Chapter Twelve: Atoms and the Periodic Table

- 12.1 The Structure of the Atom
- 12.2 Electrons
- 12.3 The Periodic Table of Elements
- 12.4 Properties of the Elements

Chapter 12.4 Learning Goals

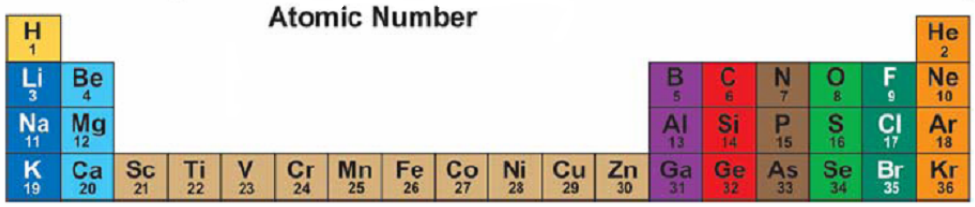
- Differentiate the electrical and thermal conductivity of metals and nonmetals.
- Define periodicity and discuss examples.
- Predict properties of an element based on its position on the periodic table.

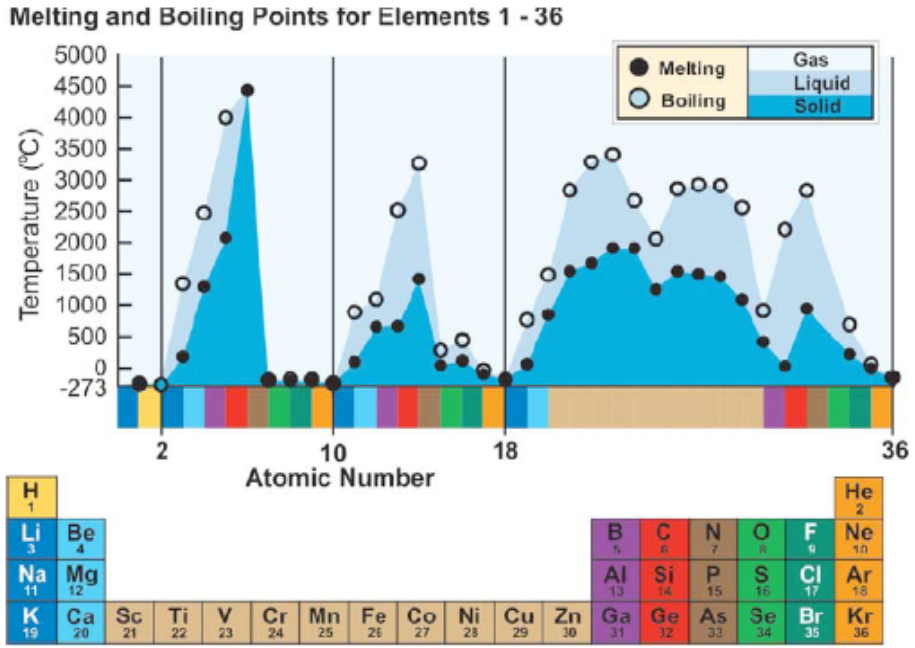
12.4 Properties of the elements

- Most of the pure elements are solid at room temperature.
- Only 11 naturally occurring elements are a gas.
- Only 2 elements (Br and Hg) are liquid at room temperature.

12.4 Periodic properties of elements

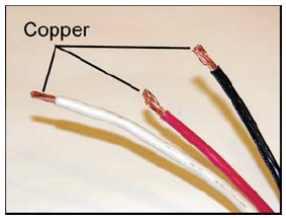
- Periodicity means properties repeat each period (row) of the periodic table.



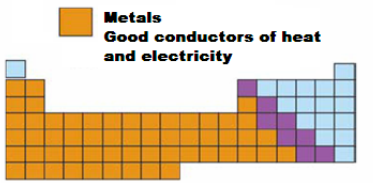


This pattern is an example of *periodicity*.

12.4 Thermal and electrical conductivity



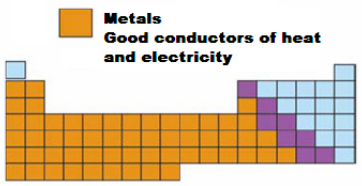
- Electricity is the movement of electric charge, usually electrons.
- Metals are good electrical conductors.



