Atoms, Elements, and Minerals - basic vocabulary

acid [æsid]	kyselina
amount	množství
arranged [ə'reindž]	uspořádaný
arrangement	uspořádání
ax**is**, pl ax**es** [æksis, æksi:z]	osa - osy
compound [kəm'paund]	sloučenina
conchoidal	lasturnatý
crystalline solid [kristəlain]	krystalicky pevný
depth [depθ]	hloubka
designated [dezigneitid]	označený
differ from	lišit se
dilute [dai'lju:t]	ředit, zředěný
distinguish (A from B) [dis'tiŋgwiš]	odlišovat (A od B)
dull	matný
edges [edžiz]	hrany
element	prvek
flake [fleik]	šupinka, odštěpek
fracture [frækčə]	lom (fyzikální vlastnost minerálu)
grain [grein]	zrno
grow-grew-grown [grəu, gru:, grəun]	růst – narostlý
hard – hardness [ha:dnis]	tvrdý – tvrdost
heft [heft]	specifická hmotnost, váha
height [hait]	výška
impurities [im'pju:riti:z]	příměsi, nečistoty
inorganic [ino:'gænik]	anorganický
ion [aiən]	iont
join [džoin]	spojovat
key elements [ki:]	základní prvky
luster, Br.lustre [lastə]	lesk
magnifying glass [mægnifaiiŋ]	lupa
mass [mæs]	hmotnost
matter [mætə]	hmota
mistaken for	mylně považovaný za
mixture [miksčə]	směs
natural [næčrəl]	přírodní
observe [ob'zə:v]	pozorovat
occur [o'kə:]	vyskytovat se
pale	bledý, světlý
periodic table	periodická tabulka
physical property (-ies)	fyzikální vlastnost (-i)
proportion [prə'po:šn]	poměr
rare(ly)	vzácný, vzácně
release [ri'li:s]	uvolnit
resemble [ri'zembl]	podobat se
sample [sa:mpl]	vzorek

scratch	poškrábat
silicate minerals [silikeit]	silikáty
silky	hedvábný
smooth	hladký
specimen [spesimen]	vzorek (ukázka)
streak [stri:k]	vryp
substance [sabstəns]	látka
surface [sə:fis]	povrch
tetrahedron [tetrə'hi:drən], pl -s, tetrahedra,	čtyřstěn, tetraedr
thickness [θiknis]	síla, tloušťka, mocnost
trace elements	stopové prvky
traces of	stopové (nepatrné) množství
tiny [taini]	drobný, nepatrný
uneven	nestejný, nerovný (lom)
width [widθ]	šířka

Minerals

agate [ægit]	achát
biotite mica [baiətait maikə]	biotit
calcite [kælsait]	kalcit
emerald [emərəld]	smaragd
feldspar [feldspa:]	živec
fluorite [fluərait]	fluorit
galena [gə'li:nə]	galenit
garnet [ga:nit]	granát
graphite [græfait]	grafit, tuha
gypsum [džipsəm]	sádrovec
halite [hælait]	kamenná sůl
magnetite [mægnitait]	magnetit
microcline [maikrəklain]	mikroklin (modifikace živce draselného)
muscovite [maskəvait]	muskovit
olivine [olivi:n]	olivín
opal [əupl]	opál
orthoclase feldspar [o:θəkleis]	ortoklas (modifikace živce draselného)
pyrite [pairait], chalcopyrite [kælkə'pairait]	pyrit, chalkopyrit
quartz [kwo:ts], smoky quartz, rose quartz	křemen, záhněda, růženín
turquoise [tə:kwoiz]	tyrkys

Linking

(al)though [ðəu] , however- ačkoliv (přípustka)	either - or buď - nebo
despite / in spite of - navzdory	apart from - kromě A i další položky
while, whereas - zatímco (kontrastní spojky)	except - kromě = vyjma A
whether [weðə] - zdali, jestli	regardless - nehledě

Adverbs

likely	pravděpodobně
unlikely	**ne**pravděpodobně
rarely [reəli]	zřídka, vzácně
have st in common	mít něco společného

Atoms, Elements, and Minerals

Anything that occupies space and has mass is **matter**.
The smallest complete part of an element with all the properties of that element is an **atom.**
A **substance** that contains only one kind of atom is an **element**. Each element has its own **symbol** and is designated by its atomic number, which tells its place on the **periodic table.** Elements are arranged according to their atomic masses. The element having the smallest atomic mass is hydrogen. The natural element having the greatest atomic mass is uranium.

