The Science of Metals

CVBG

Central Virginia Blacksmith Guild

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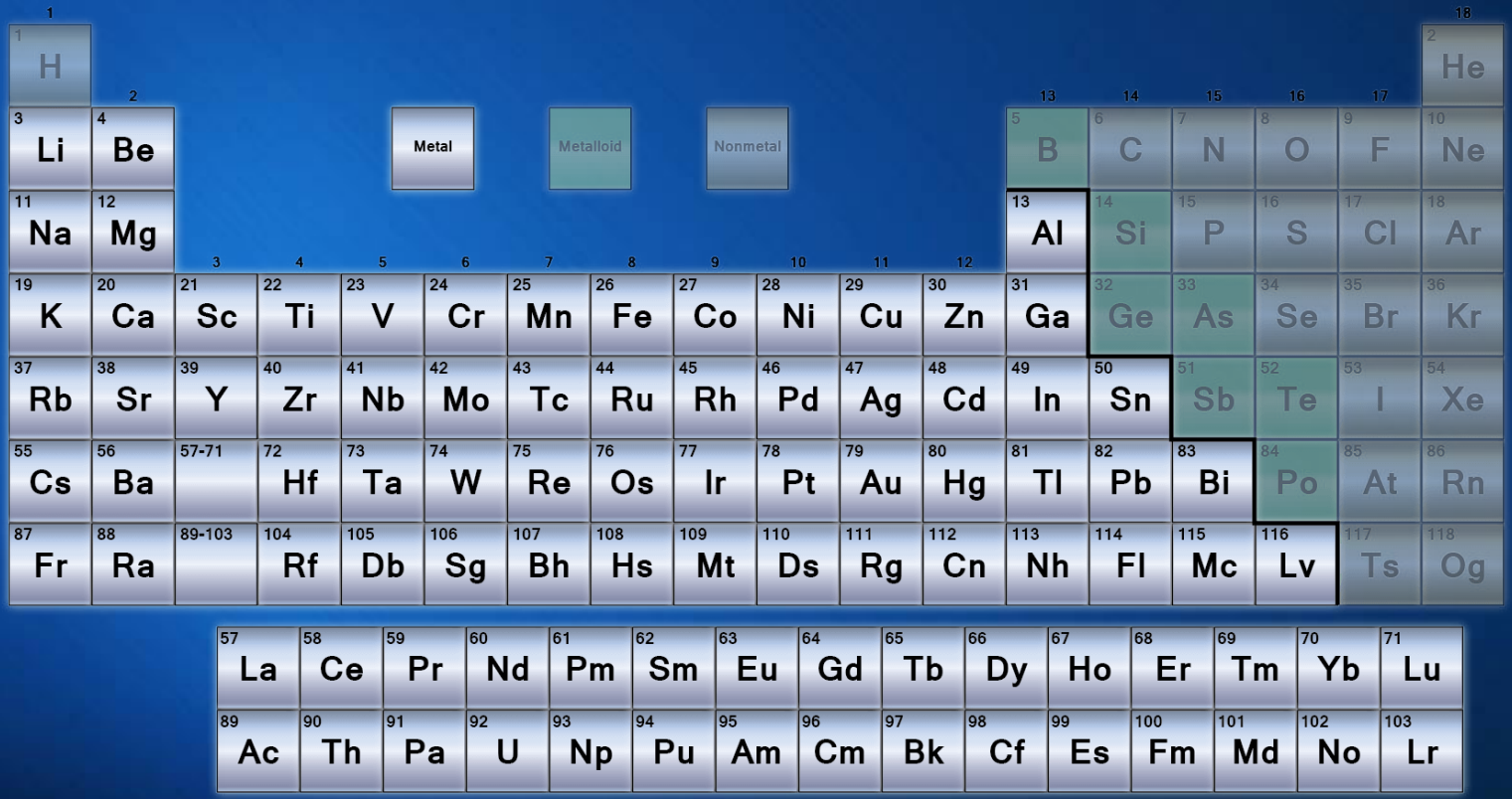
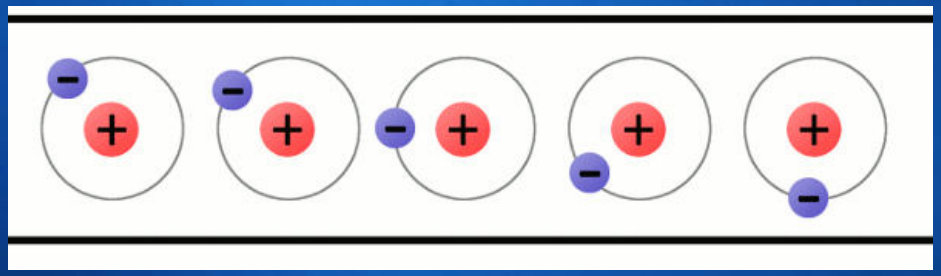
Metals on the Periodic Table



