

Minerals





Mineral: a naturally occurring inorganic solid that possesses a definite chemical structure, which gives it a unique set of physical properties.

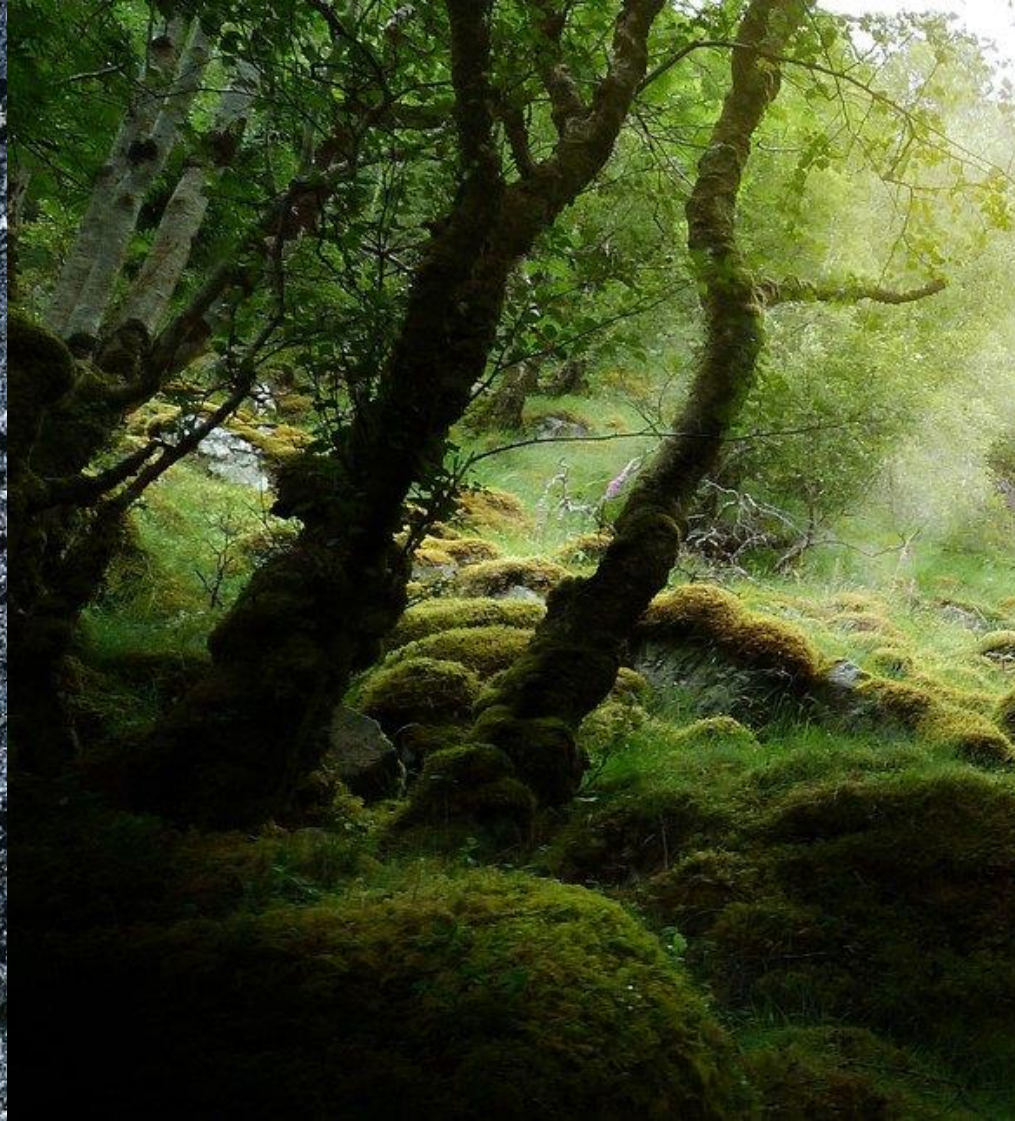


How much of that definition do you remember?