Learn the correct pronunciation of these elements:

Al	aluminum	[ə'luminəm] (Us)	
	aluminium	[ælju'miniəm] (Br)	hliník
Ca	calcium	[kælsiəm] -	vápník
C	carbon	[ka:bən]	uhlík
Cu	copper	[kopə]	měď
F	fluorine	[fluəri:n]	fluor
Au	gold	[gəuld]	zlato
H	hydrogen	[haidrədžən]	vodík
Cl	chlorine	[klo:ri:n]	chlór
Cr	chromium	[krəumiəm]	chrom
I	iodine	[aiədi:n]	jód
Fe	iron	[aiən]	železo
Pb	lead	[led]	olovo
M	magnesium	[mæg'ni:ziəm]	hořčík
Mn	manganese	[mæŋgə'ni:z]	mangan
Hg	mercury	[mə:kjuri]	rtuť
Ni	nickel	[nikl]	nikl
N	nitrogen	[naitrədžən]	dusík
O	oxygen	[oksidžən]	kyslík
P	phosphorus	[fosfərəs]	fosfor
Pt	platinum	[plætinəm]	platina
K	potassium	[pə'tæsiəm]	draslík
Rn	radon	[reidən]	radon
S	sulfur, sulphur (Br)	[salfə]	síra
Sn	tin	[tin]	cín
U	uranium	[ju'reiniəm]	uran
Zn	zinc	[ziŋk]	zinek

Elements, in different combinations, make up all the substances on earth. Eight of these elements make up over 98% of the earth's outer layer, a crust. The three most abundant elements are oxygen (46.5%), silicon (27.8%), and aluminum (8.1%), and so about 75% of the Earth´s crust is made up of these three elements. The relative amounts of the other elements are much smaller - 5.1%- iron, 3.6% - calcium, 2.5% - sodium and also potassium, and 2.1% - magnesium.
A substance made up of two or more elements joined together in fixed proportions is a **compound**.
These compounds, when found as natural solids within the earth´s crust, are called minerals.
A crystalline substance is considered a **mineral** (in geologic terms) if it is naturally occurring and inorganic and has a definite chemical composition. Despite the great number of minerals and despite the many differences among them, all minerals have four things in common: all minerals are made up of key elements, they are natural, inorganic and crystalline solids.

Key elements. Quartz , for example, is made up of the elements silicon and oxygen. There are a few minerals that are made up of only one element - diamond, graphite, crystalline gold, and crystalline sulfur.
Natural. Minerals are found in nature, although people have learned how to make a synthetic mineral like quartz, rubies and diamonds to use them in industry.
Inorganic. Most minerals form from a combination of atoms without the help of plants and animals.
Coal is not a mineral because it is made from organic plant remains.
Most compounds made by living things are organic. Bones, teeth and shells are the only common parts of living things that are made of minerals.

Crystalline solid. A crystalline solid is a solid substance whose atoms are locked together into fixed patterns that repeat in **height**, **width**, and **depth** or thickness. Mineral grains form by atoms attaching themselves in a three -dimensional pattern, which is related to one of the six systems. Each system is distinguished by a set of imaginary internal lines called **axes**. When the mineral grains have complete freedom to form in any direction, the atoms of the mineral produce a certain shape by lining up along these axes. This solid shape is called a **crystal**. Arrangement of various faces on a crystal in a definite geometric relationship to one another is a crystal form.

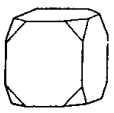
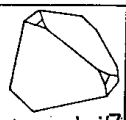
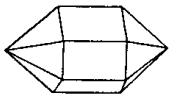
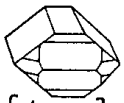
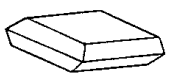
In many mineral samples that you will look at, you will see no crystals at all. Rarely are minerals found as separate crystals large enough to be seen with a naked eye. Minerals may not form crystals at all. However, mineral grains are still crystalline solids and can be studied with a microscope.

