**For today’s lecture, you should have read the PDF of *Rocks & Minerals*, ch. 2 in Montgomery’s book *Environmental Geology* available at epsc116a.wustl.edu

**Main Points**

Rocks and minerals are the major resources we will consider in this class:

“If you can’t grow it, it has to be mined.”

What are these rocks and minerals good for? Look at their properties.

Geology: applying knowledge from chemistry, physics, biology, and mathematics to understand earth materials and earth processes.

Resource geology: applying knowledge of earth materials and processes to better understand how and where different resources form, as well as the environmental impacts of mining, processing, and using those resources.

I’ll give you some background in basic geology as I “spin” this discussion of rocks and minerals to reflect resource needs.

**Minerals**: basic building blocks of rocks; naturally occurring chemical compounds. Chemistry.

**Elements**: building blocks of minerals. One of the reasons for mining certain minerals is to obtain desired elements from them.

90 naturally occurring elements; only 8 of them account for 98.5% of earth’s crust:

| O | Si | Al | Fe | Ca | Mg | Na | K | [Ti] |

Most of metals that we will study ALL TOGETHER constitute the remaining 1-2 wt.% of crust.

Chemical properties of element: atomic number (# of protons)

# electrons = # protons in neutral atom

Electron interactions control chemical reactions and formation of compounds

Impacts for YOU?

Atoms or ions **bond**: ionic bonding, covalent bonding; some atoms always neutral

**Compounds** (bonded, stable configurations of atoms) typically have properties different from those of constituent atoms – uses; synthesis

What physical properties distinguish materials? Controlled by bonding.

**Minerals**: natural, inorganic, solid compound with definite composition, crystal structure

No 2 minerals have same combination of composition and structure

OVER ➔
Physical properties: color, luster, streak, hardness, crystal form, cleavage, specific gravity.

Resource-important **physical** properties: hardness, strength, ductility, melting point, density, electrical conductivity, heat conductivity/insulation.

Chemical properties: reactivity, ability to combine with other materials, elemental composition

Resource-important **chemical** properties: weather- and chemical-resistance, which elements can be retrieved from mineral and how much energy is required, how difficult it is to recover those elements, what undesired residues left after element recovery.

Different compositional groups of minerals

Si + O \(\sim\) 75 wt.% of earth’s crust. **SILICATES** (Si-O compounds) are the most abundant minerals.

Using Si-O\(_4\) tetrahedra as building blocks; variations on a theme: properties differ.

Examples: quartz, feldspar, garnet, olivine (Mg\(_2\)SiO\(_4\); Mg\(\rightarrow\) Fe)

Other compositional groups of minerals:
- carbonates \((CO_3)^{2-}\) calcite CaCO\(_3\) seashells, chalk; TUMS
- sulfates \((SO_4)^{2-}\) gypsum CaSO\(_4\)•2H\(_2\)O plaster
- sulfides S\(^2\) pyrite FeS\(_2\) fool’s gold; sulfuric acid

**Rocks:** aggregates of one or more minerals

3 types of rocks based on process of formation: **Rock cycle**
- **igneous:** crystallized from molten silicate magma (volcano; great depth)
- **sedimentary:** low temp., near surface; fragments or chemical precipitates
- **metamorphic:** transformation of pre-existing rock by temperature and pressure

Hand samples:
- igneous: basalt, granite
- sedimentary: sandstone, limestone, coquina, shale, chert
- metamorphic: marble (from limestone), slate (from shale), mica schist, granite gneiss

“Fake rocks”: cement, plaster, earthenware/ceramics

***Remember our field trip next Monday.*** Arrive in class **on time.** We will load into a bus and drive about 15 minutes. We will **return 20-30 minutes later than the usual end of class.** I can give to you or e-mail to the professor of your next class a note to explain your lateness. Please e-mail me with the name of the professor, the name of your class, and the professor’s e-mail address.
Materials looked at in class:
Cracker boxes of tiny minerals
Ball-and-rod model
SiO₄ tetrahedron: cardboard; large clear plastic balls
Quartz, feldspar, garnet, olivine
Gypsum, calcite, pyrite, galena, magnetite, halite
Rock samples—see list above