NATURALLY OCCURRING – NOT SYNTHETIC



Inorganic – NOT Organic



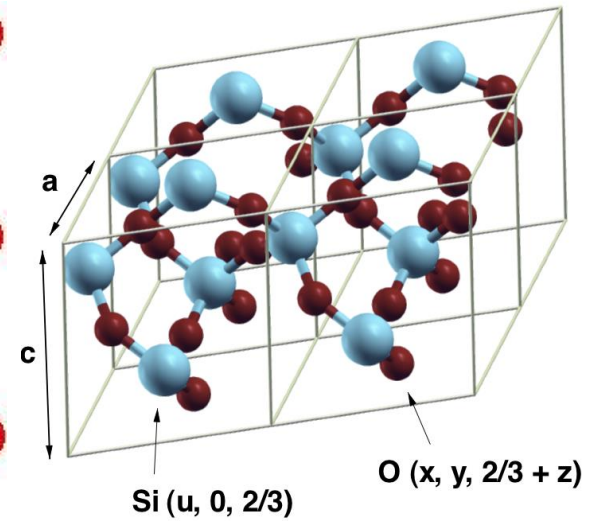
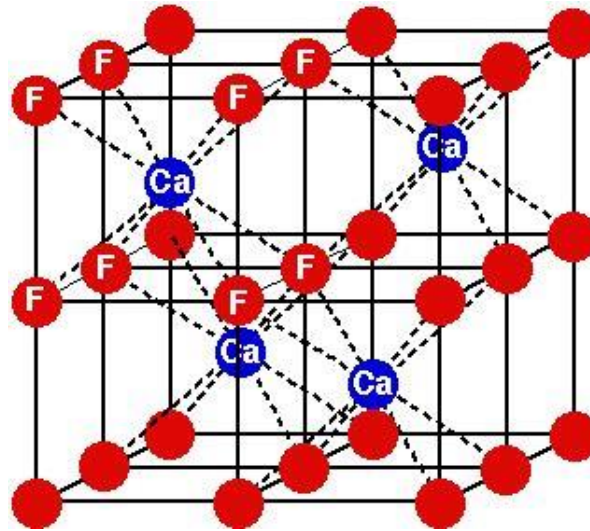
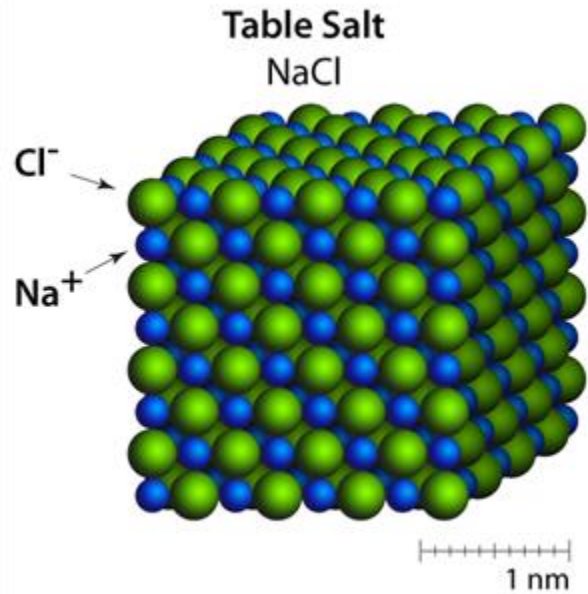
So, is coal a mineral?

Solid NOT Liquid or Gas



If you melt gold, is it still a mineral?

