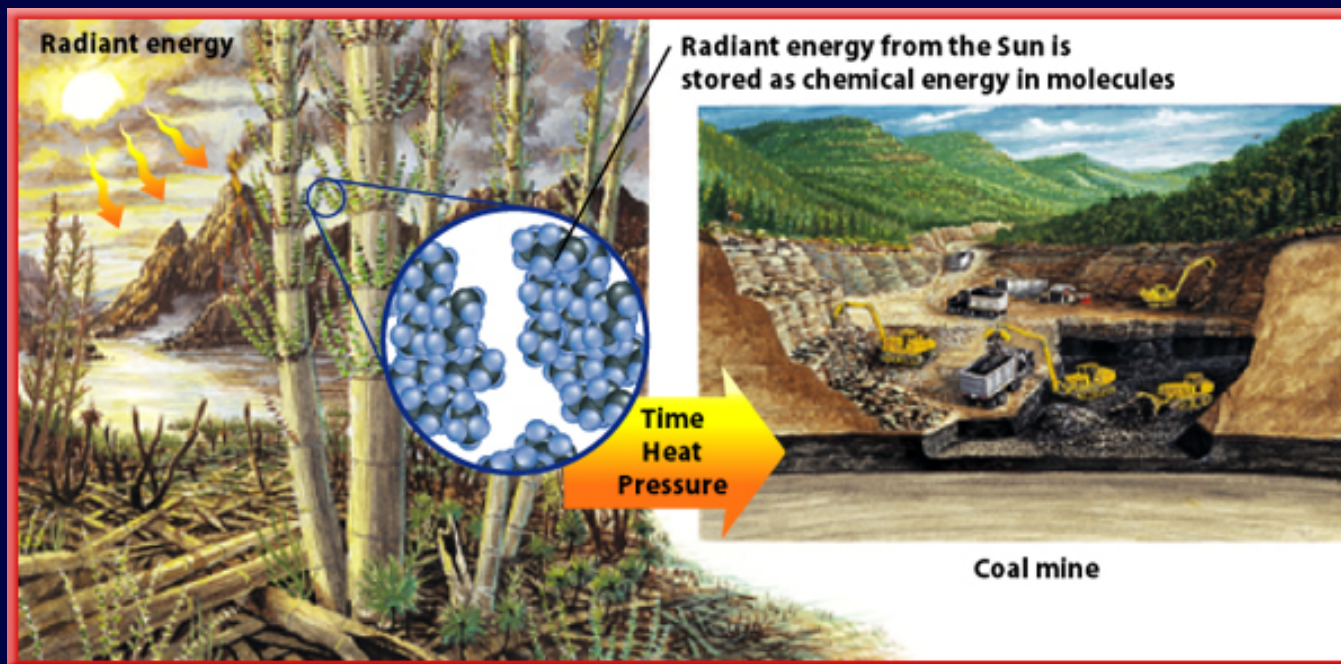
- Fossil fuels are coal, oil, and natural gas.
- Oil and natural gas were made from the remains of microscopic organisms that lived in Earth's oceans millions of years ago.
- Heat and pressure gradually turned these ancient organisms into oil and natural gas.



3

Fossil Fuels

- Coal was formed by similar process from the remains of ancient plants that once lived on land.




CHAPTER RESOURCES



END

3

Using Fossil Fuels

- It takes millions of years to replace each drop of gasoline and each lump of coal that is burned.
- An energy source that is used up much faster than it can be replaced is a **nonrenewable resource**. 
- Fossil fuels are nonrenewable resources.



