THE ROCK CYCLE

- There are three basic classes of rocks:
  - Igneous: formed by the crystallization of molten rock material, or magma.
  - Sedimentary: made up of the materials formed by the chemical and/or physical (mechanical) break-down or "weathering" of pre-existing rocks.
  - Metamorphic: Formed when igneous or sedimentary rocks are subjected to changes in pressure and temperature (e.g. by deep burial or by heating during the intrusion of magma). This causes rocks to change their original texture (e.g. the size, shape and orientation of mineral grains) and composition (the types of minerals present).

Types of Igneous Rocks

- Plutonic: Coarsely crystalline rocks formed by slow cooling of magma deep beneath the surface.
- Volcanic: Finely crystalline or glassy rocks formed by the rapid cooling of magma erupted at the surface (at the surface magma = lava)

Types of Sedimentary Rocks

- Detrital sediments are formed by the transport and accumulation (usually as layers) of broken and fragmental rock materials.
  - e.g. conglomerate (coarse with pebble-sized or larger grains)
  - e.g. sandstone (medium-grain size made up of consolidated sand)
  - e.g. shale (very fine grained, composed of clay-sized materials)

Types of Sedimentary Rocks

- Chemical sediments are formed by the dissolution of rocks and minerals and the precipitation of these dissolved components at depositional site.
  - e.g. “rock salt” and other minerals precipitated when lake water evaporates.
  - e.g. calcite (“lime”) , iron oxide (“rust”) and other minerals which precipitate from ground water and cement loose sedimentary grains together forming a rock.

Types of Sedimentary Rocks

- Note: Some chemical sediments are actually formed from the skeletons of organisms and are therefore “biochemical” in origin.
  - e.g. limestone and chalk.

Sedimentary Processes

- Water plays a fundamental role in both the physical break-up (e.g. expansion upon freezing) and the chemical dissolution of rock materials.
- Running water is also the chief agent for the erosion (=transport) of sediments to a site of deposition. Other important agents of erosion include gravity, glacial ice and wind.
- The accumulation of sediments at a depositional site is called sedimentation. Accumulation over time creates distinct sedimentary layers or strata.

Sedimentary Processes

- Lithification: The process that turns loose sediments into a rock.
  - Compaction: As sedimentary layers become buried deeper and deeper, they compact as all the pore space is squeezed out by the weight of the overlying sediments.
  - Ground water moving through buried sediments can deposit dissolved minerals as cements which fill up the pore spaces and “glue” the grains together.

Types of metamorphic rocks

- Increases in pressure and temperature cause mineral grains to grow larger and to change orientation.
- This can create banded textures where the grains are segregated into light and dark bands, or "foliated" textures where the elongated or platy minerals become aligned,
  - In metamorphic rocks the grains are often aligned at right angles to the forces acting on the rock as it is progressively buried and heated.
    - e.g. Gneiss: Banded metamorphic rock.
    - e.g. Schist: Foliated rock where all platy and elongate mineral grains are aligned.
    - e.g. "Stretched" pebble conglomerates

Why is the study of rocks and minerals important to historical geology?

- The texture of a rock provides important clues about its origin (e.g. fine-grained textures in igneous rocks indicate rapid cooling at the surface; poorly-sorted, coarse sediments indicate short, often transport from the source area; sediment grain size and sorting and larger-scale sedimentary structures, such as cross bedding or ripple marks provide information about water velocity and transport energy; fossil mudcracks indicate a period of dessication; etc.)
- The mineralogy of a rock can tell us something about the conditions under which it formed (e.g. olivine and pyroxene are formed by the crystallization of mafic magmas; crystallization temperatures at the surface can be in excess of 1400 degrees Celsius; kaolinite clays form by the low temperature aqueous weathering of feldspars; metamorphic minerals like garnet or corundum can provide important information about the temperatures and pressures of deep burial of importance in reconstructing tectonic (e.g. rifting or mountain building) events; etc.).
- In combination, the mineralogy, texture and larger-scale structures of rocks are a primary tool in reconstructing ancient environments and the history of geologic change that is the context for species evolution and extinction.