Definite Chemical Structure



Unique Properties

APATITE



Color – green, brown, blue, yellow, violet, clear

Luster – glassy

Hardness – 5

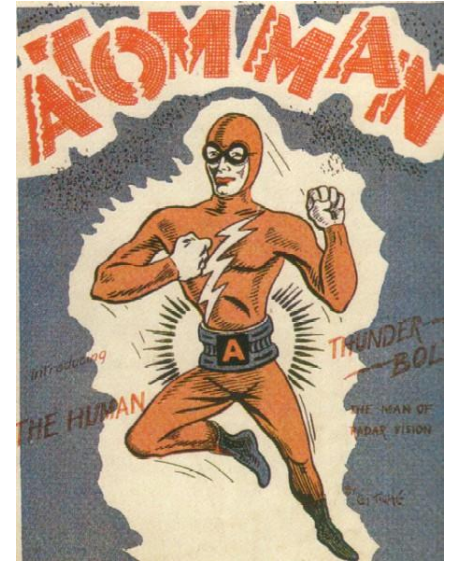
Streak – white

Cleavage – no

Fracture – rounded

Uses – fertilizer, gemstone, part of teeth and bones

Building Blocks of Matter



Element: Fundamental building block of matter that cannot be broken down by chemical means.

Atoms: The smallest particle of an element.

Nucleus: The central region of an atom containing the protons and neutrons.

Proton: A subatomic particle with a positive electrical charge.

Neutron: A subatomic particle about the same mass as a proton but electrically neutral.

Electron: A subatomic particle with a negative electrical charge that exists in orbitals outside the nucleus of an atom.

Atomic Number: The number of protons in the nucleus of an atom.

Ion: A particle or collection of particles with a net electrical charge.

Mass Number: The sum of the number of protons and neutrons in an atom.

IUPAC Periodic Table of the Elements

1 H hydrogen 1.008 [1.0078, 1.0082]																	18 He helium 4.0026						
3 Li lithium 6.94 [6.938, 6.997]	4 Be beryllium 9.0122																	5 B boron 10.81 [10.805, 10.821]	6 C carbon 12.01 [12.009, 12.012]	7 N nitrogen 14.007 [14.006, 14.008]	8 O oxygen 15.999 [15.999, 16.000]	9 F fluorine 18.998	10 Ne neon 20.180
11 Na sodium 22.990	12 Mg magnesium 24.305 [24.304, 24.307]																	13 Al aluminium 26.982	14 Si silicon 28.085 [28.084, 28.086]	15 P phosphorus 30.974	16 S sulfur 32.06 [32.059, 32.076]	17 Cl chlorine 35.45 [35.446, 35.457]	18 Ar argon 39.95 [39.952, 39.963]
19 K potassium 39.098	20 Ca calcium 40.078(4)	21 Sc scandium 44.956	22 Ti titanium 47.867	23 V vanadium 50.942	24 Cr chromium 51.996	25 Mn manganese 54.938	26 Fe iron 55.845(2)	27 Co cobalt 58.933	28 Ni nickel 58.693	29 Cu copper 63.546(3)	30 Zn zinc 65.38(2)	31 Ga gallium 69.723	32 Ge germanium 72.630(8)	33 As arsenic 74.922	34 Se selenium 78.971(8)	35 Br bromine 79.904 [79.901, 79.907]	36 Kr krypton 83.798(2)						
37 Rb rubidium 85.468	38 Sr strontium 87.62	39 Y yttrium 88.906	40 Zr zirconium 91.224(2)	41 Nb niobium 92.905	42 Mo molybdenum 95.95	43 Tc technetium	44 Ru ruthenium 101.07(2)	45 Rh rhodium 102.91	46 Pd palladium 106.42	47 Ag silver 107.87	48 Cd cadmium 112.41	49 In indium 114.82	50 Sn tin 118.71	51 Sb antimony 121.76	52 Te tellurium 127.60(3)	53 I iodine 126.90	54 Xe xenon 131.29						
55 Cs caesium 132.91	56 Ba barium 137.33	57-71 lanthanoids	72 Hf hafnium 178.49(2)	73 Ta tantalum 180.95	74 W tungsten 183.84	75 Re rhenium 186.21	76 Os osmium 190.23(3)	77 Ir iridium 192.22	78 Pt platinum 195.08	79 Au gold 196.97	80 Hg mercury 200.59	81 Tl thallium 204.38 [204.36, 204.39]	82 Pb lead 207.2	83 Bi bismuth 208.98	84 Po polonium	85 At astatine	86 Rn radon						
87 Fr francium	88 Ra radium	89-103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium	113 Nh nihonium	114 Fl flerovium	115 Mc moscovium	116 Lv livermorium	117 Ts tennessine	118 Og oganesson						