3

Using Fossil Fuels

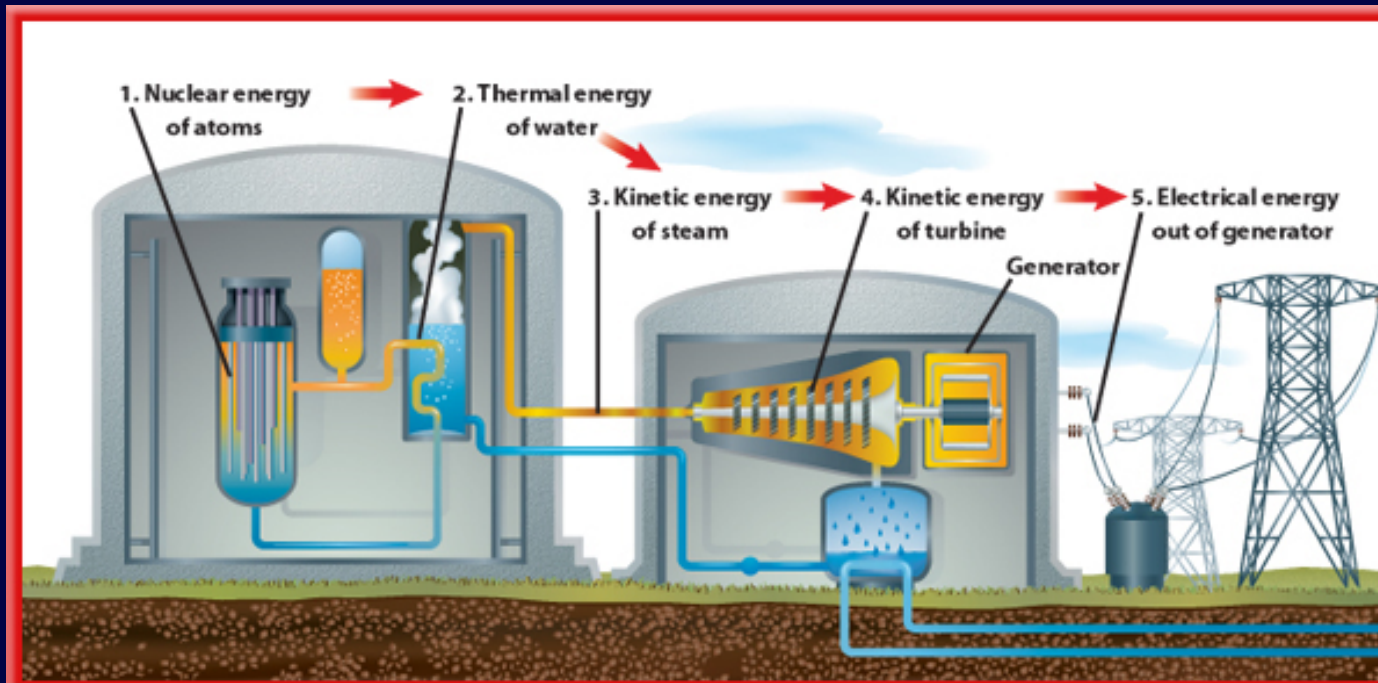
- Burning fossil fuels to produce energy also generates chemical compounds that cause pollution.
- Each year billions of kilograms of air pollutants are produced by burning fossil fuels.
- These pollutants can cause respiratory illness and acid rain.



3

Nuclear Energy

- To obtain electrical energy from nuclear energy, a series of energy transformations must occur.



CHAPTER RESOURCES



END

3

Nuclear Energy

- Generating electricity using nuclear energy helps make the supply of fossil fuels last longer. Also, nuclear power plants produce almost no air pollution.
- In one year, a typical nuclear power plant generates enough energy to supply 600,000 homes with power and produces only 1m³ of waste.



3

Nuclear Wastes

- Like all energy sources, nuclear energy has its advantages and disadvantages.
- One disadvantage is the amount of uranium in Earth's crust is nonrenewable.
- Another is that the waste produced by nuclear power plants is radioactive and can be dangerous to living things.



3

Nuclear Wastes

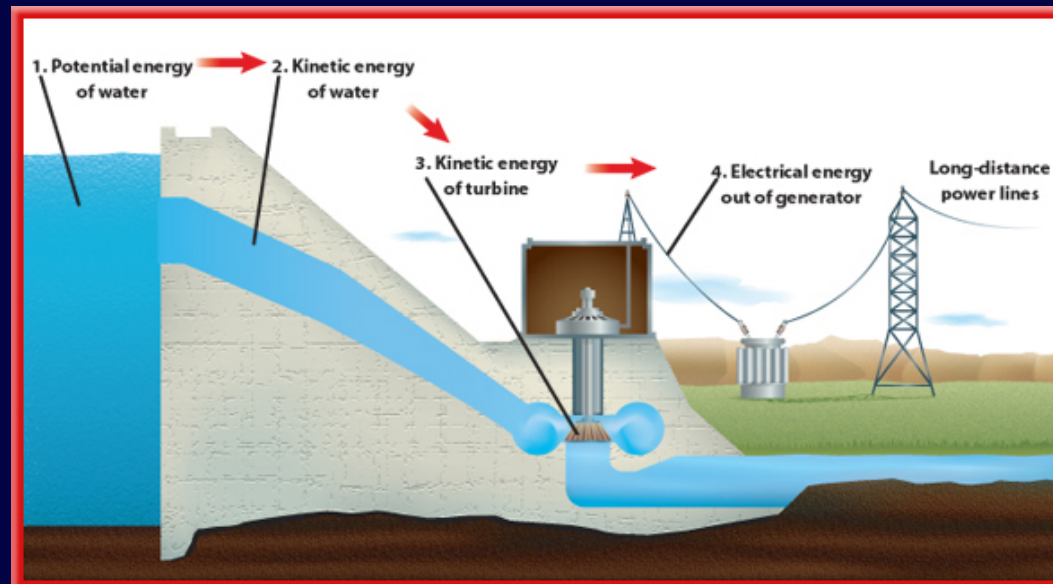
- As a result the waste must be stored so no radioactivity is released into the environment for a long time.
- One method is to seal the waste in a ceramic material, place the ceramic in protective containers, and then bury the containers far underground.