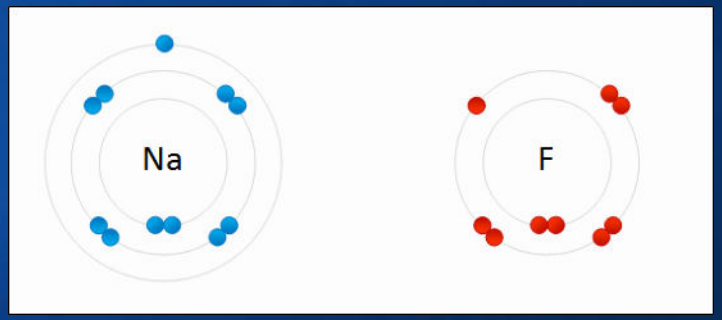
Appearance of Metals

Chemical Properties of Metals

- Contain a "sea of electrons"
- Metals react with oxygen, water, and acids
- Metals ions lose electrons



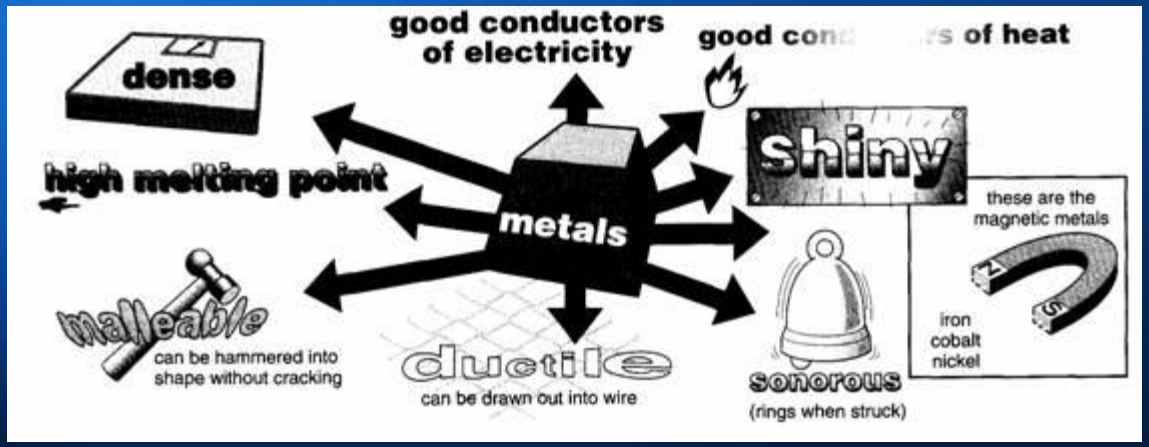
The "sea of electrons" allows metals to conduct electricity through wires.



Metals transfer electrons to nonmetals to form ionic bonds.

