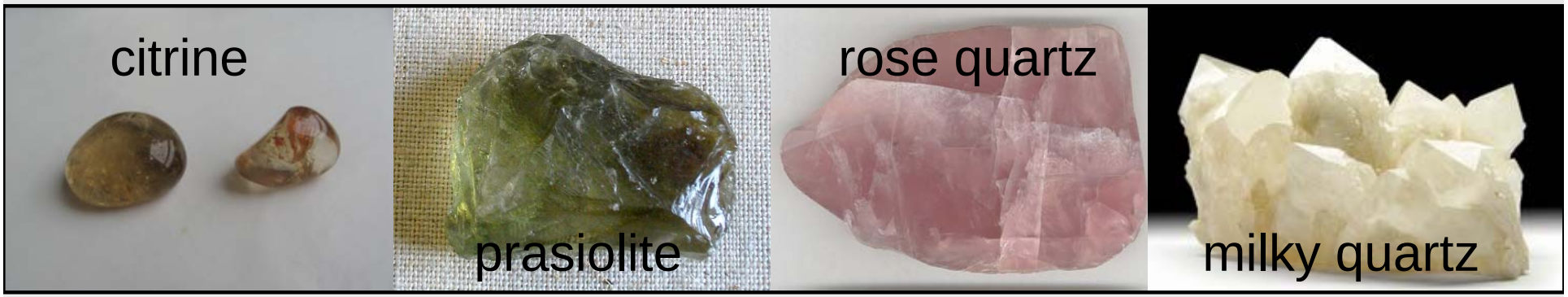
Examining Minerals and Rocks

What is a mineral?

A **mineral** is homogenous, naturally occurring substance formed through geological processes that has a characteristic chemical composition, a highly ordered atomic structure and specific physical properties.

Physical properties



1. COLOR

Physical properties

The color of a mineral when it is powdered is called the **streak** of the mineral.

Physical properties

The **luster** of a mineral is the way its surface reflects light.

Hardness-Mohs scale

1 talc 2 gypsum 3 calcite 4 fluorite 5 apatite

6 feldspar 7 quartz 8 topaz 9 corundum 10 diamond

Cleavage

Cleavage is the way a mineral breaks.

one direction	two directions	three directions
mica	feldspar	calcite

Fracture

conchoidal

Fracture is breakage that is not flat. The two main kinds of fracture are conchoidal (shell-shaped, as in quartz) and uneven.

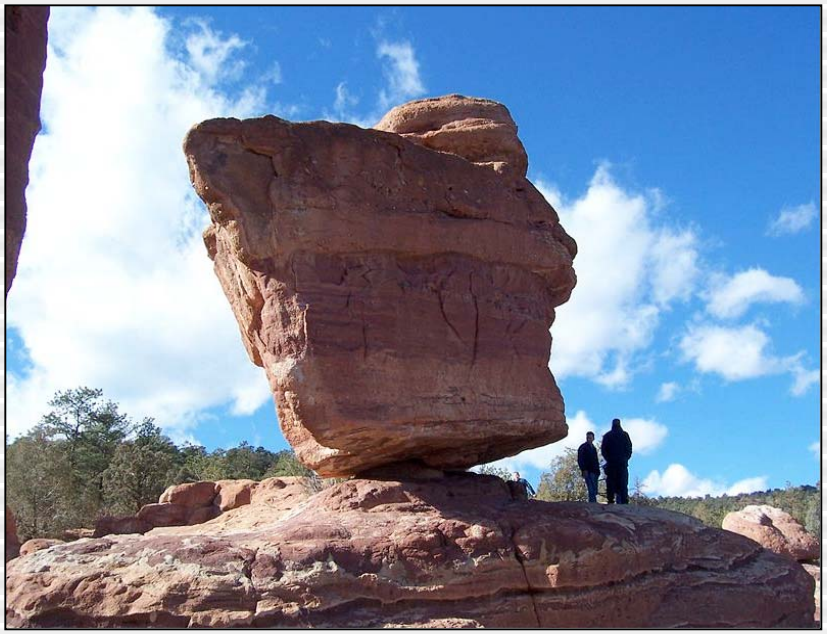
Others…

Heft is how heavy a mineral feels in the hand, an informal sense of density.