Classification of minerals

Minerals can be classified according to key elements. The **silicate minerals** form the most common class. They all contain silicon and oxygen. The basic building block made up of one silicon atom and four oxygen atoms is called a silica **tetrahedron** (pl tetrahedron**s**, tetrahedr**a**; from Greek - tetra means four, hedra means sides). The quartz, feldspar, and mica are common silicate minerals. They can look very different from each other because they contain different key elements.
Quartz contains oxygen and silicon.
Feldspar contains oxygen, silicon, aluminum, and sodium, potassium, or calcium.
Biotite mica contains oxygen, silicon, aluminum, iron, potassium and magnesium.
Silicate minerals can also look different from each other because of the way their silica tetrahedra are arranged - in some kinds, e.g. garnet, as separate units, in other kinds they are joined together in pairs, chains, sheets, or even complete box shaped networks, e.g. quartz.

Garnet forms according to the isometric or cubic system. Quartz belongs to the hexagonal system.

Look at the table of crystal names and some examples of mineral crystals.
Learn their pronunciation with correct stresses.

System Name	Example Mineral Crystals	Axes
Isometric or cubic system [aisəu'metric] [kju:bik]	 [gə'li:nə] Galena	3 axes All of equal length All at right angles
Tetragonal system [te'trægənəl]	 [kælkəu pairait] Chalcopyrite	3 axes 2 of equal length All at right angles
Hexagonal system [he'ksægənəl]	 Quartz [kwo:ts]	4 axes 3 of equal length The fourth one at right angles to the other three
Orthorhombic system [ɔ:θəu'rombik]	 Olivine [oliv'i:n]	3 axes All different lengths All at right angles
Monoclinic system [monəu'klinik]	 Gypsum [džipsəm]	3 axes Lengths variable 2 at right angles
Triclinic [trai'klinik] system [maikrəu klain]	 Microcline	3 axes All different lengths None at right angles

Galena belongs to isometric/cubic system. All three **axes** are of equal length and at right angles.

Which system does olivine belong to?
Which system does chalcopyrite form according to?

Ask these questions about gypsum and microcline.
Write the question if it sounds new to you.

…….

Now ask which minerals belong to various systems.
Note the different grammar (without do/does), because now we ask about the subject:

Which minerals belong to cubic/isometric system?
Which mineral forms according to tetragonal system?

Ask about other crystal systems:

All minerals can also look different from each other because of **impurities** - atoms of elements other than the key elements of a mineral. They can be expected in any mineral and they cause the different colors found among samples of the same mineral, e.g. in the diamond they can cause it to be pale yellow, blue, red, or even black. Regardless of color, all are the same mineral - diamond.

Nonsilicate minerals

Calcite, which is calcium carbohydrate, is a **carbonate** mineral.
Galena, lead sulfide, is a **sulfide** mineral.
Magnetite, iron oxide, is an **oxide** mineral.
Fluorite, calcium fluoride, is a **halide** mineral with fluorine as a key element, but halide minerals can contain any one of several other key elements - chlorine, bromine, and iodine are the most common.
All **sulfates** contain sulfur and oxygen as their key elements. **Gypsum** is calcium sulfate and water.

Do you know any other classes of minerals?

Physical properties of minerals

For an exact study of minerals, a laboratory and special equipment like a microscope or an electron micro probe is used. In many cases, however, geologists can see enough with no more than a magnifying glass to identify a hand-size mineral sample. 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.

Cleavage is the ability of a mineral to break into smooth, parallel surfaces (along preferred planes).
A mineral may have none, one, two, or more sets of flat breaks, each set in a different direction.
Each of these flat breaks represents a direction of weakness. Cleavage may be determined as none - poor / indistinct - imperfect - good / distinct - very good - perfect.
Mica breaks along one cleavage direction. Calcite, on the other hand, has three cleavage directions.
Smooth crystal faces can be mistaken for cleavage surfaces, but they differ because they appear only on the surface of crystals, while cleavage goes all the way through the crystal. This difference can be seen on broken edges of the mineral. Sometimes the crystal faces and cleavages are in the same direction, e.g. in common table salt.

Fracture is the way in which a mineral breaks where not controlled by cleavage. Certain minerals can be distinguished by their type of fracture, but also none fracture or **irregular/uneven/hackly** fracture may be observed. Quartz, for example, breaks along smoothly curving surfaces - it has **conchoidal** fracture. Pyrite and magnetite have irregular fracture. Other fractures: **micaceous**, **fibrous**, **splintery**, **step-like**.

