10-12 PLTW Engineering

10-12/Electrons and Electricity

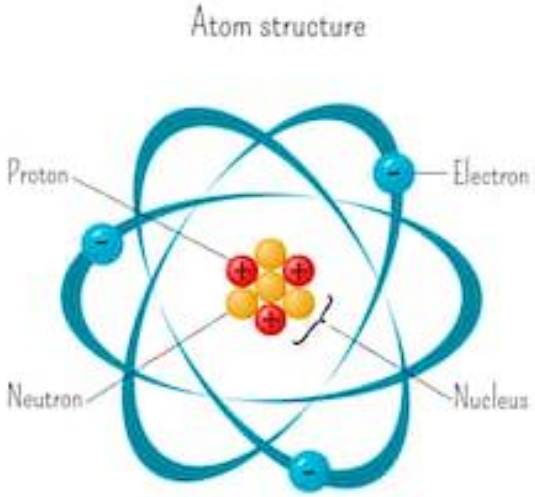
March 10, 2020

10-12/Digital Electronics
Lesson: **4/10/2020**

Objective/Learning Target:
Students will understand the the building blocks of the atom and be able to identify its parts, as well as be able to identify conductors, semiconductors, and insulators

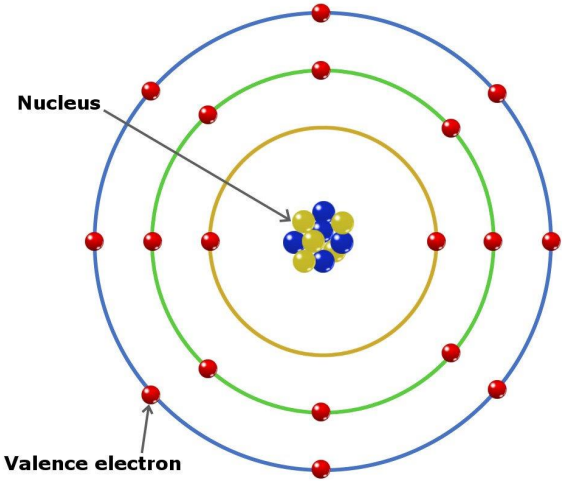
Parts of an Atom

Atoms are made up of a Nucleus containing Protons and Neutrons.
Orbiting around the Nucleus are Electrons.



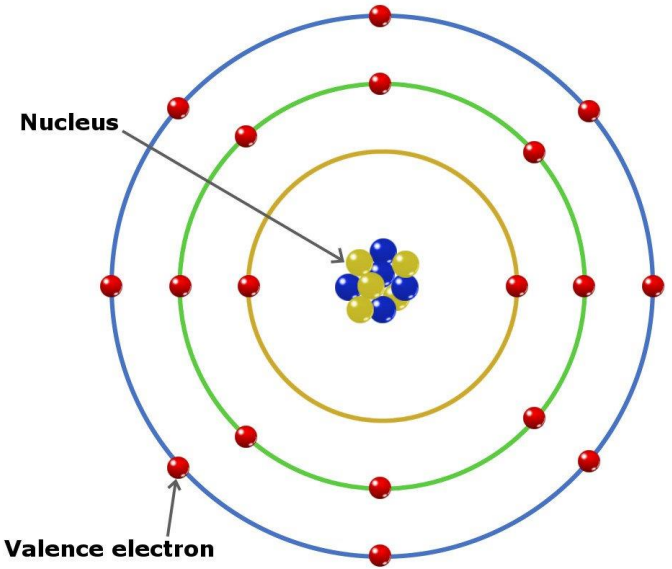
Parts of an Atom

The number of Electrons orbiting around the nucleus of an atom determine if the atom is considered a conductor, semiconductor, or insulator. Specifically, we want to look at the outermost ring. The electrons in this ring are called Valence Electrons.



Valence Electrons

Every atom can have a minimum of 1 and a maximum of 8 valence electrons orbiting in the outmost ring.



Conductors Semiconductors Insulators

If the outer ring is full of valence electrons with 8, that atom is considered stable – meaning whatever the material that atom is a part of can not accept current to travel into it.

Atoms with a full outer ring of valence electrons are considered to be the best insulators. Materials with atoms containing 6 and 7 valence electrons are still considered insulators.

