The main types of rocks

- **IGNEOUS ROCKS**
  - Form from hot, liquid magma
  - Plutonic: Cools below surface
  - Volcanic: Cools on surface
- **SEDIMENTARY ROCKS**
  - Form as layered deposits in oceans, lakes, and on land
- **METAMORPHIC ROCKS**
  - Form when pressures, temperatures and fluids change rocks in the solid state

Rocks are made from Minerals

- **A mineral:**
  1. Is Naturally occurring
  2. Is an inorganic solid
  3. Has a fixed or narrowly limited chemical composition
  4. Has a definite internal crystal structure
  5. Has limited stability in the face of varying pressure, temperature, or in the presence of water

Water as a mineral

- **Is Naturally occurring**
- **Is an inorganic solid**
- **Has a fixed or narrowly limited chemical composition**
- **Has a definite internal crystal structure**
- **Has limited stability in the face of varying pressure, temperature or in the presence of water**

Silicates

- Comprise most of the rocky material on earth
- Depending on which metals/ions it combines with it can form a variety of minerals

Igneous Rocks

- Begin as molten rock, or magma
- Melting depends on temperature and pressure (depth)
Convection

- Cold (high density) fluids sink
- Warm (low density) fluids rise
- This creates circulating currents

Convection in the mantle

- Warmer magma expands and becomes less dense
- The buoyant force causes it to rise
- Older, colder rocks sink, but have water in them

Crystal size is determined by the rate of cooling

- Once minerals cool below a certain temperature, the mineral components are no longer free to move

Weathering changes rock

- Physical weathering is caused by water and living activity

Chemical weathering

- Water and carbon dioxide make acid
  - $\text{H}_2\text{O} + \text{CO}_2 = \text{H}_2\text{CO}_3$
- Acid dissolves calcite
  - $\text{CaCO}_3 + \text{H}_2\text{CO}_3 = \text{Ca}^{2+} + 2\text{HCO}_3^-$

Chemical weathering of Plagioclase

- $2\text{NaAlSi}_3\text{O}_8 + 2\text{H}_2\text{CO}_3 + 9\text{H}_2\text{O} = 2\text{Na}^{+} + 2\text{HCO}_3^- + 4\text{H}_4\text{SiO}_4 + \text{Al}_2\text{Si}_2\text{O}_8(\text{OH})_4$

- Rock + Acid + Water = Dissolved Ions + Clay
Sedimentary rocks

- Limestone
- Gypsum
- Sandstone
- Etc.

Metamorphic rock

- High temperatures and pressures cause the rocks to change (metamorphose).
- Most rocks are metamorphic, since they form at high temperature and pressure, but we don’t see them at the surface.
  - Marble is changed from limestone.
- Foliation (Layering) can occur when non-uniform forces are present when the rock forms.

The rock cycle again