CORNELL NOTES
Directions: You must create a minimum of **5 questions** in this column **per page** (average). Use these to study your notes and prepare for tests and quizzes. Notes will be turned in to your teacher at the end of the Unit for scoring.

UNIT 4: Earth Science
Chapter 20: Earth Materials (pages 606-643)

I. Minerals

A. Common Elements

1. Of the first 92 elements on the periodic table, ___ **are found in Earth**

a. Only **small number** combine to make up most of common minerals in **Earth's** _____

b. Major _____ in Earth's crust includes:

Major Elements in Earth's Crust			
Element	Percent (by mass)	Element	Percent (by mass)
Oxygen	46.6%	Sodium	2.8%
Silicon	27.7%	Potassium	2.6%
Aluminum	8.1%	Magnesium	2.1%
Iron	5.0%	All others	1.5%
Calcium	3.6%		

2. Composition of Earth's Crust

a. _____ is outer most layer

b. Includes all **continental** material and _____ **bottom**

c. Extends down _____ **of kilometers**

3. Chemical Element Building Blocks- most minerals of the crust contain abundant _____ and **silicon**

B. What's a Mineral

1. **Mineral**- a naturally occurring _____ or _____ that is inorganic, solid, and has a crystalline structure

a. Have predictable _____ **compositions**

b. Can be indicated by single **elements** or **chemical** _____

C. Physical Properties

1. Each mineral has characteristic set of _____ **properties**

b. **Physical properties**- Any characteristic of a material that you can observe without _____ the identity of the substances that make up the material (**color, shape, size, density, melting point, boiling point**)

b. Care should be taken studying mineral properties, especially _____ (may be due to impurities)

2. **Atom arrangement**- Some physical properties controlled by the arrangement of _____ in mineral

a. **Orderly pattern** is what makes a mineral _____

b. Arrangement of _____ reflect way mineral **breaks, hardness,** and what type of **crystal shape** it has

3. How Minerals Break

a. _____- when mineral breaks along planes creating **flat surface**

b. _____- Do not split along well-defined flat surfaces- **breaks unevenly**

4. _____- The physical property that measures resistance to scratching

Mohs Scale of Hardness	
1	Talc
2	Gypsum (fingernail)
3	Calcite (copper penny)
4	Flourite
5	Apatite (glass plate)
6	Feldspar
7	Quartz (streak plate)
8	Topaz
9	Corundum
10	Diamond

a. Determined by **strength of** _____ that connect atoms

b. Measured in scratching test called _____ **Scale**

1). When rub two objects together, the _____ of the two will **wear away**

2). **Mohs Scale of Hardness**

5. **Luster and Streak**-

a. _____- Physical property- way a mineral **reflects light**

b. _____- physical property- **color** mineral in **powdered form**

1). May be same color as mineral or different

2). Performed by rubbing on **white** _____ **plate**

6. **Crystal shape**- Arrangement of atoms often indicated by its external _____ shape (Sorted by 6 crystal systems)

D. Mineral Formation

1. Mineral crystals _____ as atoms are added

a. Types of atoms added depends on atoms _____

b. _____ controlled by how fast atoms can **migrate** to crystal, **temperature**, and **pressure** conditions

2. **Minerals from** _____ **water**- Some minerals produced from hot-water solutions rich in dissolved mineral matter

a. Occurs around edges of **hot** _____

b. Also formed when hot water passes through _____ in cooler rock (i.e. gold, silver, or copper)

3. **Minerals from** _____- occurs when magma cools

4. **Minerals from Evaporation**- Also form from water on Earth's surface when water slowly _____

E. Mineral Groups

1. Over _____ **minerals** identified in nature

2. Only a **few** minerals needed to make up almost the entire _____ of Earth

3. _____- The most important by volume of Earth's crust

a. Most minerals contain _____

b. Common term for compound containing **silicon** plus _____ or **silicon dioxide**

c. Forms tetrahedron shape

d. Other _____ **atoms** can attach to the oxygen atoms

4. Minerals of the Crust- **silicate** groups form most of **Earth's** _____

a. **Quartz** and **feldspar** make up most of _____ **crust**

b. _____ **crust** is **denser**

5. Important non-silicates- many important mineral groups are not silicates

a. Include **carbonates**, **oxides**, **halides**, **sulfides**, **sulfates**, and **native metals**

b. Source of many valuable ore minerals (I.e. _____ ore, **bauxite** (aluminum), **carbonate** (used to make _____)

F. Mineral Uses

1. Humans have relied on minerals for their everyday _____

2. Used minerals either directly as objects of _____, or as raw materials to **make things**.

II. Igneous Rocks

A. What is a Rock?

1. _____- a naturally formed consolidated mixture containing **minerals**, **rock fragments**, or **volcanic glass**

2. Identified by their **composition** and _____

B. Intrusive Igneous Rocks

1. Rocks formed from **molten rock material** called _____

a. Termed "**plutonic**" after Pluto, Greek god of the _____

b. Called **intrusive** because form _____, or push into, regions of Earth's crust

2. Nature of Magma- As it passes through rock, magma might cause **partial** _____ of rock it intrudes

3. Intrusive Igneous Rock Composition

a. **Composition** of intrusive igneous rocks gives clues to where in Earth they _____

b. _____ rock settles toward bottom and **less dense** float to top of magma chamber

4. Intrusive Igneous Rock Texture

a. Texture describes size and arrangement of rock components

b. **Size** of individual **mineral crystals** tells you how quickly or slowly the **magma** _____

