Unit 17: Energy Sources

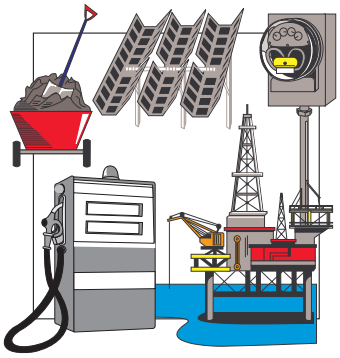
This unit focuses on the identification of energy sources and their uses. Students will review renewable and nonrenewable sources of energy. There is an emphasis on fossil fuels.

Student Goals

- Determine effects of solar radiation on various materials.
- Identify different energy sources.
- Distinguish between renewable and nonrenewable resources.
- Know how fossil fuels are formed.
- Describe the advantages and disadvantages of several energy sources.

Unit Focus

- Know that layers of energy-rich organic materials have been gradually turned into great coal beds and oil pools (fossil fuels) by the pressure of the overlying earth and that humans burn fossil fuels to release the stored energy as heat and carbon dioxide. (SC.G.2.4.1)



Vocabulary

Use the vocabulary words and definitions below as a reference for this unit.

anthracite ..... the final stage in the formation of coal; it is very hard and burns cleanly

biomass fuel ..... a burnable fuel made from plant and animal material
Examples: wood and peat

bituminous ..... the third stage in the formation of coal; it is soft and gives off a lot of heat when burned

coal ..... fossil fuel that comes from plants that lived millions of years ago

conserve ..... to save natural resources for the future

electricity ..... the type of energy produced by using natural resources such as water, wind, and fossil fuels to power a generator

energy ..... the ability to do work or move objects

fossil fuel ..... fuel made from decayed plants and animals that lived millions of years ago preserved below Earth's crust
Examples: coal, oil, natural gas

geothermal energy ..... energy produced by the heat from inside Earth's crust

hydroelectricity ..... electricity produced by falling water

lignite ..... the second stage in the formation of coal; it is moist and still has bits of woody tissue in it

methane ..... natural gas used in stoves and for heating homes

natural gas ..... a fossil fuel in its gaseous state found along with oil deposits

natural resources ..... materials found on or inside Earth's crust that people can use

nonrenewable resources ..... materials that are used up faster than they can be replaced in nature or can be used only once

nuclear energy ..... energy produced by splitting the nucleus of the uranium atom

oil shale ..... sedimentary rock with oil trapped between its layers

peat ..... the first stage of the formation of coal; formed from decomposed plants

petroleum or **oil** ..... liquid fossil fuel formed from plants and animals that lived in the sea

renewable resources ..... materials that can be replaced in nature at a rate close to their rate of use or used over again

solar cells ..... a device used to collect energy from the sun and transform it into electricity

solar collectors ..... large panels that collect solar energy that will be used to heat water, etc.

solar energy ..... energy from the sun

tidal power ..... the energy from the two-way flow of the tides used to produce electricity

wind power ..... energy of the wind used to create electricity

Introduction

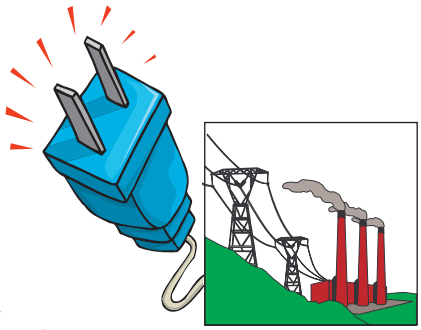
It is a well-known fact that nothing lasts forever. Our **energy** resources are no exception. We need *energy* to power our cars and factories, heat our schools and homes, refine metals, make steel, and to do many of the things that we take for granted. Because the price of **petroleum** or **oil** tends to increase and their supply is limited, we are trying to find other methods for producing energy. **Coal**, gas, *oil*, wind, water, the sun, the tides, and nuclear reactions are but a few of Earth's energy resources. Some are **renewable** and some are not. If we understand these resources, and whether they are *renewable* or **nonrenewable**, we can make informed decisions about producing and using energy.

We need energy to power our cars and factories.

The price of petroleum tends to increase and supply is limited.

