Chapter 17 Notes

Section 1

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 _____ energy resource formed from the remains of organisms that lived long ago; examples include oil, coal, and natural gas.

- _____ 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 _____.

- Fossil fuels are central to life in modern societies, but there are _____ main _____ with fossil fuels.
    - The supply of fossil fuels is limited.

    - Obtaining and using them has _____ consequences.

- In the 21st century, societies will continue to explore alternatives to fossil fuels but will also focus on developing more _____ ways to use these fuels.

Fuels for Different Uses

- Fuel is used for four main purposes:

    - _____
    - Manufacturing
    - Heating and cooling buildings

    - Generating _____ 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 _____, cost, availability, safety, and _____.

Electricity-Power on Demand

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

have to be used to _____ it.

How Is Electricity Generated?

- An **electric generator** is a device that converts _____ energy into electrical energy.
- Generators produce electrical energy by moving an electrically _____ material within a _____ field.
- Most commercial electric generators convert the movement of a _____ into electrical energy. A *turbine* is a wheel that changes the _____ of a moving gas or a liquid into energy that can do work.
- The turbine spins a _____ to produce electricity.
- The turbine spins because of the _____ released from boiling water.
- The water is heated using a coal-fired or gas-fired plant, or is heated from the _____ of _____ in nuclear plants.

World Energy Use

- _____, from the food you eat to the clothes you wear requires energy.
- There are dramatic _____ in fuel use and efficiency throughout the world.
- People in _____ societies use more energy than people in _____ countries do.
- And within developed societies, there are differences in energy _____.
- The difference in energy use among developed countries depends on how energy is _____ and used in those countries.

Energy Use in the United States

- The United States uses more energy per person than any other country except _____ and the United Arab Emirates.
- The U.S. uses more than _____% of its energy to transport goods and people.
- Other countries, such as Japan and Switzerland, depend on extensive _____ systems and are smaller, compact countries
- Residents of the United States and Canada enjoy some of the _____ gasoline taxes in the world. There is little incentive to _____ gasoline when its cost is so _____.
- Countries with _____ fossil-fuel resources supplement a greater percentage of their energy needs with other energy sources, such as _____ or nuclear.

How Fossil-Fuel Deposits Form

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

Coal Formation

- Coal forms from the remains of _____ that lived in swamps hundreds of millions of years ago.
- As ocean levels rose and fell, swamps were repeatedly covered with _____.
- Layers of sediment _____ 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 _____ to _____ 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 _____ that accumulated on the bottom of the ocean millions of years ago.
- These remains were buried by sediments and then _____ until they became complex energy-rich carbon molecules.
- These molecules, over time, migrated into the _____ rock formations that now contain them.

Coal

- Most of the world's fossil-fuel _____ are made up of coal.
- Coal is relatively inexpensive and it needs little _____ after being mined.
- _____ and North America are particularly rich in coal deposits.
- Over _____ 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 _____ effect on the environment at the surface, but surface coal-mining operations sometimes remove the top of an entire _____ to reach the coal deposit.
- A lot of research focuses on locating the most _____, clean-burning coal deposits and finding _____ methods of mining coal.

Air Pollution

- The quality of coal varies. Higher-grade coals, such as _____ coal, produce more heat and less pollution than lower-grade coal, such as _____.
- _____, found in all grades of coal, can be a major source of pollution when coal is burned.
- The air pollution and _____ 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 _____ air pollution in countries such as the United States.

Petroleum

- **Petroleum** is a liquid mixture of complex _____ compounds that is used widely as a fuel source.
- Petroleum, also known as _____.
- Anything that is made from crude oil, such as fuels, chemicals, and _____, 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, _____, and salt domes, that tend to _____ 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 _____, Venezuela, the North Sea, Siberia, and Nigeria.
- Geologists use many different methods to locate the rock formations that could contain oil.
- When geologists have gathered all of the data that they can from the Earth's surface, _____ wells are drilled to determine the volume and availability of the oil deposit.
- If oil can be extracted at a _____ 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 _____ to be converted into fuels and other petroleum products.