Key:
atomic number
Symbol
name
conventional atomic weight
standard atomic weight



INTERNATIONAL UNION OF
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57 La lanthanum 138.91	58 Ce cerium 140.12	59 Pr praseodymium 140.91	60 Nd neodymium 144.24	61 Pm promethium	62 Sm samarium 150.36(2)	63 Eu europium 151.96	64 Gd gadolinium 157.25(3)	65 Tb terbium 158.93	66 Dy dysprosium 162.50	67 Ho holmium 164.93	68 Er erbium 167.26	69 Tm thulium 168.93	70 Yb ytterbium 173.05	71 Lu lutetium 174.97
89 Ac actinium 227.03	90 Th thorium 232.04	91 Pa protactinium 231.04	92 U uranium 238.03	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium

For notes and updates to this table, see www.iupac.org. This version is dated 1 December 2018.
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United Nations
Educational, Scientific and
Cultural Organization



International Year
of the Periodic Table
of Chemical Elements



Luster



Metallic



Submetallic



Adamantine



Resinous



Vitreous



Pearly



Greasy



Dull



Earthy



Silky

Let's look at some minerals.

Mohs Hardness Scale

Talc

1



Feldspar

6



Gypsum

2



Quartz

7



Calcite

3



Topaz

8



Fluorite

4



Corundum

9



Apatite

5



Diamond



















10



Let's look at some minerals.

Cleavage



Number of Cleavage Directions	Shape	Sketch	Directions of Cleavage	Sample
1	Flat sheets			 Muscovite
2 at 90°	Elongated form with rectangle cross section (prism)			 Feldspar
2 not at 90°	Elongated form with parallelogram cross section (prism)			 Hornblende
3 at 90°	Cube			 Halite
3 not at 90°	Rhombohedron			 Calcite
4	Octahedron			 Fluorite



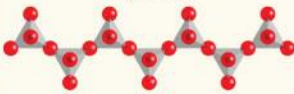
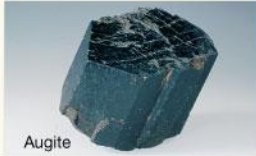
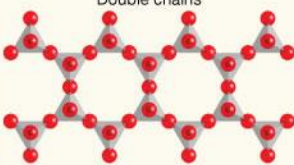

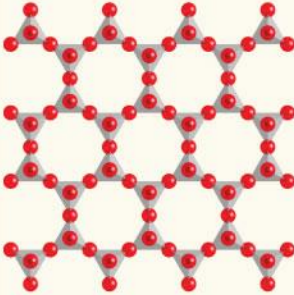


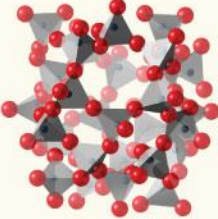


Let's look at some minerals.

Streak



Let's look at some minerals.

The Silicates

Mineral/Formula		Cleavage	Silicate Structure	Example
Olivine group $(\text{Mg, Fe})_2\text{SiO}_4$		None	Single tetrahedrons 	 Olivine
Pyroxene group (Augite) $(\text{Mg, Fe})\text{SiO}_3$		Two planes at 90°	Single chains 	 Augite
Amphibole group (Hornblende) $\text{Ca}_2(\text{Fe, Mg})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$		Two planes at 60° and 120°	Double chains 	 Hornblende
Micas	Biotite $\text{K}(\text{Mg, Fe})_3\text{AlSi}_3\text{O}_{10}(\text{OH})_2$	One plane	Sheets 	 Biotite
	Muscovite $\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{OH})_2$			 Muscovite
Feldspars	Potassium feldspar (Orthoclase) KAlSi_3O_8	Two planes at 90°	Three-dimensional networks 	 Potassium feldspar
	Plagioclase $(\text{Ca, Na})\text{AlSi}_3\text{O}_8$			 Quartz
Quartz SiO_2		None		

Crystal Habit







Let's look at some minerals.

Mining









What do you think are some pros and cons of mining?