3


Hydroelectricity

- Currently, transforming the potential energy of water that is trapped behind dams supplies the world with almost 20 percent of its electrical energy.



3

Hydroelectricity

- Hydroelectricity is the largest renewable source of energy.
- A **renewable resource** is an energy source that is replenished continually. 



CHAPTER RESOURCES



END


3

Hydroelectricity

- Although production of hydroelectricity is largely pollution free, it has one major problem. It disrupts the life cycle of aquatic animals, especially fish.
- This is particularly true in the Northwest where salmon spawn and run.
- In attempt to help fish bypass some dams, fish ladders are being installed.




Alternative Sources of Energy

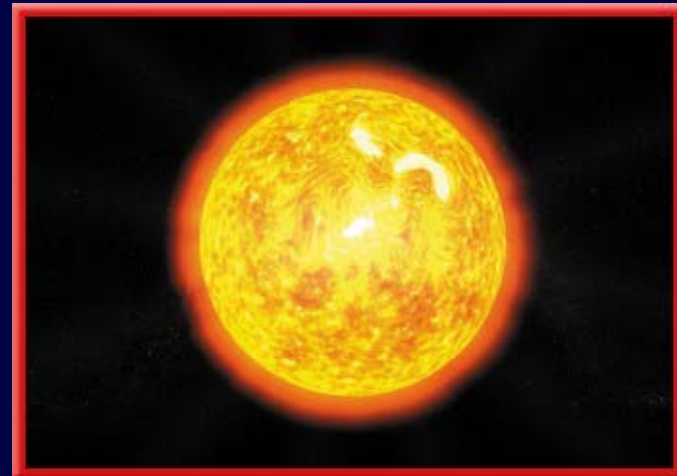
- New sources of energy that are safer and cause less harm to the environment are called **alternative resources**. 
- Alternative resources include solar energy, wind, and geothermal energy.



3

Solar Energy

- The Sun is the origin of almost all the energy that is used on Earth.
- Because the Sun will go on producing an enormous amount of energy for billions of years, the Sun is an inexhaustible source of energy.
- An **inexhaustible resource** is an energy source that can't be used up by humans. 



3

Solar Energy

- Less than 0.1 percent of the energy used in the United States comes directly from the Sun.
- One reason is that solar energy is more expensive to use than fossil fuels.




Collecting the Sun's Energy

- A thermal collector heats water by directly absorbing the Sun's radiant energy.
- Water circulating in this system can be heated to about 70°C.
- The hot water can be pumped through the house to provide heat.



3

Collecting the Sun's Energy

- A **photovoltaic** is a device that transforms radiant energy directly into electrical energy. 
- Photovoltaics are used to power calculators and satellites, including the *International Space Station*.



3

Geothermal Energy

- The heat generated inside Earth is called geothermal energy.
- Some of this heat is produced when the unstable radioactive atoms inside Earth decay, converting nuclear energy to thermal energy.



3

Geothermal Energy

- At some places deep within Earth the temperature is hot enough to melt rock.
- This molten rock, or magma, can rise up and close to the surface through cracks in the crust.
- In other places, magma gets close to the surface and heats the rock around it.



3

Geothermal Reservoirs

- In some regions where magma is close to the surface, rainwater and water from melted snow can seep down to the hot rock through cracks and other openings in Earth's surface.
- The water then becomes hot and sometimes can form steam.
- In some places, the hot water and steam are close enough to the surface to form hot springs and geysers.

