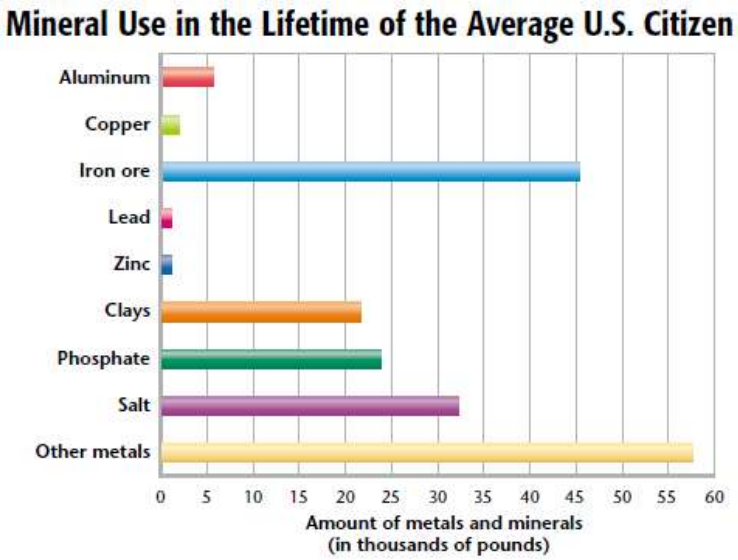
Name: _____ **Date:** _____ **Period:** _____

Environmental Science Chapter 16: Mining and Mineral Resources

16.1 Minerals and Mineral Resource

A. What is a Mineral?

- _____ is a naturally occurring, _____solid that has a characteristic chemical composition and physical _____.
- The atoms of minerals are arranged in regular repeating _____ patterns.
- _____ _____are minerals made of only elements (gold, silver and copper)
- Most minerals are _____



B. Ore Minerals

- _____ _____are minerals that are valuable and economical to extract.
- _____ *minerals* are minerals that have no commercial value
-

Common Elements and Their Ore Minerals	
Element	Important ore minerals
Aluminum (Al)	gibbsite, boehmite, diaspore (bauxite)
Beryllium (Be)	beryl
Chromium (Cr)	chromite
Copper (Cu)	bornite, cuprite, chalcocite, chalcopyrite
Iron (Fe)	goethite, hematite, magnetite, siderite
Lead (Pb)	galena
Manganese (Mn)	psilomelane, pyrolusite

Element	Important ore minerals
Mercury (Hg)	cinnabar
Molybdenum (Mo)	molybdenite
Nickel (Ni)	pentlandite
Silver (Ag)	acanthite
Tin (Sn)	cassiterite
Titanium (Ti)	ilmenite, rutile
Uranium (U)	carnotite, uraninite
Zinc (Zn)	sphalerite

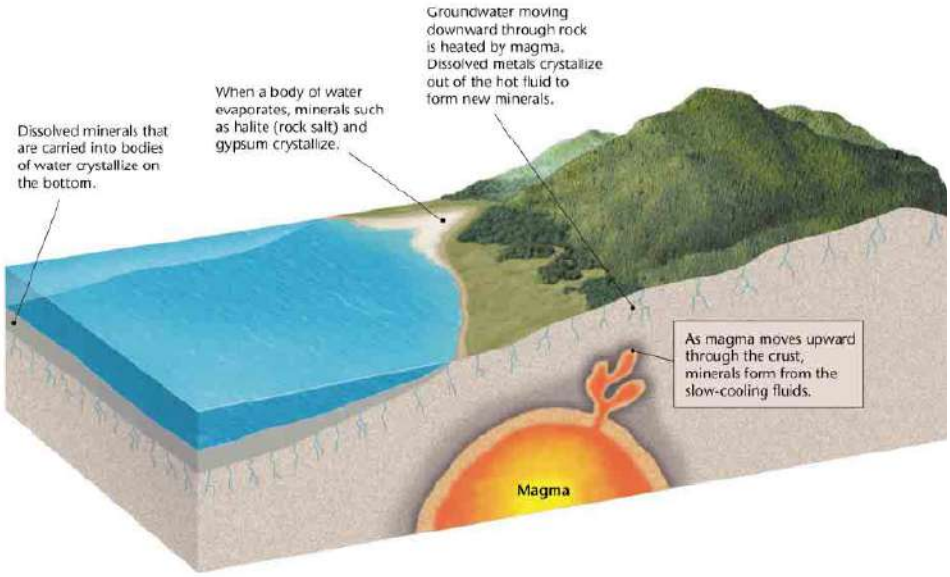
1. Metallic Minerals
    - Metals conduct _____, have _____ services and are opaque
    - _____ metallic minerals are native elements such as _____, silver and copper.
2. Nonmetallic Minerals