They allow electrons to flow easily through them.

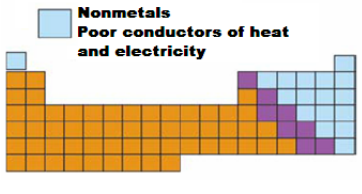
12.4 Thermal and electrical conductivity

- Like copper, most metals are also good thermal conductors.



- That is one reason pots and pans are made of metal.

12.4 Thermal and electrical conductivity

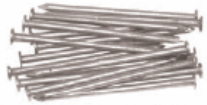


- Elements on the far right of the table are called non-metals.
- Nonmetals make good insulators.
- An insulator is a material which slows down or stops the flow of either heat or electricity.

12.4 Metals and metal alloys

- An alloy is a solid mixture of one or more elements.
- Most metals are used as alloys and not in their pure elemental form.
- Yellow brass is an alloy of 72% copper, 24% zinc, 3% lead, and 1% tin.

Stainless steel kitchen knife (does not rust)



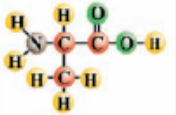
Ordinary steel nails (will rust)

12.4 Metals and metal alloys

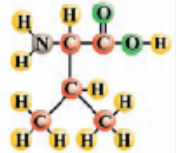
- Titanium combines the strength and hardness of steel with the light weight of aluminum.
- Titanium, a rare and expensive alloy, is used for military aircraft and racing bicycles.

12.4 Carbon and carbon-like elements

- Almost all the molecules that make up plants and animals are constructed around carbon.
- The chemistry of carbon is so important it has its own name, organic chemistry.



Alanine
$(C_2H_4NO_2)CH_3$



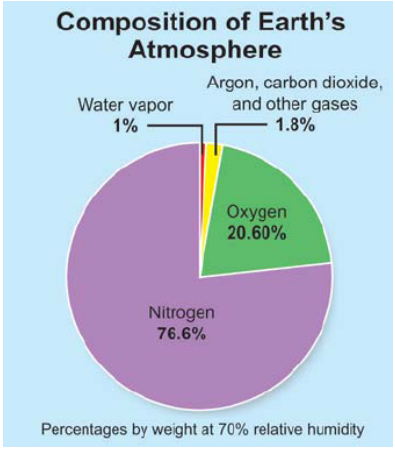
Valine
$(C_2H_4NO_2)C_3H_7$

12.4 Carbon and carbon-like elements

Why are carbon and silicon important?

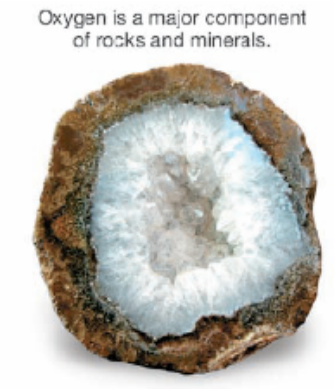
- Pure carbon is found in nature as either graphite or diamond.
- Silicon is the second most abundant element in the Earth's crust, second only to oxygen.

12.4 Nitrogen, oxygen and phosphorus



- Oxygen and nitrogen are crucial to living animals and plants.
- For example, proteins and DNA both contain nitrogen.
- Phosphorus is a key ingredient of DNA, the molecule responsible for carrying the genetic code in all living creatures.

12.4 Nitrogen, oxygen and phosphorus


Oxygen is a major component of rocks and minerals.

- Proteins and DNA both contain oxygen and nitrogen, making these elements crucial to life.
- 46% of the mass of Earth's crust is also oxygen bound up in rocks and minerals.

12.4 Nitrogen, oxygen and phosphorus

- Phosphorus is a key ingredient of DNA, the molecule responsible for carrying the genetic code in all living creatures.
- When phosphorus atoms absorb light, they store energy, then release it in a greenish glow.

Investigation 12C

Activity Series of Metals

- **Key Question:**
  How reactive are different metals?

Silicon– The Super Element

- Although silicon can form a myriad of useful compounds, it's best known for its impact on the modern world in the form of the microchip, a miniaturized electric circuit that fits into computers, cellular telephones, microwaves, and other digital appliances.