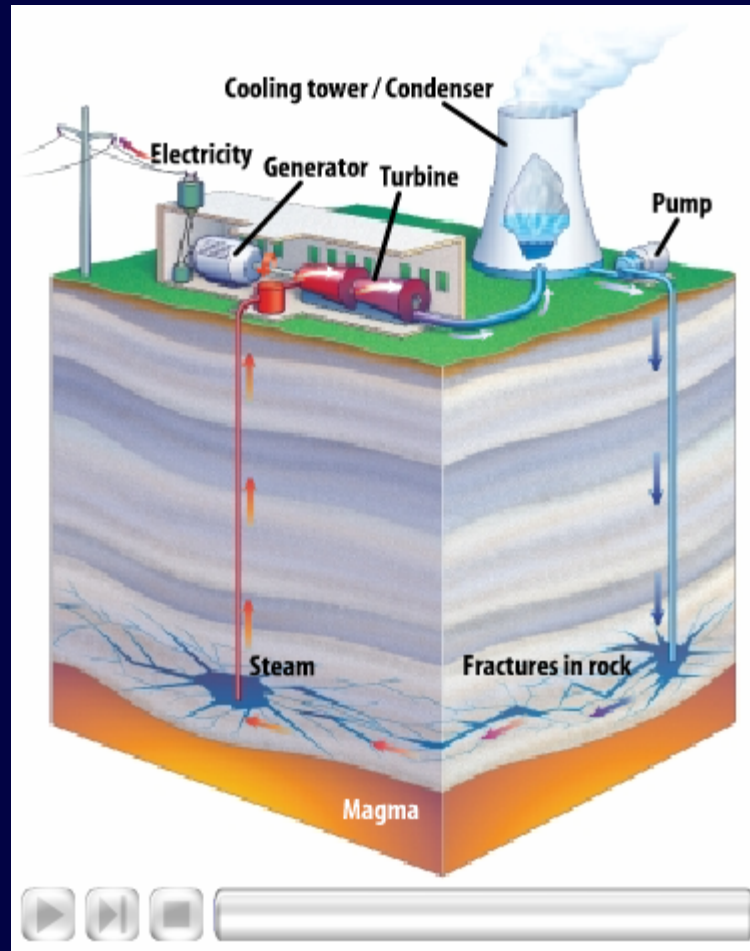


Geothermal Power Plants

- In places where the geothermal reservoirs are less than several kilometers deep, wells can be drilled to reach them.
- The hot water and steam produced by geothermal energy then can be used by geothermal power plants to generate electricity.



Geothermal Power Plants



X MAC OSX users click here to view.



CHAPTER RESOURCES



3

Geothermal Power Plants

- While geothermal power is an inexhaustible source of energy, geothermal power plants can be built only in regions where geothermal reservoirs are close to the surface, such as in the western United States.



3

Heat Pumps

- A heat pump contains a water-filled loop of pipe that is buried to a depth where the temperature is nearly constant.
- In summer the air is warmer than this underground temperature.
- Warm water from the building is pumped through the pipe down into the ground.



3

Heat Pumps

- The water cools and then is pumped back to the house where it absorbs more heat, and the cycle is repeated.
- During the winter, the air is cooler than the ground below.
- Then, cool water absorbs heat from the ground and releases it into the house.



3

Energy from the Oceans

- The rise and fall in the ocean level is called a tide.
- The constant movement of the ocean is an inexhaustible source of mechanical energy that can be converted into electric energy.



3

Using Tidal Energy

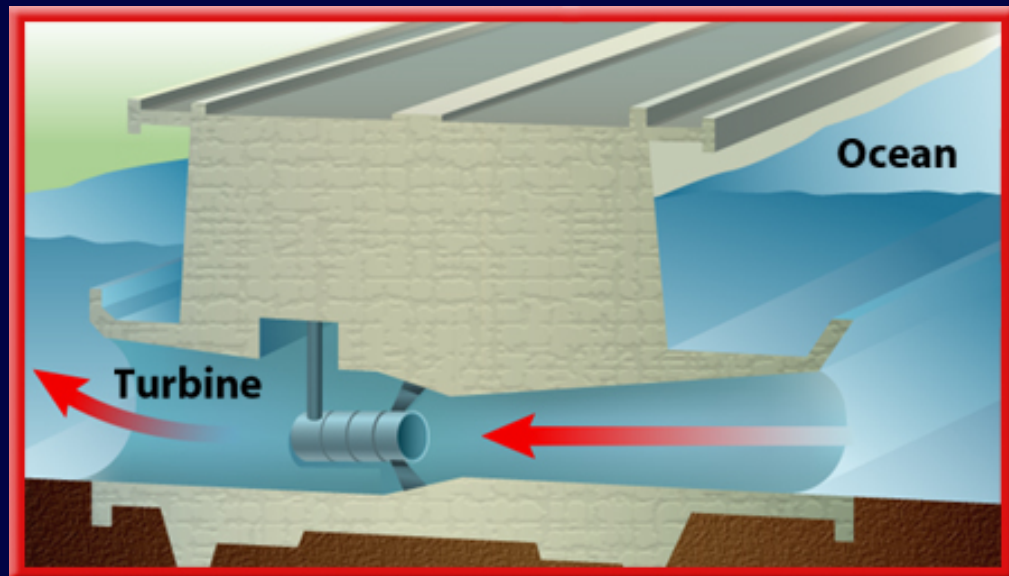
- A high tide and a low tide each occur about twice a day.
- A tidal power plant can generate electricity when the tide is coming in and going out.



