THE ROCK CYCLE

ROCKS! WHAT ARE THEY? Rocks are aggregates of any combination of minerals (Quartz, Calcite, Galena), elements (S-sulfur, Au-Gold), solid organic material (coal), and/or other rocks.

ROCKS = MINERALS + ELEMENTS + SOLID ORGANICS + OTHER ROCKS

The relative abundance of the three rock groups in the earth's crust:	
Igneous	**65%**
Metamorphic	**27%**
Sedimentary	**8%**

IGNEOUS ROCKS: Ultimately the parent of all other rocks. **Magma** is hot molten rock material generated within the earth. When magma reaches the surface it is called **lava.** Igneous rocks are the result of cooling and crystallization of magma and lava**.** These include **intrusive** rocks that crystallize below the earth's surface (granite, gabbro), and **extrusive** rocks that crystallize on the earth's surface (obsidian, rhyolite, basalt).

Intrusive igneous rocks cool slowly, producing a coarse texture with mineral grains visible to the naked eye. The minerals that form are determined by the chemistry of the magma and the way that it cools (relatively slowly or quickly, steadily or variably). The grains are typically interlocking, and of more-or-less the same size.

These rocks can vary in color from almost white to dark green and black, including varying tones of gray, pink, and red.

Granite	Light-intermediate color, quartz present
Diorite	Intermediate-dark color, quartz absent
Gabbro	Dark color (very), few light minerals

Large, irregular intrusive rock masses are called **batholiths** (e.g. the Sierra Nevada) **Dikes** are tabular igneous bodies formed vertically or across sedimentary bedding. Those formed horizontally or parallel to bedding are called **sills.**

Extrusive (sometimes called volcanic) igneous rocks cool quickly, which causes very small crystals to form, if any at all. This produces fine-grained rocks, which without a microscope, can be identified only by color. The color is determined by the minerals that form during cooling.

Like the intrusive rocks, the minerals formed reflect the chemistry of the magma. Colors vary from white to black, with pink, tan, and gray being common intermediate colors. The texture of these rocks can also be influenced by the amount of gas trapped in the lava when it cools.

Rhyolite	Usually pink or tan, sometimes white
Obsidian	Volcanic glass, often black but many colors are possible.
Andesite	Intermediate-dark color
Basalt	Dark gray or gray-green to black

SEDIMENTARY ROCKS: Rocks formed from the consolidation of loose sediment (Sandstone) or from chemical precipitation (Limestone) at or near the earth's surface. Sedimentary rocks are formed by the weathering, (physical and chemical) of igneous, metamorphic and other sedimentary rocks. The weathered fragments are transported via water, air or ice before they are deposited and transformed.

Sediments are transformed into rocks by:

Cementation- usually calcite, silica or iron oxides that glue the fragments together.
Compaction- fragments being squashed together.
Re-crystallization- which produces interlocking textures.

Sedimentary rocks generally occur in layers or beds that range in thickness from inches to thousands of feet. Their texture ranges from very fine grained, to very coarse. Colors include red, brown, gray, yellow, pink, black, green and purple.

Examples of sedimentary rocks are Limestone, Sandstone, Shale, Conglomerate, Gypsum and Calcite.

METAMORPHIC ROCKS: Rocks derived from pre-existing igneous and sedimentary rocks. The original rock has been changed in form by the earth's temperature, pressure and chemical fluids to form a new metamorphic rock. Examples would include areas where an igneous intrusion forces its way through the earth's crust resulting in pressure and temperature changes due to conducted heat, force and friction.

Metamorphism can also occur in areas of stress such as faulting and folding of rock or in areas of plate tectonics such as the oceanic crust colliding into the continental crust. The principal characteristic of metamorphic changes is that they occur while the rock is solid.

Texture characteristics are very important in classifying metamorphic rocks. They range from very fine-grained to coarse-grained minerals. Metamorphic rocks can be divided into two textural groups, foliated (layered) and unfoliated (not layered).

Foliation: Parallel layers of minerals, sometimes of different composition, giving the rock a distinctive planar to platy feature (Schist, Gneiss).

Unfoliated: No preferred orientation of minerals. The rock has no preferred orientation of breakage (Quartzite and Marble).

Rock Cleavage: A property of a rock that allows for easy breaking along parallel planes or surfaces. Metamorphic rocks tend to break or cleave most easily along planes parallel with foliation.

Original Rock	Metamorphic Rock
Mudstone/Shale	Slate
Shale	Chlorite Schist
Basalt/Gabbro	Biotite Schist
Granite/Diorite	Gneiss
Limestone/Dolomite	Marble
Quartz-rich Sandstone	Quartzite