Taste is definitive for halite (rock salt), of course, but a few other evaporite minerals also have distinctive tastes.

What is a rock?

A **rock** is a naturally occurring aggregate of minerals and/or other rock fragments



Rock classification

Igneous

Sedimentary

Metamorphic

Igneous rocks

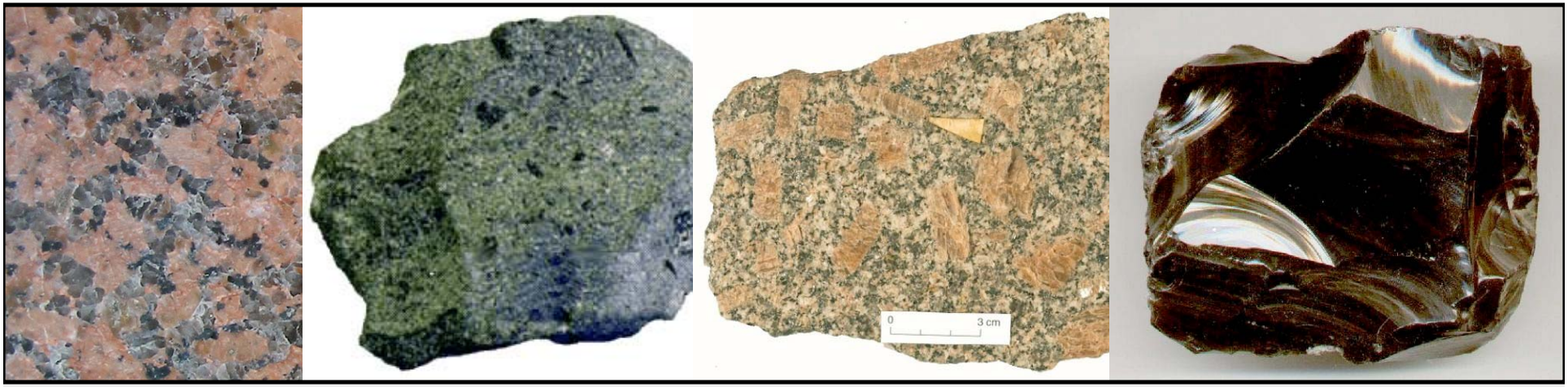
Igneous rocks form when molten rock (magma) cools and solidifies, with or without crystallization,either below the surface as intrusive (plutonic) rocks or on the surface as extrusive (volcanic) rocks.

Texture

Texture refers to the physical appearance or character of a rock, such as grain size, shape, and arrangement.

Igneous rocks that crystallize slowly beneath the Earth's surface, typically have visible individual minerals. Extrusive igneous rocks tend to cool much more rapidly, and the minerals grow quicker and can not get as large. They thus have a sugary or fine grained texture.

Texture



coarse coarse coarse Glassy/fine

Mineralogic contents

·***felsic*** **rock**, with predominance of quartz, alkali feldspar and/or feldspathoids: *the felsic minerals*; these rocks (e.g., granite) are usually light colored, and have low density.

·***mafic*** **rock**, with predominance of mafic minerals pyroxenes, olivines and calcic plagioclase; these rocks (example, basalt) are usually dark colored, but not always, and have a higher density than felsic rocks.

·***ultramafic*** **rock**, with more than 90% of mafic minerals (e.g., dunite)

Sedimentary rocks

Sedimentary rocks are classified by the source of their sediments, and are produced by one or more processes that follow:

Sedimentary rocks

Clastic sedimentary rocks are composed of fragments of older rocks that have been deposited and consolidated

- **boulders** greater than 25.6 cm
- **cobbles** 6.4 to 25.6 cm
- **pebbles** 2 mm to 6.4 cm
- **sand** 1/16 mm to 2 mm
- **silt** 1/256 mm to 1/16 mm
- **clay** less than 1/256 mm

Sedimentary rocks

Chemical sedimentary rocks form when minerals precipitate from a solution, usually sea water. Halite and gypsum are examples of minerals that precipitate from aqueous solutions to form chemical sedimentary rocks.

Biochemical sedimentary rocks are composed of accumulations of organic debris. Coal and some limestones are examples of biological sedimentary rocks.