3

Using Tidal Energy

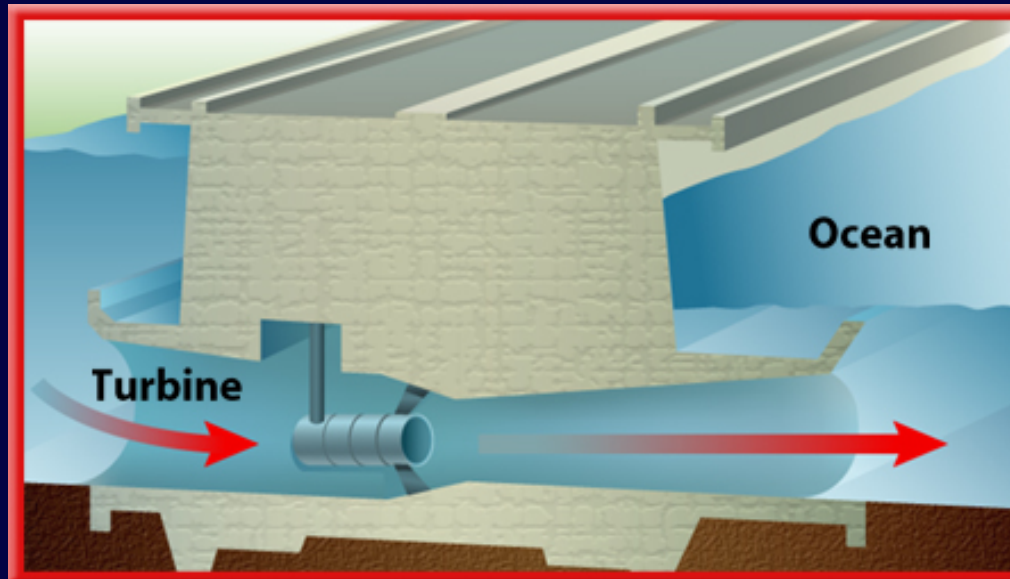
- As the tide comes in, it turns a turbine connected to a generator.
- When high tide occurs, gates are closed that trap water behind a dam.



3

Using Tidal Energy

- As the tide goes out and the ocean level drops, the gates are opened and water from behind the dam flows through the turbine, causing it to spin and turn a generator.



CHAPTER RESOURCES



END

3

Using Tidal Energy

- While tidal energy is a nonpolluting, inexhaustible energy source, its use is limited.
- Only in a few places is the difference between high and low tide large enough to enable a large electric power plant to be built.



