Section Objectives

► Mineral resources can be either *metals,* such as gold, Au, silver, Ag, and aluminum, Al, or *nonmetals*, such as sulfur, S, and quartz, SiO_2.

► Metals can be identified by their shiny surfaces, as good conductors of heat and electricity, and they tend to bend easily when in thin sheets.

► Most nonmetals have a dull surface and are poor conductors of heat and electricity.

11.1 Mineral Resources

Ores: a natural material whose concentration of economically valuable minerals is high enough for the material to be mined profitably

Metallic minerals such as gold, silver, and copper, Cu, are called *native elements* and can exist in Earth's crust as nuggets of pure metals.

Most other minerals in Earth's crust are *compounds* of two or more elements.

Ores Formed by Cooling Magma

►Some ores, such as chromium, Cr; and nickel, Ni, form as the magma cools and the dense metallic minerals sink.

►As the minerals sink, layers of these minerals accumulate at the bottom of the magma chamber to form ore deposits.

►

Ores Formed by Contact Metamorphism

lode a mineral deposit within a rock formation.

►Heat and chemical reactions with hot fluids from the magma can change the composition of the surrounding rock. This process is called *contact metamorphism.*

►Some ores, such as copper, Cu; and zinc, Zn, form by *contact metamorphism.*

►Contact metamorphism also occurs when hot fluids called *hydrothermal solutions* move through small cracks in a large mass of rock.

►When the minerals from the surrounding rock dissolve into the hydrothermal solution, new minerals will precipitate from the solution and form narrow zones of rocks called *veins*.

Ores Formed by Moving Water

placer deposit a deposit that contains a valuable mineral that has been concentrated by mechanical action

►The movement of water helps to form ore deposits.

►Tiny fragments of native elements, such as gold, Au, are released from rock as it breaks down by weathering.

Uses of Mineral Resources

gemstones a mineral, rock, or organic material that can be used as jewelry or an ornament when it is cut and polished

►Metallic ores are sources of valuable minerals and elements, like gold, Au, platinum, Pt, and silver, Ag.

►Some nonmetallic minerals display extraordinary brilliance and color when they are specially cut for jewelry.

►Other nonmetallic minerals, such as calcite and gypsum, are used as building materials.

11.2 Fossil Fuels

nonrenewable resource a resource that forms at a rate that is much slower than the rate at which it is consumed

fossil fuel a nonrenewable energy resource that formed from the remains of organisms that lived long ago; examples include oil, coal, and natural gas

►Much of the energy humans use every day comes from the burning of the hydrocarbons that make up fossil fuels.

Formation of Coal

►Coal is the most commonly burned fossil fuel, formed during a complex process called *carbonization.*

►Carbonization occurs when partially decomposed plant materials is buried in swamp mud and becomes peat.

►As bacteria consume some of the peat and release the gases methane, CH_4, and carbon dioxide, CO_2, the contents of peat gradually change until mainly carbon remains.

►Peat remains if conditions are not optimal for carbonization. Peat may be burned as fuel.

Types of Coal Deposits

►The partial decomposition of plant remains forms a brownish-black material called *peat.*

►Peat is buried by other sediment. As heat and pressure increase peat becomes *lignite*. Lignite is also called brown coal.

►Increased temperature and pressure compacts the lignite and forms *bituminous coal.* Bituminous coal is made of 80% carbon.

►*Anthracite*, the hardest form of coal, is produced when bituminous coal is under high temperatures and pressures. Anthracite coal is made of 90% carbon.

Formation of Petroleum & Natural Gas

►Petroleum and natural gas are mixtures of hydrocarbons.

►These fossil fuels formed when heat and pressure caused chemical changes to the remains of microorganisms and plants.

Petroleum & Natural Gas Deposits

►Petroleum and natural gas are very important sources of energy for transportation, farming, and many other industries.

►They are mined from permeable sedimentary rocks.

►Petroleum accumulates beneath *cap rock* and fill the space to form an oil reservoir. Natural gas rises above petroleum, because it is less dense than both oil and water.

Oil Traps

►When a well is drilled into an oil reservoir, the petroleum and natural gas often flow to the surface.

►After the pressure of the overlying rock is removed, fluids rise up and out through the well. (draw the picture from page 200**)**

Fossil Fuel Supplies

►Fossil fuels are nonrenewable resources.

