

## **UNIT-IV**

# **Fundamentals of semiconductor devices and digital circuits**

Lecture 27

Prepared By:

Krishan Arora

Assistant Professor and Head

# What is a Semiconductor?



# What is a Semiconductor?



Microprocessors



Transistors

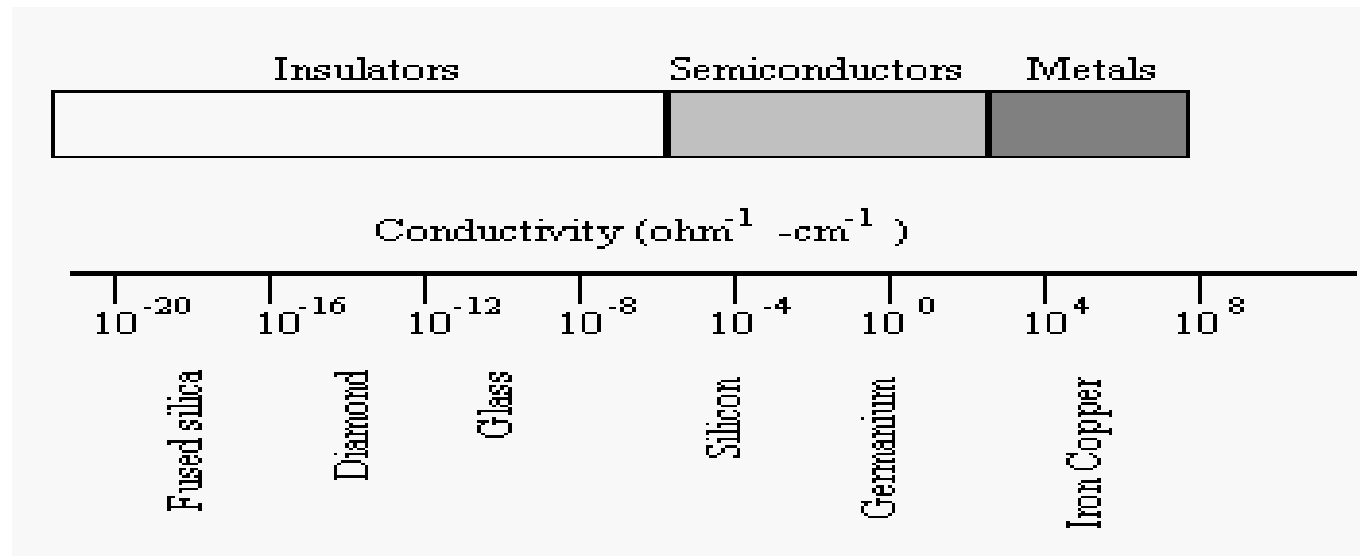


Capacitors



LED

# Range of Conductiveness

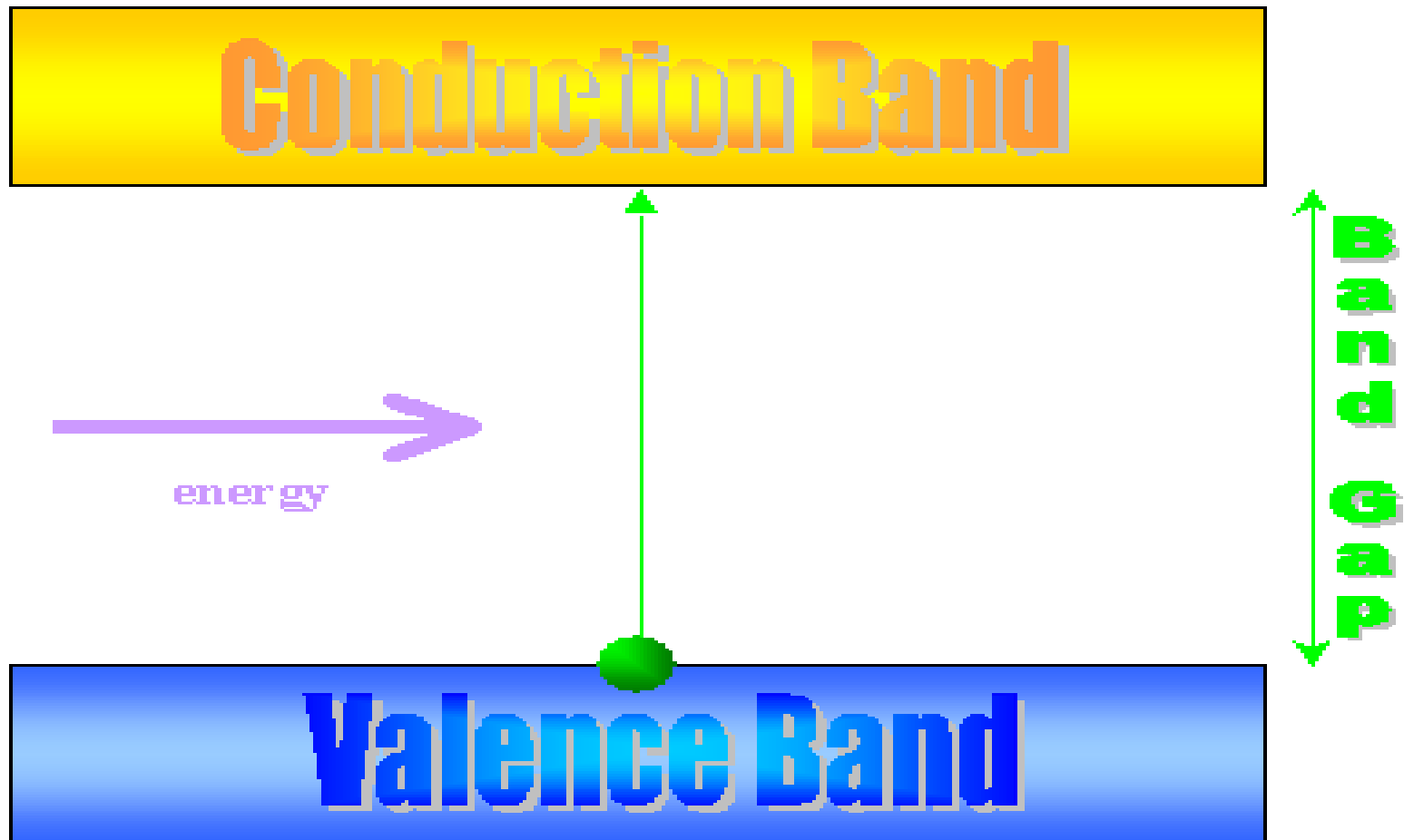