- _____tend to be good _____ have shiny or dull surfaces and may allow light to pass through them.
- Nonmetallic minerals can be _____elements or _____.

C. How do Ore Minerals Form?

- The types of _____ that form depend on the _____ in which they form

Environments of Mineral Formation



1. Hydrothermal Solutions
   - _____*solutions* are hot subsurface waters that contain dissolved minerals.
   - As they flow through cracks in rocks they _____minerals
   - New minerals _____ out of the solutions then fill fractures to form _____ deposits called _____
2. Evaporites
   - Water in the seas or lakes _____deposits of _____ are left behind
   - Evaporates form in _____ regions where rates of evaporation are high
   - Include _____ _____and gypsum.

D. Mineral Resources and their Uses

- Some metals can be _____ or pressed into various _____ or stretched very thinly
- Some are good _____ of heat and electricity
- _____are formed when two or more metals are combined
- Nonmetals are most w_____ used minerals in the world
- _____are nonmetallic minerals prized purely for their _____, rarity, or _____.

Name: _____ Date: _____

Section16.1: Minerals and Mineral Resources **Active Reading**

Read the passage below and answer the questions that follow.

Certain metals are of major economic and industrial importance. Some metals can be pounded or pressed into various shapes or stretched very thinly without breaking. Other metals are good conductors of heat and electricity, or are prized for their durability and resistance to corrosion. Often, two or more metals are combined to form *alloys.* Alloys are important because they often combine the most desirable properties of the metals used to make them. Many new technologies depend on the mining of metallic minerals.

Nonmetals are among the most widely used minerals in the world. For example, gypsum has many applications in the construction industry. It is used to make Sheetrock™, or wallboard, for homes and commercial buildings. It is also a major component of concrete, which is used to build roads, buildings, and other structures. Industrial sand and gravel have uses that range from glassmaking to the manufacture of computer chips. Some nonmetallic minerals, called *gemstones,* are prized purely for their beauty, rarity, or durability. Important gemstones include diamond, ruby, sapphire, emerald, aquamarine, topaz, and tourmaline.

IDENTIFYING MAIN IDEAS

In the space provided, write the letter of the term or phrase that best completes each statement or best answers each question.

_____ 1. The value of a mineral is determined by its
a. properties.
b. mining technique.
c. gemstones.
d. alloys.

_____ 2. What types of minerals are among the most widely used in the world?
a. metals
b. alloys
c. gemstones
d. nonmetals

_____ 3. Which of the following is an example of a gemstone?
a. gypsum
b. sapphire
c. gravel
d. glass

VOCABULARY DEVELOPMENT

In the space provided, write the letter of the description that best matches the term or phrase.

_____ 4. gypsum

_____ 5. gemstones

_____ 6. industrial sand

_____ 7. alloy

_____ 8. certain metals

a. the combination of two or more metals
b. a major component of concrete
c. conductors of heat and electricity
d. topaz and tourmaline
e. a substance used in manufacturing computer chips

Read each question and write the answer in the space provided.

9. The verb *corrode* means "wear away gradually, usually by a chemical reaction." A metal that is prized for its "resistance to corrosion" has what property?

_____

_____

_____

_____

10. *Aqua* means "water" or "a light blue color." *Marine* refers to the sea. Use this information to determine what the gemstone *aquamarine* might look like.