Sources of Energy

Energy is the ability to do work. We get energy from our **natural resources**. Some energy is used directly, such as burning **natural gas** to cook. Many times we change a *natural resource* into another form of energy, such as **electricity**. *Electricity* is produced by a generator. A generator uses energy from coal, gas, oil, wind, uranium, steam, tides, or falling water to turn the blades of a large wheel called a *turbine*. The turbine turns the coils in the generator to produce electricity.



Electricity is produced by a generator.

Our major sources of energy include the sun, moving water and wind, tides, **fossil fuels**, nuclear reactions, plant and animal materials, and heat inside Earth's crust.

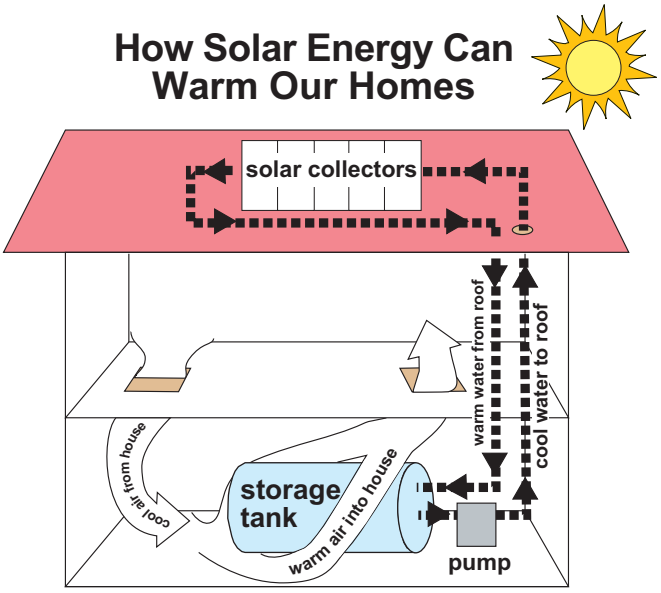
Types of Energy

Some of the energy we use comes from natural resources which can be used over and over again, such as water and wind. Other resources, such as soil and forests, can be replaced within a relatively short period of time. These resources are said to be *renewable*; they can be replaced or used over again. Other resources, such as *fossil fuels*, are *nonrenewable*. Fossil fuels—oil, gas, and coal—take millions of years to form. They can be used up faster than they can be replaced in nature or used only once. We must **conserve** our use of nonrenewable resources so that they do not run out in the foreseeable future.

Fossil fuels—oil, gas, and coal—take millions of years to form.

Renewable Resources

Solar Energy. Energy from the sun is called **solar energy**. Many homes and buildings are heated by using **solar collectors**. *Solar collectors* are panels, usually put on the roof of a house, to collect heat to use for hot water, cooking, washing, and heating swimming pools. *Solar energy* can also be converted to electricity through the use of **solar cells**. Using *solar cells* is expensive. They are not used very often, except in spacecrafts.



The *advantages* of using solar energy include the following:

1. It is a renewable resource because there is a continuous supply of sunshine.

2. Solar energy does not pollute the atmosphere, land, or water.

The *disadvantages* of solar energy include the following:

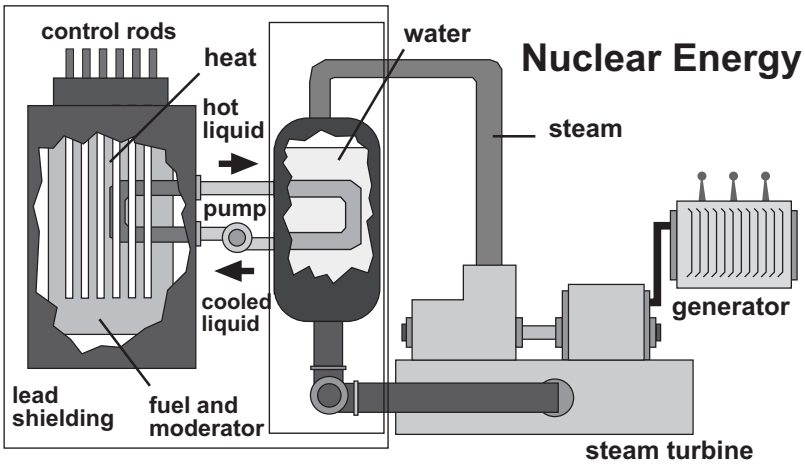
1. It cannot be collected at night.