***The semiconductors fall somewhere midway between conductors and insulators.***

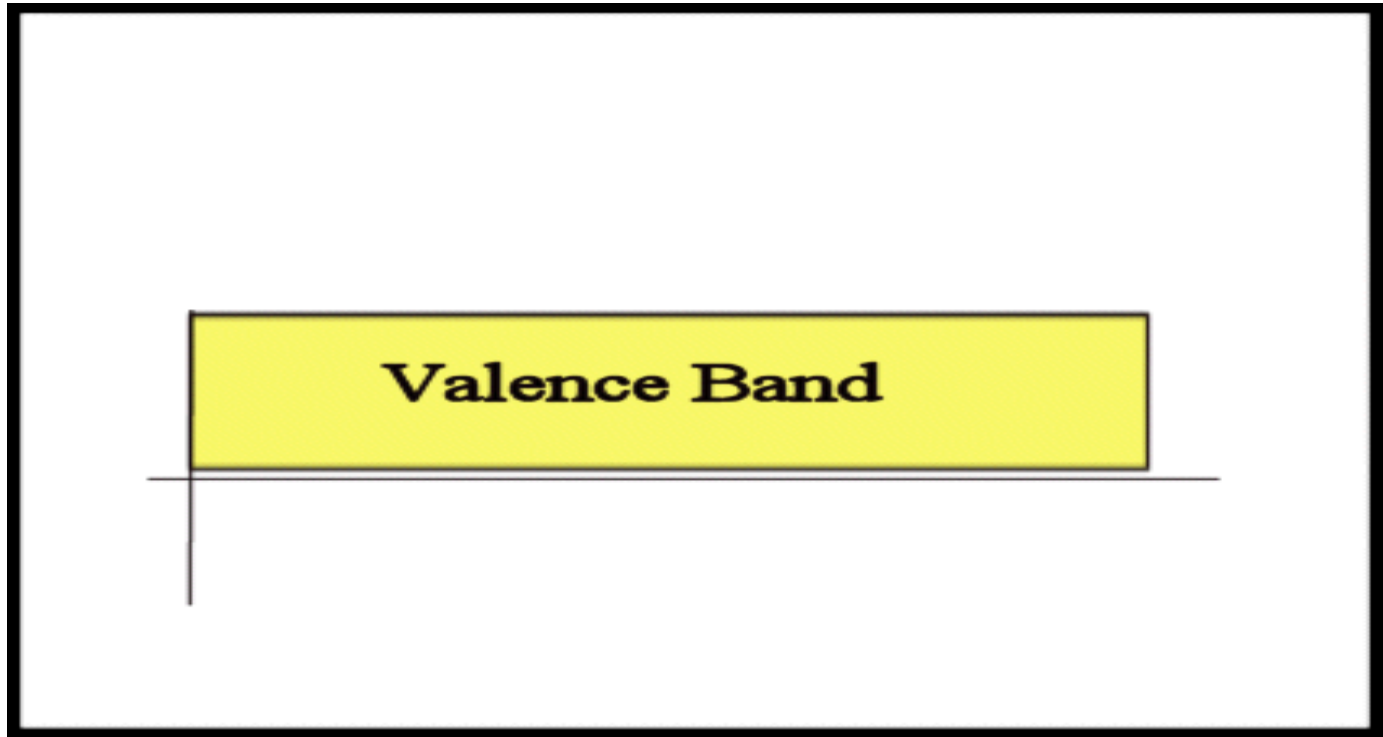
# Definition

- **Conductors:** The materials or the substances that allow the electricity to flow through them are known as conductors. Aluminium is used in cooking utensils, that absorb and store heat, and even they are used in packing the food.
- **Semiconductors:** Materials that have the characters to behave like conductors, as well as insulators under different conditions, are known as semiconductors. Semiconductors are used in power devices, light emitters (including solid-state lasers), optical sensors.
- **Insulators:** Insulators are the substances whose characters are different from the conductors, as they do not allow heat or electricity to pass through them. Woollen clothes and blankets that are used in winters to keep the body warm.