Hardness is the ability of a mineral to scratch another mineral. (Also: The relative ease or difficulty with which a smooth surface of a mineral can be scratched). It is commonly measured by Mohs' Scale of Hardness. A German mineralogist Friedrich Mohs chose a series of minerals as a scale for hardness in 1822. As you can see, talc is the softest, while diamond is the hardest mineral.
Apatite is harder than calcite, but gypsum is softer.

1 Talc [tælk]
2 Gypsum [džipsəm]
3 Calcite [kælsait]
4 Fluorite [fluərait]
5 Apatite [æpətait
6 Orthoclase feldspar [o:θəukleis]
7 Quartz [kwo:ts]
8 Topaz [təu'pæz]
9 Corundum (ruby [ru:bi] and sapphire [sæfaiə])
10 Diamond [daiməɳd]

Several other standards can also be used to test for hardness:
a person´s fingernail = about 2 ½
an iron nail = 5 to 5 ½
10 crowns coin = ? *Find out.*

Luster is the quality and intensity of light reflected from the surface of a mineral.
Reflection like metal is called **metallic**. **Nonmetallic** lusters include **glassy/ vitreous, pearly, silky, waxy**, **greasy** (=mastný), **resinous** [rezinəs] - pryskyřičný, **adamantine** [ædə'mæntain]=diamantový.
If no shine is observed, the mineral is **dull**. Silver tarnishes, or loses its shine, if not polished.
Quartz, calcite, and fluorite are likely to have a glassy luster; gypsum may look silky or pearly. Galena has a metallic luster.

Streak is the color of a pulverized substance of a mineralagainst a white background. This is tested by rubbing the sample on a piece of unglazed porcelain and noting the color of the powder left on the porcelain. Streak is a useful property for mineral identification. Note that if the mineral sample is harder than the porcelain (7), the powder will be not from the mineral but from the porcelain. Pyrite leaves a black streak.
Which other mineral has a dark streak? Find out in the table below.

Specific gravity / density of a mineral**,** given in grams per cubic centimeter, is the ratio of the mass of a substance to the mass of an equal volume of water, determined at a specified temperature.
Heft is a rough-estimate weight test for minerals. When you pick up a mineral sample in your hand and its weight is about the same as an equal piece of quartz, the heft is average. Using this heft test, gypsum will appear light to average, orthoclase average, and galena heavy.

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.

Physical properties of nine minerals are given in the table.
Note how inconclusive (=irrelevant) color is as a distinguishing physical property of many minerals.
Describe physical properties of some sample minerals. Remember to use other useful verbs, not only "have",e.g. Biotite mica breaks along one cleavage direction, it is quite a soft mineral, it can be dark brown to dark black, it has a light tan streak, glassy luster and average heft. It belongs to monoclinic system. It forms flakes and sheets.

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/alt/	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

Exercises

1) Do you remember the correct pronunciation of these elements?
Bromine, fluorine, chlorine, iodine, hydrogen, oxygen, nitrogen, copper, manganese, radon, lead, uranium, sulfur / sulphur.

2) Fill in the gaps with the most suitable expression:

against although account designated despite key per 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.

Specific gravity of a mineral is given in grams _____ cubic centimeter.

Streak is the color of a colored powder _____ a white background.

Explain the words in bold type:

Conductors = , in common =

3a) Make these negative by adding a suitable prefix (předponu):

____organic, ____regular, ___likely, _____metallic, _____even, _____silicate, ___pure

*3b) Make these negative by adding a suitable suffix (příponu):*color___ , breath_____, count_____

4) Compare these adjectives: e.g. big - bigger - the biggest
Heavy - , dense - , abundant - , hard - ,
Light - , dark - , rare - , soft - , natural

5) Form the plurals of these words:
axis - , tetrahedron - , analysis - , hypothesis -

*6) Explain the difference between the prepositions **apart from x except.** Use them in sentences.*

Homework: Prepare your oral credit task

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.

Adapted from Fariel, R. - Hinds, R. - Berey,D.: Earth Science, Addison-Wesley 1987
http://www.mindat.org/advanced_search.php