_____

_____

_____

_____

RECOGNIZING CAUSE AND EFFECT

One reading skill is the ability to recognize cause and effect.

In the space provided, write the letter of the phrase that best answers the question.

_____11. Why do people value gemstones?

a. for their use in industry
b. for their resistance to corrosion
c. for their beauty and rarity
d. for their benefit to technology

Read each question and write the answer in the space provided.

12. Why are alloys especially important?

_____

_____

_____

_____

13. What are some properties of metals that give them economic and industrial importance?

_____

_____

_____

_____

Name: _____ Date: _____ Period: _____

19.2 Mineral exploration and Mining

A. Mineral Exploration

- 1st step in finding an ore _____ and _____ rock for mineralization.
- Planes carry instruments that identify _____ in the land
- 2nd step rock _____ are taken from the areas and analyzed to determine ore _____

B. Subsurface Mining

- _____ _____ is how ore deposits beneath Earth's surface.
- *Room-and-pillar mining* is a common method used to _____ t coal and salt.
- _____ of entries (rooms) are cut into a _____ layer of coal.
- Between each room is a _____ of coal left to support the roof.
- When mining is _____ the pillars of coal are _____.

1. Longwall Mining
    - _____ _____ is a more efficient way to remove coal form a subsurface seam.
    - A machine (_____ r) moves back and forth across the face of a coal seam.
    - The _____ is sheared from the surface and falls on a c_____ then transported out of the _____.
2. Solution Mining
    - _____ mineral ores can be removed by solution mining.
    - Hot water is _____ into the oar and _____ it.
    - Compressed _____ is pumped into the dissolved ore and _____ it to the surface.

C. Surface Mining

- _____ _____ methods used when ore deposits are located close to Earth's surface.
- _____ *mining* is often used to mine _____ quantities of near-surface
- _____ is mined downward, layer by layer.

1. Surface Coal Mining
    - _____ is rock that covers near-surface coal seams
    - 1st step is to _____ and set aside the _____
    - 2nd overburden is removed by heavy _____.
    - 3rd _____ enter the pit and remove the _____ coal

- 4th once _____ l is removed the pit is filled with _____, contoured and _____ with the soil

2. Quarrying
   - _____ stones (granite and marble) are mined in _____.
   - _____ (sand, _____, and crushed rock) are the main products of quarrying.
3. Solar Evaporation
   - _____ _____ is the process of placing sea water into enormous shallow ponds.
   - _____ evaporates the water and increases the _____ of sodium chloride
   - This method of salt _____ is used in areas that receive little rainfall and have high _____ rates.
   - Solar evaporation is used largely in _____ countries and _____ of worlds salt comes from solar evaporation.

D. Placer Mining

- _____ _____ are minerals that are concentrated by wind and water into surface deposits.
- Streams transport _____ grains to a point where they fall to the _____ and are concentrated.
- Stream placers often occur at _____ in rivers where the current _____.
- _____, diamonds and other heavy _____ are mined by _____.

E. Smelting

- _____ is where crushed ore is melted at high temperatures in _____ to separate impurities from molten _____ .
- _____ bonds with impurities and _____ them from the molten metal
- Molten metal falls to the _____ of the furnace and is _____.
- The _____ (impurities)form a layer on the _____
- _____ (sulfur dioxide) are captured so they do not enter the _____

F. Undersea Mining

- _____ floor contains significant _____ resources
- _____ and great waters _____ at which minerals are found are two reasons undersea mining has not been _____.

Name: _____ Date: _____ Period: _____

Section 16.2: Mineral Exploration and Mining **Active Reading**

Read the passage below and answer the questions that follow.

Through mineral exploration, mining companies can identify areas where there is a high likelihood of finding valuable mineral resources in quantities that are worth mining. Usually, a mineral deposit has 100 to 1,000 times the concentration of the mineral than ordinary rocks do and enough material to justify opening a mine.