Physical Properties of Metals

- Good conductors of electricity and heat
- Solid at room temperature
- High melting and boiling points
- Luster – shiny appearance



Types of Metals

Ferrous Metals

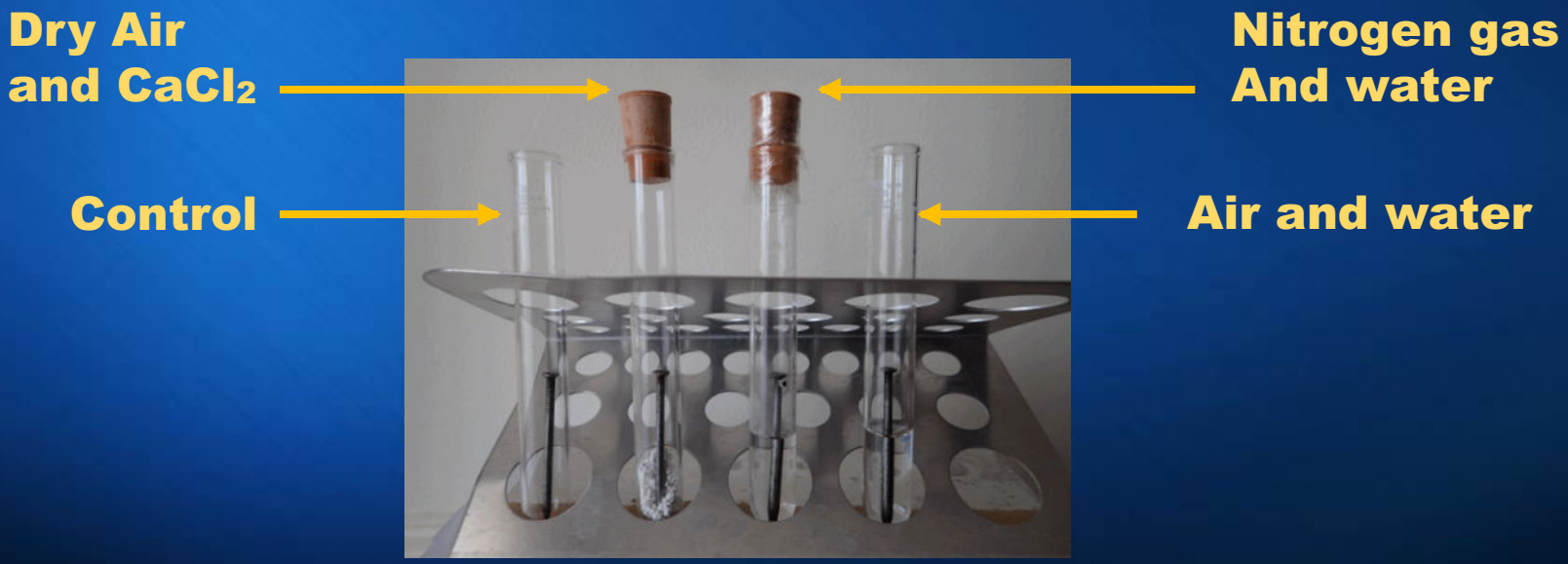
- Contain iron
- Magnetic
- Corrosive

Non-Ferrous Metals

- Do not contain iron
- Not magnetic
- Resist corrosion

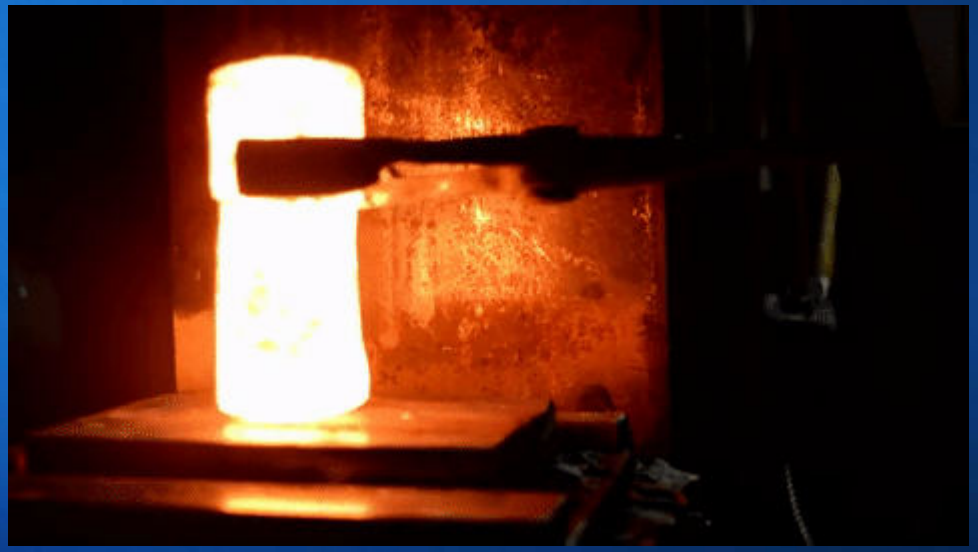
Types of Oxidation

- Metal oxides include rust and tarnish
- Metals react with oxygen from the air, from water, and from acids



Thermal Radiation