2. It can only be used in areas that receive a lot of sunshine.

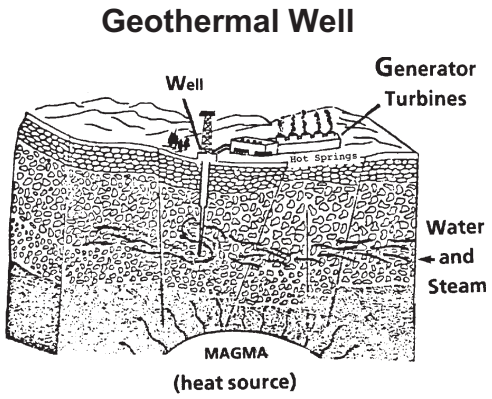
3. It is impractical for large buildings because too many solar panels would be required.

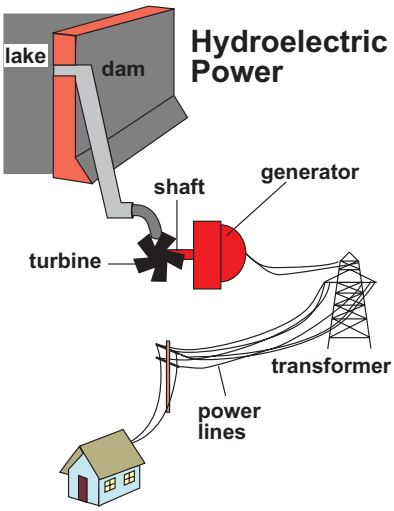
4. Converting solar energy to electricity by using solar cells is currently expensive.

Nuclear Energy. **Nuclear energy** is produced by splitting the nucleus or center of the uranium atom. When the atom splits, a great deal of energy is released as heat. This heat energy is then used to turn water into steam. Then, the steam turns the turbines of generators that produce electricity. A major disadvantage of *nuclear energy* is that it produces radioactive wastes that can destroy cells and change or destroy genetic material. These wastes may leak from storage facilities. The leaked wastes may contaminate the soil or groundwater. In extreme instances, cores may *melt down*. That is, they may become so hot due to faulty power plant operation that they may melt through the floor and shielding.



Geothermal Energy. **Geothermal energy** uses the heat from inside Earth's crust. Wells are drilled into hot water deposits in Earth. The water then escapes to the surface as steam. The steam is then used to run generators to make electricity. Sometimes the hot water comes to the surface naturally in hot springs and geysers. In Iceland, most homes get their hot water from hot springs and geysers. *Geothermal energy* is renewable; however, even if all of the geothermal energy available were used, it could only provide a very small amount of the energy we need.





Water Power. Water is one of the major sources of electricity in the United States. Water power produces electricity called **hydroelectricity**. To harness the power of water, a dam is built on a river to control the flow of the water. The flow of the water turns the turbines of generators that produce electricity. Hydroelectric power has many advantages. It is renewable and relatively inexpensive, and does not pollute the atmosphere. One disadvantage is that many times rivers are not located where the power is needed.

Wind Power. The energy of the wind, or **wind power**, can be turned into electrical energy through the use of windmills. Windmills can be used to pump water or grind grain. Prior to the industrial revolution of the 1800s, windmills were very common, but many have been replaced by electric and fossil fuel-operated motors. The recent energy shortages have brought about an increase in new, modern types of windmills that do not require fuels in order to perform the work desired. Because the wind is not predictable in most areas of the world, it is not a widely used resource. Wind is a renewable resource.

Tidal Power. The energy from the two-way flow of the tides through narrow passages can also be used to generate electricity. **Tidal power** is not a widely used source of energy because there are only a few areas in the world with usable tidal conditions. Tides are a renewable resource. Experimental *tidal power* plants have been built in Canada, near the Bay of Fundy, where the vertical difference in low and high tides is 13.6 meters (44.6 feet).

Biomass Fuels. **Biomass fuels** are combustible fuels made from plant and animal materials. Some plants can be converted into alcohol and burned for fuel. Wood can also be burned to create heat. *Biomass fuels* are a renewable resource. Burning garbage is being considered as an alternative to some biomass fuels.

