6.4 The Structure of Metals

**Metallic Bond**
- Metal atoms join together to become cations surrounded by a pool of shared electrons.
- The cations in a metal form a lattice that is held in place by the strong metallic bonds (between the cations and the surrounding pool of shared electrons).
- The electrons are moving among the atoms, but the total number does not change – so the metal is neutral.
- The more valence electrons an element has, the stronger the metallic bonds it will form.

**Properties of Metals** – many properties of metals can be explained by the mobility (ability to move around) of the electrons within a metal lattice.
- **Conduct electricity.** Electricity is moving electrons, so it can be carried/conducted by the mobile electrons in metals
- **Malleability/malleable** (the ability to be hammered without shattering) Since the electrons are free to move around in the lattice, if the metal is struck with a hammer and the cations move, the electrons can just move where they are needed to maintain the metallic bond.
- **Ductility/ductile** (the ability to be pulled into thin wires without breaking)
Alloys
  o An alloy is a mixture of two or more elements, with at least one being a metal.
  
  o Alloys have the properties of metals (like those listed above)
  
  o Scientist can design alloys with specific properties by varying the types and amounts of elements in the alloy.
  
  o Gold jewelry is almost always an alloy of gold (which is very tarnish-resistant) and other metals (to increase the hardness and reduce scratching and denting).
  
  o The added elements often provide more valence electrons, which forms stronger metallic bonds.

Copper Alloys
  o Bronze is a mixture of copper and tin
    o Both copper and tin are soft, but bronze is hard and durable.
  
  o Brass is a mixture of copper and zinc
    o While bronze and brass are both alloys of copper, they have different properties.

Steel Alloys
  o Steel is an alloy of Iron with a small amount of Carbon (0.2% - 3%).
  
  o The type and properties of steel depends on the type and amount of other elements added.
  
  o Stainless steel contains more than 10% Chromium, but almost no carbon.
    o Stainless steel is very resistant to rusting, but is more brittle than steel containing more carbon.

Other Alloys
  o Pure Aluminum is lightweight, but it bends and dents too easily to be used to make aircraft.
  
  o Adding small amounts of copper or manganese greatly increases the strength while remaining lightweight.
  
  o When even more lightweight aluminum is needed, Magnesium is added.