- Metal glows producing electromagnetic waves when its heated

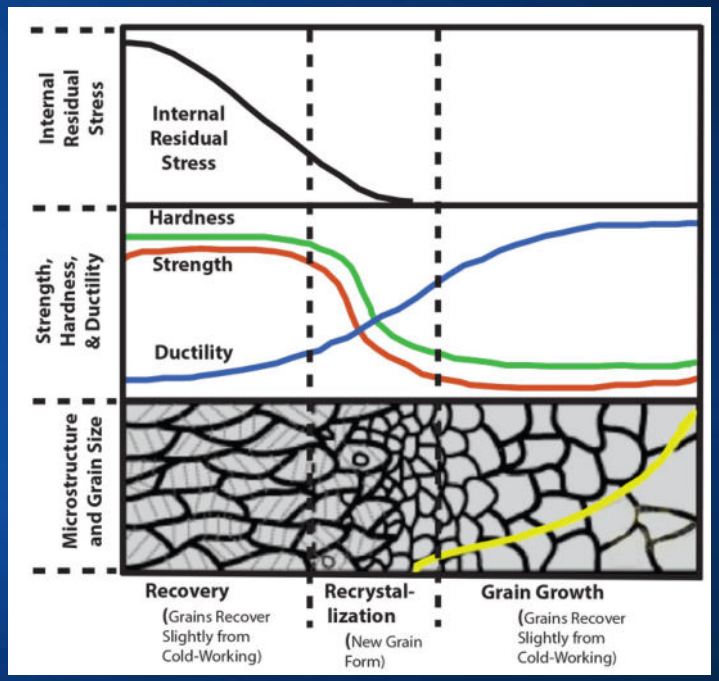


Industrial Kiln

- Metal can be poured into molds and cooled into specific shapes

Work Hardening Metal

- Heat overcomes the intermolecular forces
- Plastic deformation – the hot metal can be stretched and folded
- Cooling locks the crystals in place
- Smaller grains improve the strength of the metal



Heat Treating Metals

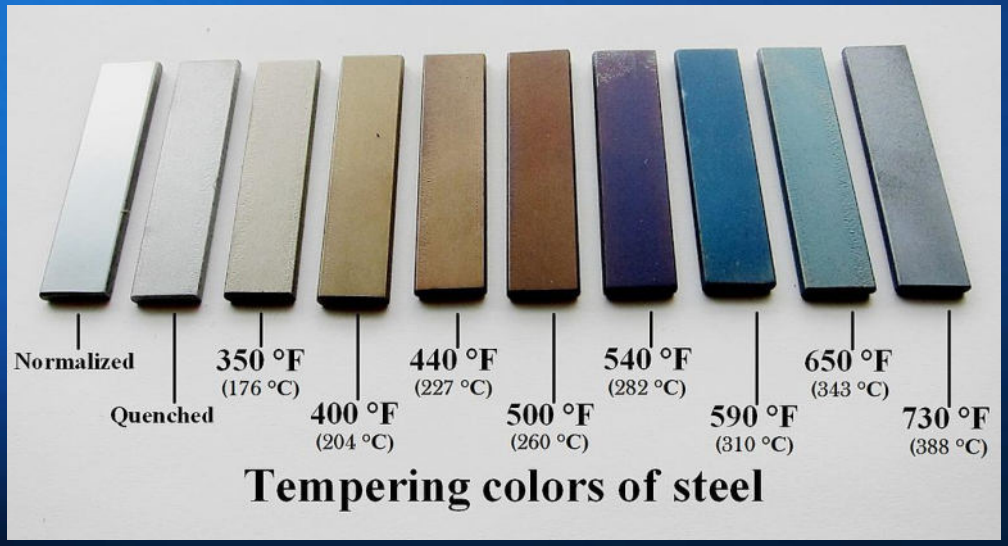
- Quenching – cools rapidly; ferrous gets harder and non-ferrous gets softer

