Atoms, Elements, and Minerals

Atoms are composed of protons (+), neutrons, and electrons (-). A given element always has the same number of protons. An atom in which the positive and negative electric charges do not balance is an ion.

Ions or atoms bond together in very orderly, three-dimensional structures that are crystalline.
crystal form- Arrangement of various faces on a crystal in a definite geometric relationship to one another.
A crystalline substance is considered a mineral (in geologic terms) if it is naturally occurring and inorganic and has a definite chemical composition.

Crystal –

Crystaline solid –
Each element is designated by its atomic number ---table ---

The three most abundant elements in the earth's crust are oxygen, silicon, and aluminum. Most minerals are silicates, with the silicon-oxygen tetrahedron as the basic building block.

Feldspars are the most common minerals in the earth's crust. The next most abundant minerals are quartz, the pyroxenes, the amphiboles, and the micas. All are silicates.

Minerals are usually identified by their **physical properties**. **Cleavage** is perhaps the most useful physical property for identification purposes. Other important physical properties are external **crystal form, fracture, hardness, luster, color, streak, and specific gravity / heft.**

The interaction between the internal and external forces of the earth is illustrated by the rock cycle, a conceptual device relating igneous, sedimentary, and metamorphic rocks to each other, to surficial processes such as weathering and erosion, and to internal processes such as tectonic forces. Changes take place when one or more processes force earth's material out of equilibrium.

cleavage- The ability of a mineral to break along preferred planes.
A mineral breaks along 1 cleavage direction.

fracture- The way a substance breaks where not controlled by cleavage.
Quartz has a conchoidal fracture …,. Silky … pearly … glassy

hardness- The relative ease or difficulty with which a smooth surface of a mineral can be scratched; commonly measured by Mohs' scale - talc is the softest while diamond is the hardest mineral, apatite is harder than calcite…

luster- The quality and intensity of light reflected from the surface of a mineral.
shine - silver tarnishes, or loses its shine, if not polished.

streak- Color of a pulverized substance against a white background; a useful property for mineral identification. Pyrite has a black streak…..

specific gravity- The ratio of the mass of a substance to the mass of an equal volume of water, determined at a specified temperature.

Color is likely to be the first physical property you notice about a mineral sample, but it may not help that much to identify a mineral. Many minerals can be the same color, but because of trace elements, different samples of the same mineral often have different colors.

Based on Plummer´s Physical Geology and AW Earth Science, Věra Hranáčová 2011

1. Can you pronounce the most abundant elements in the Earth's crust correctly?
Which elements have the stress (přízvuk) on the second syllable?
Oxygen, silicon, aluminum, iron, calcium, sodium, potassium, magnesium.

2. Pronounce some other elements:
Bromine, fluorine, chlorine, iodine, hydrogen, oxygen, nitrogen, copper

3. Describe crystalline systems on the following page. Give their example mineral crystals: e.g.
Galena **belongs to** isometric/cubic system. All three **axes** are of equal length and at right angles.

4. Describe physical properties of some sample minerals from the table on the following page.
Remember to use other useful verbs, not only "have".

Homework
1. Fill in the gaps with the most suitable expression:
Although account designated despite key resembles unlike whereas

Each element is _____ by its atomic number.
Oxygen and silicon _____ for almost seventy-five percent of elements in the earth's crust.
Magnesium _____ aluminum in many ways.
Iron is _____ aluminum. Iron is heavy, _____ aluminum is light.
_____ copper and aluminum are both good **conductors**, aluminum is used in aviation because it is far lighter.

_____ the great number of minerals and many differences among minerals, all minerals have four things **in common**. Each mineral is a mixture or a combination of certain _____ elements.

2. Explain the words in bold type:
Conductors = *, in common =*

3. Make these negative:
____*organic, color*___ , ____*regular,*

4. Compare:eg big - bigger - the biggest
*Heavy -*_____*, dense -* _____*, abundant -* _____
Light - _____*, dark -* _____*,*

5. Write the definitions of these terms:
Matter –
Atom –
Element –
Compound -

6. Describe two minerals of your own choice, then compare their physical properties and prepare 3 slides for your presentation. What are the two minerals similar in? How do they differ?
Use the proper vocabulary and sentence structures from Comparing and Contrasting.

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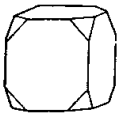
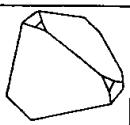
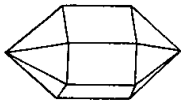
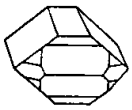
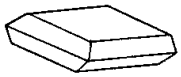
System Name	Example Mineral Crystals	Axes
Isometric or cubic system	 Galena	3 axes All of equal length All at right angles
Tetragonal system	 Chalcopyrite	3 axes 2 of equal length All at right angles
Hexagonal system	 Quartz	4 axes 3 of equal length The fourth one at right angles to the other three
Orthorhombic system	 Olivine	3 axes All different lengths All at right angles
Monoclinic system	 Gypsum	3 axes Lengths variable 2 at right angles
Triclinic system	 Microcline	3 axes All different lengths None at right angles

Mohs' Scale of Hardness

1 Talc — Softest
2 Gypsum
3 Calcite
4 Fluorite
5 Apatite
6 Orthoclase feldspar
7 Quartz
8 Topaz
9 Corundum (ruby and sapphire)
10 Diamond — Hardest

Physical Properties of Nine Minerals

Mineral Name	Cleavage/Fracture	Hardness	Color	Streak	Luster	Heft	Other
biotite mica	cleavage, 1 direction	2½ to 3	dark brown to black	light tan	glassy	average	forms flakes and sheets
calcite	cleavage, 3 directions, not at 90° to each other	3	white. clear, pink, blue, yellow	white	glassy	average	bubbles in dilute hydro-chloric acid/acid/
fluorite	cleavage, 4 directions, at 90°	4	colorless, purple, blue, green, yellow, brown	white	glassy	average	
galena /galenite/acid/	cleavage, 3 directions, at 90°, often bent	2½	silver or lead-gray	gray to black	metallic	heavy	cleavage surfaces often bent
gypsum	perfect in 1 direction, poor in 2; not at 90°	2	clear to white	white	pearly, silky, or dull	light to average	cleavage may not be seen
magnetite	irregular fracture	6	black	gray to black	metallic to dull	heavy	attracted by a magnet
orthoclase feldspar	cleavage, 2 directions, at 90°	6	white. red, pink	white	pearly	average	may appear to have a third cleavage direction
pyrite	irregular fracture	6 to 6½	silver-gold	black	metallic	heavy	
quartz	glassy, conchoidal fracture	7	white, clear. gray, pink	white	glassy	average	crystal faces common