Exploring rock for mineralization is the first step in finding an ore deposit. Planes that carry instruments for identifying patterns in gravity, magnetism, or radioactivity fly over and collect these data as well as images and photographs of an area. When used with satellite images, these data and aerial photographs can be used to create an accurate geological map of the surface. Rock samples are then taken from the exploration area. The samples are analyzed to determine ore grade—the metal content of an ore. If the ore grade is high enough, the companies will drill test holes that help them estimate the three-dimensional extent of the ore. If the ore grade is high enough and the deposit extensive enough, the cost to open a mine may be warranted.

IDENTIFYING MAIN IDEAS

One reading skill is the ability to identify the main idea of a passage. The main idea is the main focus or key idea. Frequently, a main idea is accompanied by supporting information that offers detailed facts about the main idea.

In the space provided, write the letter of the term or phrase that best completes each statement or best answers each question.

_____ 1. Mining companies conduct mineral exploration to
- a. find mineral deposits.
- b. identify new types of minerals.
- c. create geological maps.
- d. collect rock samples.

_____ 2. Airplanes used in mineral exploration carry instruments that detect
- a. gravity.
- b. radioactivity.
- c. magnetism.
- d. All of the above

_____ 3. What is ore grade?
- a. the three-dimensional extent
- b. the radioactivity of an ore
- c. the metal content of an ore of an ore
- d. the magnetism of an ore

SEQUENCING INFORMATION

One reading skill is the ability to sequence information, or to logically place items or events in the order in which they occur.

Beginning with step 1, write the five steps involved in finding an ore deposit in the order in which they occur. Write the steps in the space provided.

4. Step 1: _____
5. Step 2: _____

6. Step 3: _____
7. Step 4: _____
8. Step 5: _____

RECOGNIZING SIMILARITIES AND DIFFERENCES

One reading skill is the ability to recognize similarities and differences between two phrases, ideas, or things. This is sometimes known as comparing and contrasting.

Read each question and write your answer in the space provided.

9. How is a mineral deposit different from ordinary rocks?

_____

_____

_____

_____

10. How do both satellites and airplanes aid mining companies in finding ore deposits?

_____

_____

_____

_____

RECOGNIZING CAUSE AND EFFECT

One reading skill is the ability to recognize cause and effect.

Read each question and write the answer in the space provided.

11. What do mining companies learn from rock samples taken from an exploration area?

_____

_____

_____

_____

12. How does drilling test holes help mining companies determine whether to open a mine in a specific area?

_____

_____

_____

_____

Name: _____ **Date:** _____ **Period:** _____

16.3 Mining Regulations and Mine Reclamation

* Because of _____ impacts of mining, it is the most heavily regulated industries in the US.
* _____ the land or returning it to its _____ condition after mining is a part of _____surface coal mining operation.

A. The Environmental Impacts of Mining

- _____ of dollars are spent to clean up _____ mines.

1. Air and Noise Pollution
   - At surface coal mines _____ is produced by removing, loading, hauling and dumping _____and _____.
   - Dust is also _____ when ore is _____ apart
   - _____ is created by equipment and _____
   - Most surface mines are _____ located near _____populations
   - Regulations in US _____ mining operations to allow dust or noise t _____ the area being mined
2. Water Contamination
   - Water resources can be _____ impacted by _____
   - _____ can wash into streams where they can _____ or kill aquatic life
   - Minerals that contain a lot of _____ and react with water to produce dilute _____ _____.
3. Displacement of wildlife
   - Removing _____ from a surface mine site strips away all _____ life.
   - With the removal of plants, _____will leave the area
   - When the soil is _____ to the site different _____ and _____ may establish themselves.
   - _____disturbs river bottoms and _____ aquatic plant live.
   - Disturbance of a _____can cause sediments to contaminate a river for up to _____ km
4. Erosion and Sedimentation
   - Excess _____ from mines is dumped into large piles called _____.
   - Running water _____ unprotected dumps and may _____ water quality and aquatic life
5. Soil Degradation

- _____at a mine is removed from the _____t layer downward
- If soils is not removed and _____ in separate layers the soil may be _____ poor when it is reclaimed.
- Soil rich in _____once exposed to water and oxygen release _____
- If _____ soil is returned to the mine site it may be _____ for plants to grow.