►*Crude oil*, (unrefined petroleum), is also used in the production of plastics, synthetic fabrics and rubber, medicines, waxes, chemical fertilizers, detergents, shampoos, and many other products.

►Coal is the most abundant fossil fuel in the world. Two-thirds of the known deposits of coal occur in the United States, Russia, and China.

►*Oil shale* is a relatively abundant material that contains petroleum. But it costs more than the cost of recovering oil from other sedimentary rocks.

11.3 Nuclear Energy

► The energy that is produced from nuclear reactions is called *nuclear energy.*

► Scientists discovered that atoms had smaller fundamental parts.

► These parts could be split by creating nuclear reactions with nuclear technologies.

Nuclear Fission

nuclear fission the process by which the nucleus of a heavy atom splits into two or more fragments; the process releases neutrons and energy

► When the nucleus splits, it releases more neutrons as well as energy.

► The newly released neutrons begin a chain reaction by striking nearby nuclei, which causes those nuclei to split and release more neutrons and more energy.

► If left uncontrolled, a fission reaction will escalate quickly and may result in an explosion (bomb).

► Controlled reactions produce heat that can be used to generate electricity (reactor).

How Fission Generates Electricity

► A *nuclear reactor* is a specialized equipment in which controlled nuclear fission is carried out.

► Currently, *uranium*-235, or ^{235}U, is the only naturally occurring element used for nuclear fission.

► This ore is mined and processed into fuel pellets with high ^{235}U content.

► These uranium-enriched pellets are placed into rods to make *fuel rods*. Bundles of these fuel rods are then bombarded by neutrons to induce a nuclear reaction.

(How Fission Generates Electricity, *continued)*

► The resulting chain reaction from nuclear fission causes the fuel rods to become very hot.

► Water is pumped around the fuel rods to absorb and remove heat energy.

► The hot water becomes steam and turns the turbines that provide power for electric generators.

► So, nuclear reactors are a way to create lots of steam to run turbines for generating electricity.

Advantages and Disadvantages of Nuclear Fission

► Nuclear power plants burn no fossil fuels and produce no air pollution. (good)

► However, they produce harmful radioactive materials that have very long half-lives, wastes must be stored for thousands of years. (bad)

► These waste products give off harmful doses of radiation that can destroy plant and animal cells and can cause harmful changes in the genetic material of living cells. (bad)

Nuclear Fusion

nuclear fusion the process by which nuclei of small atoms combine to form new, more massive nuclei; the process releases energy

► All of the energy that reaches Earth from the sun is produced by nuclear fusion.

► Fusion reactions only occur at temperatures of more than 15,000,000℃.

► The only byproduct of fusion are helium nuclei, which are harmless to living cells.

11.4 Alternative Energy Sources

Solar Energy

solar energy the energy received by Earth from the sun in the form of radiation

►Solar energy can be converted to heat energy in many different ways.

►In a *passive system*, sunlight enters the house and warms the building materials, which stores some heat for the evening.

►An *active system* includes the use of solar collectors and photovoltaic cells to collect heat or convert solar energy into electricity.

Geothermal Energy

geothermal energy the energy produced by heat with Earth

►The resulting steam from water passing by nearby magma or hot gases related by magma, deep in the earth, produces a large amount of geothermal energy.

►Engineers and scientists have harnessed geothermal energy by drilling wells to reach the hot water.

►The steam and hot water are used as a source of heat and as sources of power to drive turbines, which generate electricity.

Energy from Running Water

hydroelectric energy electrical energy produced by the flow of water

►Moving water is one of the oldest sources of energy. Energy can be harnessed from the running water of rivers and streams or from ocean tides.

►Today, 11% of the electricity in the United States comes from hydroelectric power plants.

►At a hydroelectric plant, massive dams hold back running water and channel the water through the plant. Inside the plant, the water spins turbines, which turn generators to produce electricity.

Energy from Wind

►Wind energy is now being used to produce electricity in locations that have constant wind.

►*Wind farms* may have hundreds of giant wind turbines that can produce enough energy to meet the electricity needs of entire communities.

►Wind generators are not practical everywhere. Because the wind does not always blow, wind energy cannot be depended on as an energy source for every location.