The Environmental Effects of Using Oil

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

_____ cars.

- Emissions _____ 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 _____% of the world's nonrenewable energy comes from natural gas.

- Natural gas, or _____ (CH4), 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 _____% of the energy used in developed countries.

- As the demand for energy resources _____, 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 _____ contribution to our energy supply.

Predicting Oil Production

- Oil production is still _____, but it is increasing much more slowly than it has in the past.
- Many different factors must be considered when predicting oil production.

- _____ 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 _____ or to become commercial.

- Prediction must also take into account the changes in _____ 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 _____

  of obtaining fuels influences the _____ 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 _____.

- Geologists predict that oil production from fields accessible from land will _____ in about 2010.

- Additional oil reserves exist under the ocean, but it is _____ to drill for oil in the deep ocean.

- Currently, oil _____ can be built to drill for oil in the ocean, but much of the oil in the _____ is currently inaccessible.

Section 2

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 _____ and _____.

- In the 1970s and 1980s, however, many planned nuclear power plants were _____ and others under construction were abandoned.

- Today, nuclear power accounts for ____% of the world's electricity.

Fission: Splitting Atoms

- Nuclear power plants get their power from _____.

- **Nuclear energy** is the energy released by a _____ or fusion reaction. It represents the _____ energy of the atomic nucleus.

- The forces that hold together a nucleus of an atom are more than ___ million times stronger than the chemical bonds _____ atoms.

- In nuclear power plants, atoms of the element _____ are used as the fuel.

- The nuclei of uranium atoms are bombarded with atomic particles called _____. These collisions cause the nuclei to _____ in a process called nuclear fission.

- **Nuclear fission** is the splitting of the nucleus of a large atom into two or more _____.

- Nuclear fission releases a tremendous amount of _____ and more neutrons, which in turn _____ with more uranium nuclei.

How Nuclear Energy Works

- The _____ 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 _____ that drives a _____, which is used to generate electricity.

The Advantages of Nuclear Energy

- Nuclear fuel is a very concentrated energy source.

- Nuclear power plants do not produce _____ gases.

- Countries with limited _____ 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 _____.
- This makes nuclear plants no longer competitive with other energy sources in many countries.

- The actual cost of new nuclear power plants is _____, 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

  _____ nuclear waste.

- The fission products produced can remain _____ radioactive for _____ of years.
- Storage sites for nuclear wastes must be located in areas that are geologically _____ for tens of thousands of years.
- Scientists are researching a process called _____, that would recycle the radioactive elements in nuclear fuel.

Safety Concerns

- In a poorly _____ nuclear plant, the fission process can potentially get out of control.

- The Chernobyl reactor was destroyed in _____ when an unauthorized _____ caused explosions and blasted radioactive materials into the air.

- Hundreds of people in the Ukraine _____ from radioactive exposure from this explosion.

- Even today, parts of northern Europe and the Ukraine remain _____ from this disaster.

- The most serious nuclear accident in the United States occurred in _____ at the Three Mile Island nuclear power plant in Pennsylvania.

- Human _____, along with blocked valves and broken pumps, was responsible for this accident.
- Fortunately, only a small amount of radioactive _____ escaped.

- Since that accident, the U.S. Nuclear Regulatory Commission has required more than _____ safety improvements to nuclear plants.

The Future of Nuclear Power

- One possible future energy source is *nuclear* _____.

- **Nuclear fusion** is the _____ of the nuclei of small atoms to form a larger _____. Fusion releases tremendous amounts of energy.

- It is potentially a _____ energy source than nuclear fission is because it creates less dangerous radioactive _____.

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, _____ things must occur simultaneously:
    - Atomic nuclei must be heated to _____ temperatures (about 100,000,000ºC or 180,000,000ºF).
    - The nuclei must be maintained at very high _____.
    - The nuclei must be properly confined.

- The _____ problems are so complex that building a nuclear fusion plant may take decades or may never happen.