3

Wind

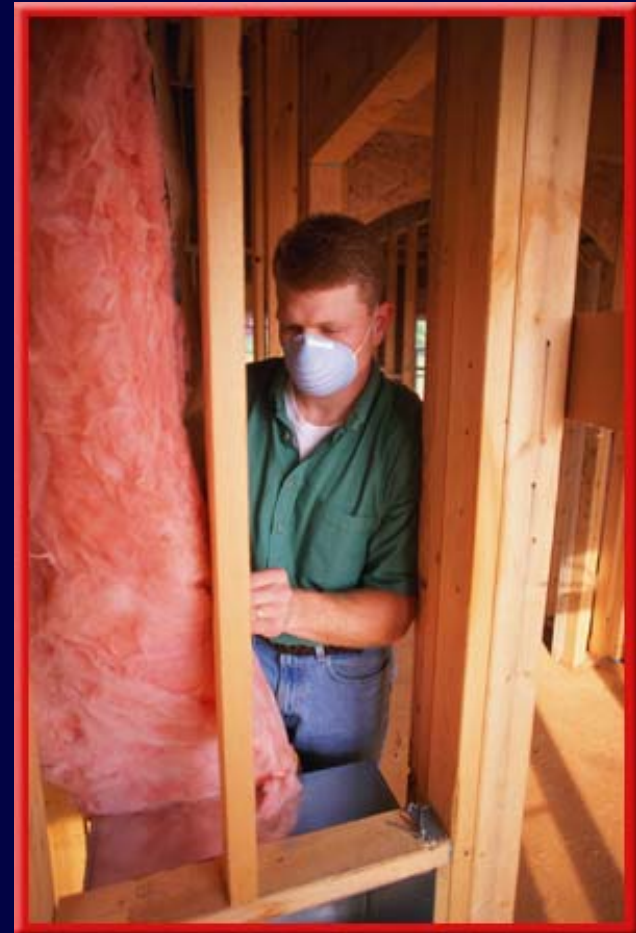
- Modern windmills convert the kinetic energy of the wind to electrical energy.
- The propeller is connected to a generator so that electrical energy is generated when wind spins the propeller.
- Some disadvantages are that windmills produce noise and that large areas of land are needed.



3

Conserving Energy

- One way to make the supply of fossil fuels last longer is to use less energy.
- Reducing the use of energy is called conserving energy.



Section Check

3

Question 1

Nearly all the energy that we use on Earth comes from _____.



CHAPTER RESOURCES



3

Answer

All the energy we use on earth comes directly or indirectly from the Sun. This includes energy sources such as oil and natural gas, which trap radiant energy that came from the Sun long ago.



Section Check

3

Question 2

Name three types of fossil fuel.



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3

Answer

Three types of fossil fuel are coal, oil, and natural gas. Fossil fuels are nonrenewable resources, which means that they can't be replaced by natural means in a short period of time.



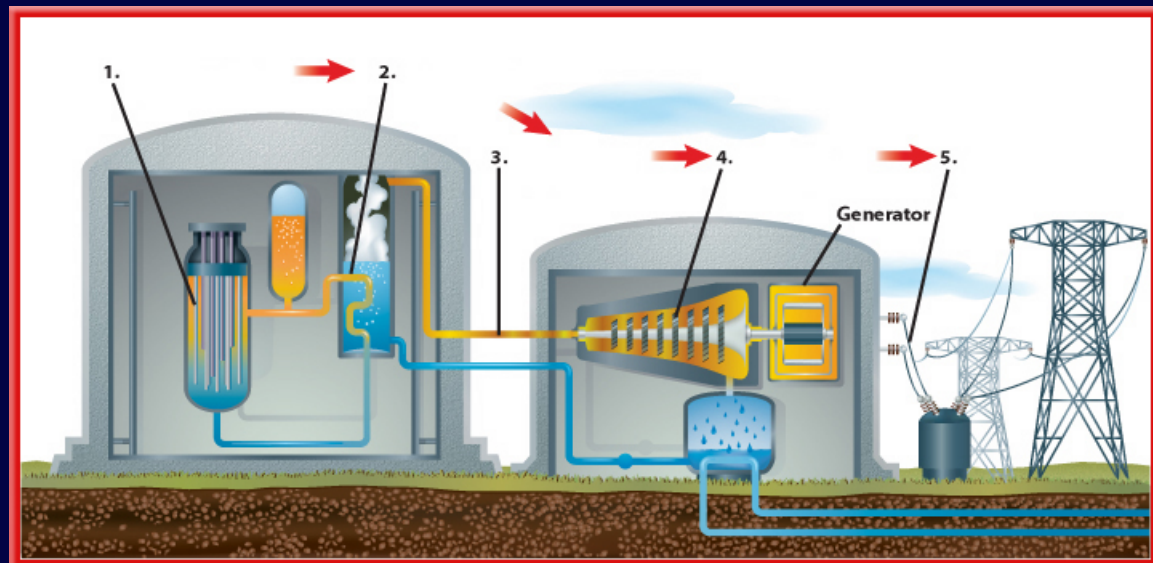
Section Check

3

Question 3

What form of energy is at work in step 2 of this image?

- A. electrical
- B. nuclear
- C. potential
- D. thermal



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END

Section Check

3

Answer

The answer is D. Thermal energy of water is transformed into the kinetic energy of steam.



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Click on this icon to return to the previous slide



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End of Chapter Summary File



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