Practice

Use the list below to write the correct term for each definition on the line provided.

coal	**fossil fuel**	**nonrenewable resources**
electricity	**natural gas**	**petroleum or oil**
energy	**natural resources**	**renewable resources**

_____ 1. the type of energy produced by using natural resources such as water, wind, and fossil fuels to power a generator

_____ 2. fuel made from decayed plants and animals that lived millions of years ago preserved below Earth's crust

_____ 3. materials found on or inside Earth's crust that people can use

_____ 4. liquid fossil fuel formed from plants and animals that lived in the sea

_____ 5. fossil fuel that comes from plants that lived millions of years ago

_____ 6. materials that are used up faster than they can be replaced in nature or can be used only once

_____ 7. materials that can be replaced in nature at a rate close to their rate of use or used over again

_____ 8. a fossil fuel in its gaseous state found along with oil deposits

_____ 9. the ability to do work or move objects

Practice

Match each definition with the correct term. Write the letter on the line provided.

_____ 1. energy produced by splitting the nucleus of the uranium atom

_____ 2. energy produced by the heat from inside Earth's crust

_____ 3. a device used to collect energy from the sun and transform it into electricity

_____ 4. energy from the sun

_____ 5. a burnable fuel made from plant and animal material

_____ 6. energy of the wind used to create electricity

_____ 7. the energy from the two-way flow of the tides used to produce electricity

_____ 8. large panels that collect solar energy that will be used to heat water, etc.

_____ 9. to save natural resources for the future

_____ 10. electricity produced by falling water

A. biomass fuel

B. conserve

C. geothermal energy

D. hydroelectricity

E. nuclear energy

F. solar cells

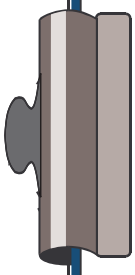
G. solar collectors

H. solar energy

I. tidal power

J. wind power

Lab Activity: Solar Energy



Facts:

- Energy from the sun is called *solar energy*. Solar collectors are used to collect heat to use for hot water, heating, swimming pools, and cooking.

Investigate:

- You will determine what type of materials should be used to collect and store solar energy.

Materials:

- 4 empty aluminum beverage cans, pop tops and labels removed
- 4 thermometers
- black paint
- silver or metallic paint
- 2 clear cellophane squares
- 2 rubber bands
- graph paper
- lamp
- red, blue, green, and black markers

1. Paint two of the cans black. Paint two with the metallic paint. Let dry.

2. Fill all 4 cans ⅓ full with water and insert thermometers into cans.

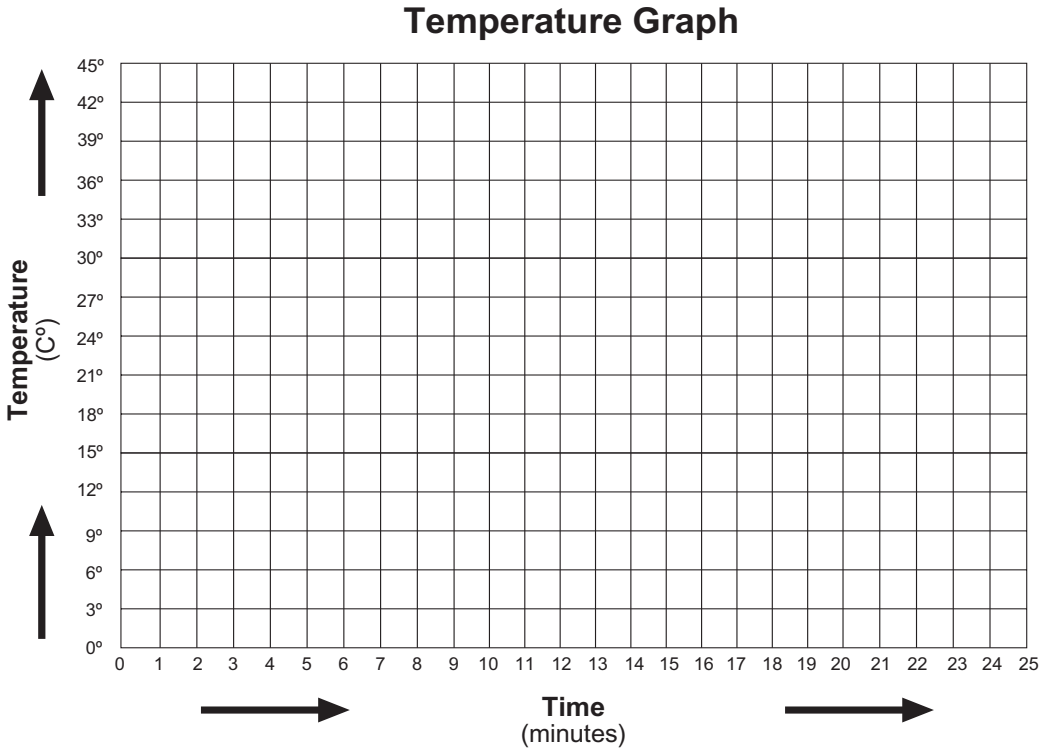
3. Cover 1 black can and 1 aluminum can with clear cellophane and secure with rubber bands.