Heat Treating Metals

- Annealing – cools slowly in order to give the crystals time to properly align

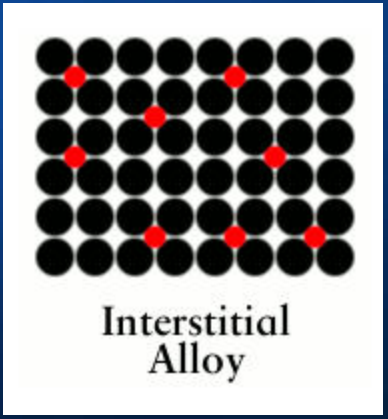
Heat Treating Metals

- Tempering – when metal is heated slowly until it glows red hot, then it is quenched and reheated at a lower temperature; increases ductility but decreases strength



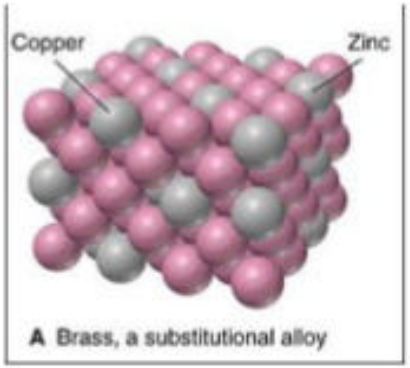
Metal Alloys

- Homogeneous mixture of metals
- Improves chemical and physical properties
- **Substitutional alloys** – atoms that are about the same size replace original atoms
- **Interstitial alloys** – smaller atoms fit in between



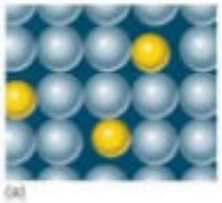
Classification of Alloys

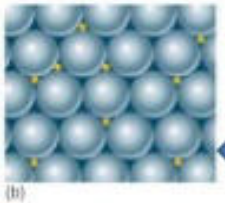
Substitutional Alloys are where the metals combining have atoms of the same size. Brass is an example.



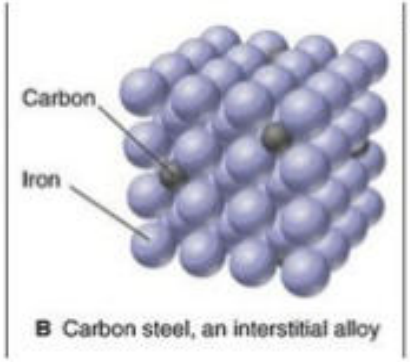
A Brass, a substitutional alloy

Substitutional Alloy.





Interstitial Alloy.



B Carbon steel, an interstitial alloy

Interstitial Alloys are where one of the alloying elements combining has atoms of smaller size. Steel is an example. Carbon atoms are much smaller and fit into the gaps in the Iron atoms.

Heat Treating Steel Lab

Type of Treatment	Method of Treatment	Strength of Bobby Pin
None (Control)	None (test as is)	Sturdy, flexible, high resistance, does not break
Annealing	Heat to red hot, cool slowly in air	Soft and flexible, no resistance, does not break
Quenching	Heat to red hot, cool quickly in water	Brittle, hard, breaks easily
Tempering	Heat to red hot, cool quickly in water, then heat at lower temp and cool slowly in air	Sturdy, flexible, medium resistance, does not break