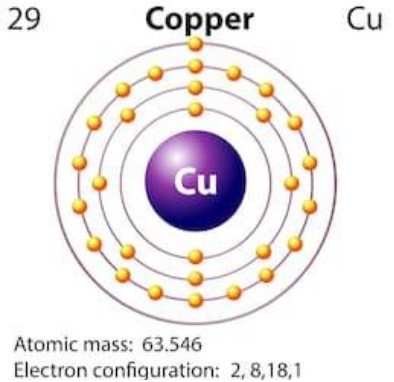
Conductors Semiconductors Insulators

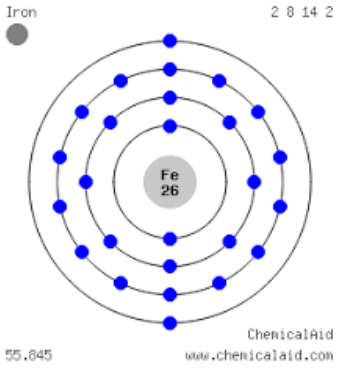
If the outer ring is missing many valence electrons, that atom is considered unstable – meaning whatever the material that atom is a part of can easily accept current to travel into it.

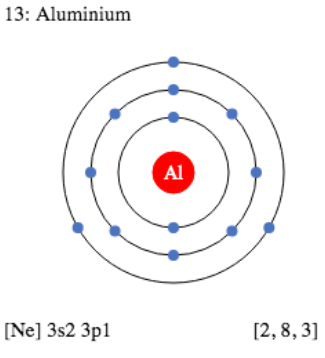
Atoms with 1 valence electron in their outer ring are considered to be the best conductors. Materials with atoms containing 2 or 3 valence electrons are still considered conductors.

Conductors Semiconductors Insulators

If we look at some materials we know to be good conductors at an atomic level we can see how this is true.



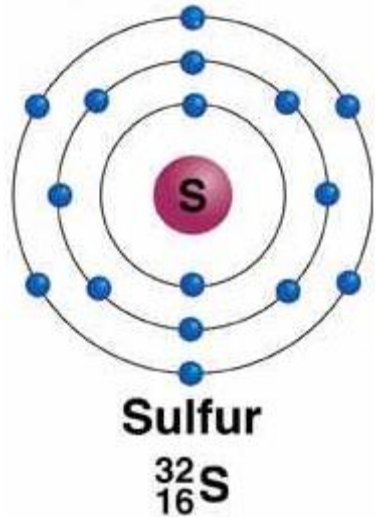




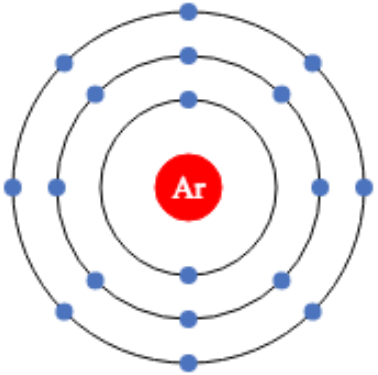
Copper, Iron, and Aluminum are all good conductors as you can see they have 1, 2 and 3 valence electrons respectively.

Conductors Semiconductors Insulators

Here we see atomic structures of some of the best insulators. Sulfur with 6 valence electrons and Argon gas with 8.



18: Argon

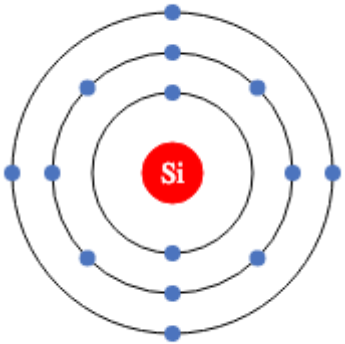


[Ne] 3s2 3p6 [2, 8, 8]

Conductors Semiconductors Insulators

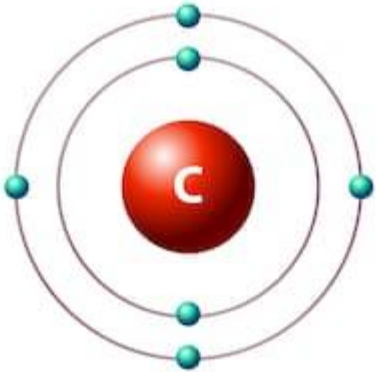
Semiconductors consist of materials like Silicone and Carbon with 4 valence electrons.

14: Silicon



[Ne] 3s2 3p2 [2, 8, 4]

6 **Carbon** C



Atomic mass: 12.011
Electron configuration: 2, 4

Review Questions

1. With 4 valence electrons - is Lead (Pb) closer to an insulator or a conductor?
2. Name the 3 parts of an atom.
3. Name 3 materials that make good conductors.
4. Name 3 materials that make good insulators.
5. What is it about the atomic structure of copper that makes it a good conductor?

Helpful Links

NDT Resource Center

BC Campus Open Textbook