4. Place all 4 cans equal distance from light source (10 to 20 centimeters from lamp with 100 watt bulb).

5. Use the graph on the next page to record the temperature in C° for each can. Take a measurement every minute for 25 minutes. Turn lamp off after 15 minutes.

6. Use the table below as a key to make a graph of the results.

Can	Color	Cellophane	Markers
A	aluminum	no	red
B	aluminum	yes	blue
C	black	no	green
D	black	yes	black



7. Place the cans in order from largest to smallest temperature changes.

8. Which can gained heat the fastest? _____

9. Which can held heat the longest? _____

10. Which can lost heat the fastest? _____

11. Is there a relationship between fast "warmers" and fast "coolers"?

    _____

    If so, what is it? _____

    _____

12. Why do asphalt parking lots and streets become very hot on a sunny day while concrete sidewalks remain relatively cool? ____

    _____

    _____

13. How does the color of material affect the material's ability to absorb energy? _____

    _____

    _____

14. What materials would you use to make a solar collector? _____

    _____

    _____

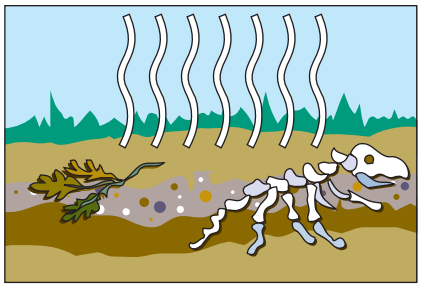
15. What materials would you use to store solar energy? _____

    _____

    _____

Nonrenewable Resources

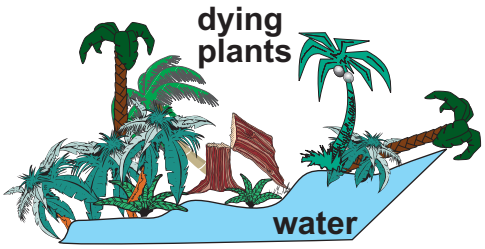
Fossil Fuels. Fossil fuels include coal, oil or *petroleum, natural gas*, and **oil shale**. Fossil fuels come from plants and animals that died millions of years ago. Over the years, these remains were chemically changed to produce our fossil fuels. Since millions of years are required to form deposits of fossil fuels, they are nonrenewable resources. These fuels are currently our most important source of energy for industry, transportation, and for use in our homes. Since they are nonrenewable, they must be *conserved*.



Fossil fuels come from plants and animals that died millions of years ago.

The largest deposits of coal and shale are found in North America. Because they are usually buried, it takes considerable effort (strip mining or shaft mining) to extract this fuel. New reserves of oil and gas are being discovered, but many environmental considerations must be weighed before drilling and recovery can begin.