6. Subsidence
   - _____ is the sinking of regions of _____ with little or no horizontal movement.
   - Can occur when _____ in a mine collapse or the mine roof or floor fails
   - _____, houses_____, bridges, underground pipelines and utilities may be _____
7. Underground Mine Fires
   - _____ in underground coal seams are one of the most _____ environmental consequences of coal mining
   - Lighting, forest fires and burning trash can cause _____ fires.
   - These fires are _____ to put out and often left to _____ out (which may take _____).
   - They release _____ and gasses that can cause _____ problems.

B. Mining Regulation and Reclamation

* Mines in US are _____ by federal and state laws
* Mining company must comply with _____.
* All mining operations must comply with the _____.

1. Reclamation
   - _____ is the process of returning land to its original or better conditions after mining is _____d.
   - The Surface Mining control and Reclamation Act of _____ (SMCRA) create a program for the _____of surface coal mining.
   - The act set _____ that minimize the effects of coal mining on environment
2. State Regulation of Mining
   - Mining companies must obtain _____ before mining

- A _____ forfeiture program is where a company must _____ funds (a bond) before mining project _____
- The states use the _____ to reclaim the site if the company does not reclaim the site according to the _____.
- State _____ are responsible for _____ mines to ensure compliance with environmental _____.
- _____ has large projects to reclaim _____ mine lands.

Section 16.3: Mining Regulations and Mine Reclamation **Active Reading**

Read the passage below and answer the questions that follow.

Mines on land in the United States are regulated by federal and state laws. To ensure that contaminants from mines do not threaten water quality, mining companies must comply with regulations of the Clean Water Act and the Safe Drinking Water Act. The release of hazardous substances into the air, soil, and water by mining is regulated by the Comprehensive Response Compensation and Liability Act. In addition, all mining operations must comply with the Endangered Species Act. This act ensures that mining activities will not affect threatened or endangered species and their habitats.

The process of returning land to its original or better condition after mining is completed is called reclamation. The Surface Mining Control and Reclamation Act of 1977 (SMCRA) created a program for the regulation of surface coal mining on public and private land. The act set standards that would minimize the surface effects of coal mining on the environment. SMCRA also established a fund that is administered by the federal government and is used to reclaim land and water resources that have been adversely affected by past coal-mining activities.

IDENTIFYING MAIN IDEAS

In the space provided, write the letter of the phrase that best completes each statement.

_____ 1. Which act ensures that mining activities will not affect the habitats of some species?
a. Comprehensive Response Compensation and Liability Act
b. Safe Drinking Water Act
c. Surface Mining Control and Reclamation Act
d. Endangered Species Act

_____ 2. What is reclamation?
a. returning land to its original or better condition after mining
b. returning land to a useful condition after mining
c. regulation of the effect of mining on water
d. regulation of the effect of mining on air and soil

_____ 3. The Comprehensive Response Compensation and Liability Act regulates
a. reclamation.
b. endangered species.
c. hazardous substances.
d. past coal-mining activities.

VOCABULARY DEVELOPMENT

In the space provided, write the letter of the description that best matches the term or phrase.

_____ 4. Clean Water Act

_____ 5. Safe Drinking Water Act

_____ 6. Comprehensive Response Compensation and Liability Act

_____ 7. Endangered Species Act

_____ 8. Surface Mining Control and Reclamation Act

a. minimizes the surface effects of mining on the environment
b. ensures that contaminants from mining do not threaten water resources
c. ensures that mining will not affect threatened species
d. ensures that contaminants from mining do not threaten drinking water
e. regulates release of hazardous substances into the air, soil, or water.

RECOGNIZING CAUSE AND EFFECT

Read each question and write your answer in the space provided.

9. Which of the acts mentioned in the passage regulate mining directly?

_____

_____

_____

_____

_____

10. Which of the acts mentioned in the passage are *not* directly related to mining?

_____

_____

_____

_____

_____

11. What are the effects of the Surface Mining Control and Reclamation Act of 1977?

_____

_____

_____

_____

_____