Metamorphic rocks

Metamorphic rocks are the result of the transformation of a pre-existing rock type, the *protolith*, in a process called metamorphism, which means "change in form". The protolith is subjected to heat (greater than 150 degrees Celsius) and/or extreme pressure causing profound physical and/or chemical change. The protolith may be sedimentary rock, igneous rock or another older metamorphic rock.

Texture - Foliated

Foliation refers to flat or wavy planar features (looking like layers) caused by the alignment of platy minerals such as mica. Foliation may also look like alternating bands of light and dark minerals.

Metamorphic Environment	50-300°C	300-450°C	Above 450°C
Metamorphic Grade	Low	Intermediate	High
Rock Name	**SLATE**	**SCHIST**	**GNEISS**
Rock Description	Minerals not visible with the naked eye or with a hand lens, rock shows slaty cleavage, is usually dark-colored. A product of low-grade metamorphism of shale or mudstone.	Rock is medium to coarse grained with visible grains of mica or other metamorphic minerals. Often shiny due to reflection of mica on foliation planes. Product of intermediate grade metamorphism of shale, slate, phyllite, basalt or granite.	Rock is coarse grained and usually banded with alternating layers of light and dark minerals. Foliation bands may be folded. Product of high grade metamorphism of shale, schist, granite or many other rock types.

Texture - Nonfoliated

Nonfoliated rocks have interlocking grains with no specific pattern. They are classified based on composition, and this usually depends on the type of rock it originally formed from.

	MARBLE	QUARTZITE	ANTHRACITE COAL
Mineral(s)	calcite	quartz	crystalline carbon
Description	Coarse-grained recrystallized limestone or dolomite. Typically harder than the protolith. May have dark bands due to organic impurities.	Rock has intergrown quartz grains, thus is massive and hard. Protolith is sandstone. Intermediate to high grade metamorphism.	Hard, black shiny coal; product of low-grade metamorphism of bituminous coal.

Homogeneous

quartz

characteristic chemical composition

Sulphur

S

characteristic chemical composition

Quartz

SiO_2

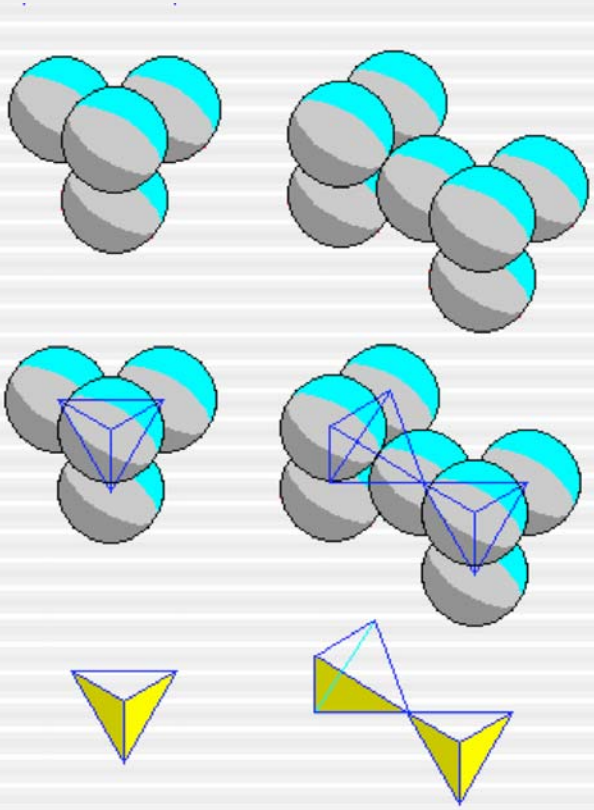
characteristic chemical composition

Tourmaline

$(Ca,K,Na)(Al,Fe,Li,Mg,Mn)_3$
$(Al,Cr,\ Fe,V)_6(BO_3)_3(Si,Al,B)_6$
$O_{18}(OH,F)_4$

ordered atomic structure

nesosilicates



sorosilicates

SiO_4

Si_2O_7

Chemical classification

- *acid* igneous rocks containing a high silica content, greater than 63% SiO_2
- *intermediate* igneous rocks containing between 52 - 63% SiO_2
- *basic* igneous rocks have low silica 45 - 52% and typically high iron - magnesium content
- *ultrabasic* igneous rocks with less than 45% silica.