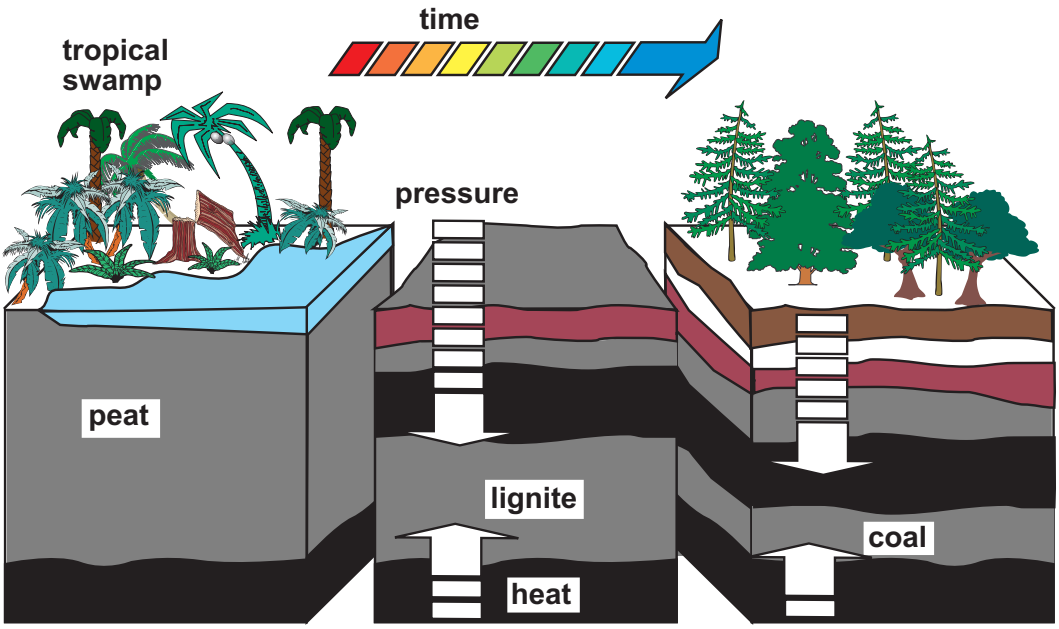
In the United States, *coal* is almost everywhere—it has been found in 38 states. Nearly one-eighth of our country lies over coalbeds. Coal comes from plants that died about 300 millions of years ago. As trees and plants died in swamps, they fell into the water. Since the water was low in oxygen, the trees and other plants did not rot, but piled up. These dead plants were then covered with more dead plants and turned into **peat**.



Coal comes from plants that died millions of years ago.

Heat, pressure, and time eventually turn the *peat* into **lignite** or brown coal. *Lignite* contains bits of woody tissue but retains some moisture; therefore, it does not burn well. **Bituminous**, or soft coal, is the next stage in coal formation. *Bituminous* coal gives off a lot of heat when burned. It is abundant. The last stage of coal formation is the production of **anthracite**. It is the hardest type of coal and burns the most cleanly, but it is very scarce. Coal is used to provide energy for trains and ships and for generating electricity in power plants and factories.

Coal Formation



As trees died in the tropical swamp, dead plant matter built up on the bottom of the swamp. These layers of dead plants turned into peat.

Over time, layers of sediment were deposited. The weight of the sediment compacted the layered plant matter into lignite.

More and more sediment was deposited over the peat. Over millions of years, the weight of the sediment changed the peat into coal.

Petroleum or oil is a liquid fossil fuel formed from plants and animals that lived in shallow coastal waters. Oil is used as a lubricant and to make gasoline, plastics, synthetic fabrics, medicine, building materials, kerosene, wax, and asphalt.

Shale is a sedimentary rock that has oil trapped between its layers. It is plentiful, but it is difficult and expensive to remove the oil from the rock. However, shale oils may be used in the near future.

Natural gas is usually found along with oil. It is the only fossil fuel that can be used as it comes from Earth, without having to be processed first. **Methane** is the most common natural gas. It is used in gas stoves and to heat homes.

Fossil fuels have some *disadvantages*, however. They include the following:

Disadvantages of Fossil Fuels

1. Fossil fuels are nonrenewable (once used up they cannot be replaced).
2. Many fossil fuels contain traces of sulfur, which causes pollution when burned. If spilled or in contact with living organisms, many fossil fuels are extremely toxic and damaging.
3. It is expensive and often difficult to remove fossil fuels from Earth's surface.

In the last 100 years, the burning of coal, oil, and gas has added carbon dioxide to the air. Some scientists have hypothesized that these increased levels have led to global warming.

Use of Natural Resources

The use of natural resources must be carefully planned and monitored.

It is crucial that the use of natural resources be carefully planned and monitored. Fossil fuels and mineral supplies are continually decreasing, and the world's population continues to rise. Without safeguards and regulations, uncontrolled burning of wood and coal can pollute the air. Inorganic materials from industries and some pesticides can pollute our waters, and nuclear energy pollutants may become a danger to not only humankind but all living creatures.

Efforts at conservation include recycling and the use of alternative energy sources. Coal is more plentiful than petroleum, so the United States is using more coal for energy production every year. Minerals, such as aluminum, can be recycled. Some minerals are found in ocean water, and in the future, these may be used more extensively.