5. Classification of Intrusive Igneous Rocks

a. _____- rich in quartz and feldspar (dominant rock of continental crust)

b. **Gabbro**- ____ quartz and abundant feldspar

C. Extrusive Igneous Rocks

1. Rocks that **cool from** _____ that has **erupted** at Earth's surface

a. Have **same composition** as intrusive igneous rocks, but **different** _____

b. Often _____ by rocks as it passes through them on way to surface

2. Extrusive Igneous Rock Textures

a. **Rapid cooling** results _____ **or no crystals**

b. _____ **eruptions** can result in many different textures and forms (**large blocks to ash**)

3. Effect of **Gases**

a. Can break apart lava to form _____

b. Can form lava with many **small holes** (_____- can float on water)

III. Sedimentary Rocks

A. Rocks from Surface Materials

1. Surface Attack- exposed rocks attacked by _____

a. Action over **long time** breaks rocks down into _____-sized pieces

b. Slow, constant **smashing**, **grinding**, and **dissolving** of **clasts** can take place in _____ and _____

_____- small bits and pieces of rocks

2. Transportation and Deposition

a. Can be **eroded** or **removed** from original _____

b. When transported to new location, clasts often become _____

c. **Porosity**- _____ between clasts

1). **Porosity** can vary

2). Porosity is what can _____ **water**, **oil**, and **natural gas** stored in the Earth

3. Buried Clasts

a. Eventually, clasts can become consolidated into _____ **rock**

1). Making of **clasts** by **weathering** is _____ process

2). Making of **sedimentary rock** occurs _____ the surface

4. **Force of** _____ (gravity) causes **clasts** to **stick together**

a. _____ carries dissolved minerals that can act like **cement**

b. **Cementation**- process where minerals fill spaces between _____ to make **sedimentary rock**

B. Detrital Sedimentary Rocks

1. **Detritus**, from Latin *deterere*, means "to lessen or wear away"

a. Sedimentary rock made mostly from _____ are **detrital sedimentary rocks**

b. In order of decreasing _____, **clasts** are known as- **gravel**, **sand**, **silt**, or **clay**

2. Detrital Sedimentary Rock Textures-

a. Scientist use **size of clasts** as clue to the kind of _____ in which a rock forms

b It takes **more** _____ (or energy) to move **gravel** than **sand**

c. When water is **moving**, silt and clay particles _____ up in water

d. When water is **calm**, most **clast** sizes _____ **out**

3. Detrital Sedimentary Rock Compositions

a. Depends on **sources** of _____ material that were **eroded**

b. Some _____ tend to be more **common** in detrital sediments (i.e. quartz)

4. Detrital Rock Classification

a. Classified according to _____ and **texture**

b. Classified as follows

Common Clast Sizes Used to Name Sedimentary Rock	
Common Clast Size	**Rock Name**
Gravel or larger	**Conglomerate**
Sand	**Sandstone**
Silt	**Siltstone**
Clay	**Shale**

C. Chemical Sedimentary Rock

1. Formed through the activity of _____ dissolved in water

2. _____ settle our of water to build and form new rock

3. **Precipitation**- the **crystallization** of excess **dissolved** _____

4. **Evaporation**- _____ matter crystallizes when water evaporates

D. Biochemical Sedimentary Rocks

1. Contain the **remains** of _____ **organisms**

` 2. _____ contains remains of marine organisms that had body parts of calcium carbonate

3. Variety of limestone (Coquina) is made from _____ **fragments**

4. **Coal**- originates from remains of mostly _____ material

a. Composed of mostly _____

b. Usually develops from **peat** found in _____ or **bogs**

c. Transformed into coal by _____ after buried by sediments

IV. Metamorphic Rocks and the Rock Cycle

A. Metamorphic Rock

1. Rocks that have been changed by some combination of **thermal energy**, _____, and **chemical** activity

2. Atoms rearrange and sometimes form new minerals

a. The word **metamorphic** comes from "meta"- meaning **to change**, and "morph"- meaning _____

b. Occurs at _____ between that which forms **sedimentary** (low) and **igneous** (high)

B. Metamorphic Rock Composition

1. Changing Minerals

a. **Clay** minerals tend to form _____

b. _____ forms with increased **temperature** and **pressure**

2. Environments of Metamorphism

a. **Movements** of large parts of **Earth's crust** and uppermost _____

b. Contact of preexisting rock with _____

C. Metamorphic Rock Textures

1. _____ Rocks- most common **sedimentary rocks** in Earth's crust are **mudrocks** such as **shale** and **siltstone**

a. Contain abundant _____ minerals

b. **Metamorphizes** into minerals in the _____ group

c. When squeezed and heated, layers of mica line up in direction **perpendicular to direction** of _____

2. **Nonfoliated** Rocks

a. Tend to have random **crystal** orientation and uniform _____ **size**

b. Results in _____ (chemically equivalent to limestone)

D. Metamorphic Rock Classification

` 1. _____ based on **texture** and **composition** (Can be **foliated** or **nonfoliated**)

2. **Mineral composition**- can tell you <u>clues</u> about the _____ **rock type**

E. The Rock Cycle

1. Includes any **chemical** and **physical** conditions that continuously form and _____ rocks

2.Some happen at **Earth's surface**, while others happen _____ **below** the surface

3. All material is conserved through process (_____ is conserved)

4. Can take many _____ **paths**

5. . <u>Occur</u> over **millions of years** or **suddenly** (erupting _____)

6.. **No** _____ **or** _____ **to rock cycle**