Some of Earth's energy resources are renewable; others are nonrenewable. Several nonrenewable energy sources are being rapidly exhausted. The wise use and conservation of natural resources is necessary to ensure that these resources remain available for future generations.

Summary

Our natural resources supply the energy needed to do work or move objects. Types of energy include solar energy, nuclear energy, geothermal energy, water power, *wind power*, tidal power, biomass fuel, and fossil fuels. Some of the sources of energy are renewable, and others are nonrenewable. Our natural resources must be conserved to safeguard the supply for our future.

Wise use and conservation are necessary to ensure that natural resources remain available for future generations.

Practice

Use the list below to complete the following statements. **One or more terms will be used more than once.**

anthracite	**lignite**	**oil shale**
bituminous	**methane**	**peat**

1. _____ coal is soft and gives off a lot of heat when burned and is abundant.

2. _____ is the most common natural gas and is used in gas stoves and to heat homes.

3. Heat, pressure, and time eventually turn the _____ into lignite or brown coal.

4. The last stage of coal formation is the production of _____ , which is the hardest type of coal and burns the most cleanly. However, it is very scarce.

5. Fossil fuels include coal, oil or *petroleum, natural gas*, and _____ .

6. After the formation of peat, the next stage in coal formation is the production of _____ or brown coal, which contains bits of woody tissue and does not burn well.

7. _____ is used in gas stoves and to heat homes.

Practice

Answer the following using complete sentences.

1. What is energy? _____

   _____

2. Where do we get most of our energy? _____

   _____

3. Name eight major sources of energy. _____

   _____

   _____

   _____

   _____

4. How is electricity produced from other energy sources? _____

   _____

   _____

   _____

   _____

5. List three renewable natural resources from which we can get energy. _____

   _____

   _____

6. List three nonrenewable natural resources from which we can get energy. _____

_____

_____

7. List two advantages of solar energy. _____

_____

_____

8. List three disadvantages of solar energy. _____

_____

_____

_____

9. How is nuclear energy released to create electricity? _____

_____

_____

_____

_____

10. How can geothermal energy be used to produce electricity? _____

_____

_____

_____

_____

11. What is electricity produced from water called? _____

_____

12. Name three advantages of water power. _____

_____

_____

_____

13. What is one disadvantage of hydroelectric power? _____

_____

_____

14. For what purpose are windmills used? _____

_____

_____

15. What is the main disadvantage of wind power? _____

_____

_____

_____

16. Why is tidal power not a widely used resource? _____

_____

_____

_____

_____

17. What is biomass fuel? _____

_____

_____

_____

_____

18. Name two ways biomass fuel can be used as energy sources.

_____

_____

_____

_____

_____

_____

19. What is our most important source of energy? _____

_____

_____

_____

20. Name four types of fossil fuels. _____

_____

_____

_____

_____

21. How is coal formed? _____

_____

_____

_____

_____

_____

_____

22. What is the disadvantage of burning fossil fuels? _____

_____

_____

_____

_____

Practice

Place an **R** *on the line if the natural resource listed is* **renewable**. *Place an* **N** *on the line if it is* **nonrenewable**.

_____ 1. fossil fuels

_____ 2. forests

_____ 3. gold and silver

_____ 4. cotton

_____ 5. nylon

_____ 6. diamonds, rubies, and emeralds

_____ 7. aluminum

_____ 8. paper

_____ 9. hydroelectricity

_____ 10. farmland used for grazing animals

_____ 11. plastic

_____ 12. minerals from Earth

_____ 13. plants

_____ 14. wind power

_____ 15. iron and steel

Name three **natural resources** *that can be* **recycled**, *or used over and over again.*

16. _____

17. _____

18. _____

Practice

Complete each statement below with the correct answer.

1. Fossil fuels come from _____

   _____ .

2. Petroleum is formed from _____

   _____ .

3. Six uses of petroleum are _____

   _____

   _____

   _____ .

4. Coal comes from _____

   _____

   _____ .

5. The first stage in the development of coal is _____

   _____

   _____ .

6. The second stage in the production of coal is the formation of

   _____ , which does not burn well.

7. The type of coal that produces a lot of heat and is very abundant is

   called _____.

8. The hardest type of coal is called _____ .

9. Two uses of coal are _____

_____

_____

_____ .

10. Natural gas is usually found _____

_____

_____ .

11. The type of natural gas we use in stoves and to heat our homes is

_____ .

12. The type of fossil fuel that is the most difficult and expensive to remove from Earth is _____ .

13. Shale is _____ .

14. Three disadvantages of fossil fuels are _____

_____

_____

_____

_____

_____ .

15. Burning of coal, oil, and gas add _____ to the air.

Practice

Circle the letter of the correct answer.

1. Materials found on or inside Earth's crust that people can use are called _____ .

   a. renewable resources
   b. nonrenewable resources
   c. fossil fuels
   d. natural resources

2. Fuels made from decayed plants and animals that lived millions of years ago and were chemically changed below Earth's crust are _____ .

   a. fossil fuels
   b. nuclear energy
   c. renewable
   d. petroleums

3. _____ materials can be replaced or used again.

   a. Renewable
   b. Petroleum
   c. Methane
   d. Nonrenewable

4. _____ materials can be used up faster than they can be replaced in nature or can be used only once.

   a. Petroleum
   b. Methane
   c. Renewable
   d. Nonrenewable

5. A liquid fossil fuel formed from plants and animals that lived in shallow coastal waters is called _____ .

   a. methane
   b. hydrocarbon
   c. petroleum
   d. renewable

6. _____ is a fossil fuel in its gaseous state found along with oil deposits.

   a. Peat
   b. Bituminous
   c. Petroleum
   d. Natural gas

7. _____ is a natural gas used in home heating and gas stoves.

   a. Anthracite
   b. Bituminous
   c. Petroleum
   d. Methane

8. _____ is a fossil fuel that comes from plants that lived millions of years ago.

   a. Uranium
   b. Biomass fuel
   c. Coal
   d. Natural gas

9. After the formation of peat, the next stage is the formation of _____ or brown coal. It is moist and still has bits of woody tissue in it.

   a. Biomass fuel
   b. Methane
   c. Bituminous
   d. Lignite

10. _____ is soft coal that gives off a lot of heat when burned.

    a. Natural gas
    b. Oil shale
    c. Anthracite
    d. Bituminous

11. _____ is the final stage in the formation of coal. It is very hard and burns cleanly.

    a. Anthracite
    b. Methane
    c. Bituminous
    d. Lignite

12. To _____ is to preserve natural resources for the future.

    a. renew
    b. energize
    c. conserve
    d. anthracite

13. _____ is energy from the sun.

    a. Geothermal energy
    b. Nuclear energy
    c. Wind power
    d. Solar energy

14. _____ is energy produced by splitting the nucleus of the uranium atom.

    a. Geothermal energy
    b. Nuclear energy
    c. Wind power
    d. Solar energy

15. _____ is energy produced by the heat from inside Earth's crust.

    a. Solar energy
    b. Nuclear energy
    c. Wind power
    d. Geothermal energy

16. _____ , an energy source made from plant and animal material, is a renewable resource.

    a. Anthracite
    b. Lignite
    c. Coal
    d. Biomass fuel

17. _____ is the type of energy produced from natural resources such as water, wind, and fossil fuels by using a generator.

    a. Solar energy
    b. Hydroelectricity
    c. Electricity
    d. Nuclear energy

18. _____ is the ability to do work or move objects.

    a. Energy
    b. Geothermal energy
    c. Solar energy
    d. Nuclear energy

19. Electricity produced by falling water is called _____ .

    a. geothermal energy
    b. nuclear energy
    c. hydroelectricity
    d. methane

20. _____ is sedimentary rock with oil trapped between its layers.

    a. Oil shale
    b. Methane
    c. Bituminous
    d. Lignite

21. _____ produced in the first stage of the formation of coal, is formed from decomposed plants.

    a. Peat
    b. Lignite
    c. Anthracite
    d. Bituminous

22. Devices used to collect energy from the sun and transform it into electricity are _____ .

    a. solar collectors
    b. oil shale
    c. peat
    d. solar cells

23. Large panels that collect solar energy used to heat water are _____ .

    a. nuclear energy
    b. solar collectors
    c. tidal power
    d. solar cells

24. The energy from the two-way flow of the tides used to produce electricity is _____ .

a. solar cells
b. nuclear energy
c. wind power
d. tidal power

25. The energy of the wind used to create electricity is _____ .

a. tidal power
b. wind power
c. geothermal energy
d. nuclear energy