# Scientific Principle of Conduction



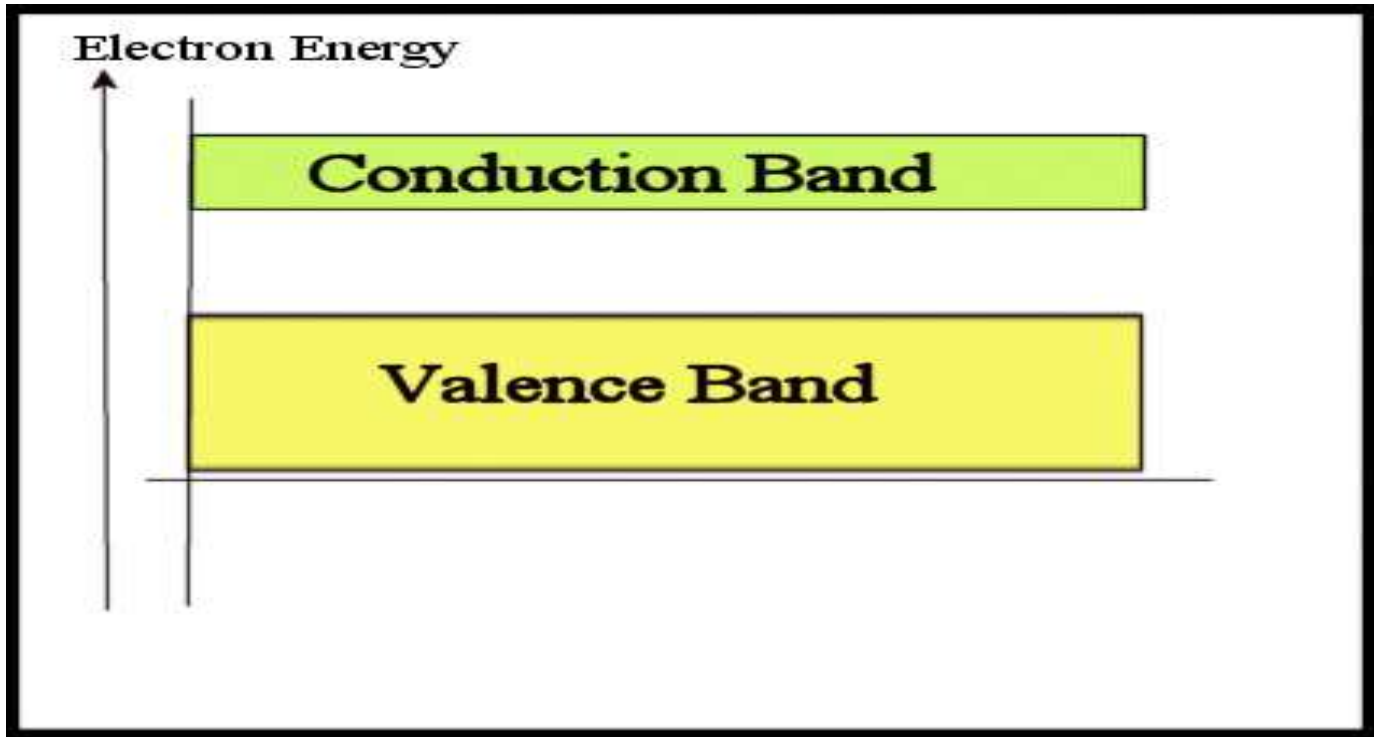
# Valence Band



*The highest occupied energy band is called the valence band.*

*Most electrons remain bound to the atoms in this band.*

# Conduction Band

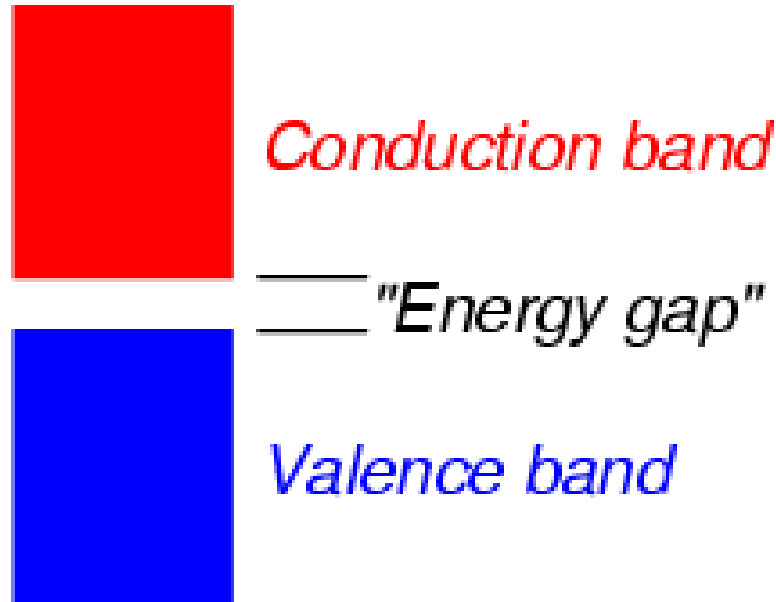


***The conduction band is the band of orbitals that are high in energy and are generally empty.***

***It is the band that accepts the electrons from the valence band.***



# Energy Gap



***The “leap” required for electrons from the Valence Band to enter the Conduction Band.***

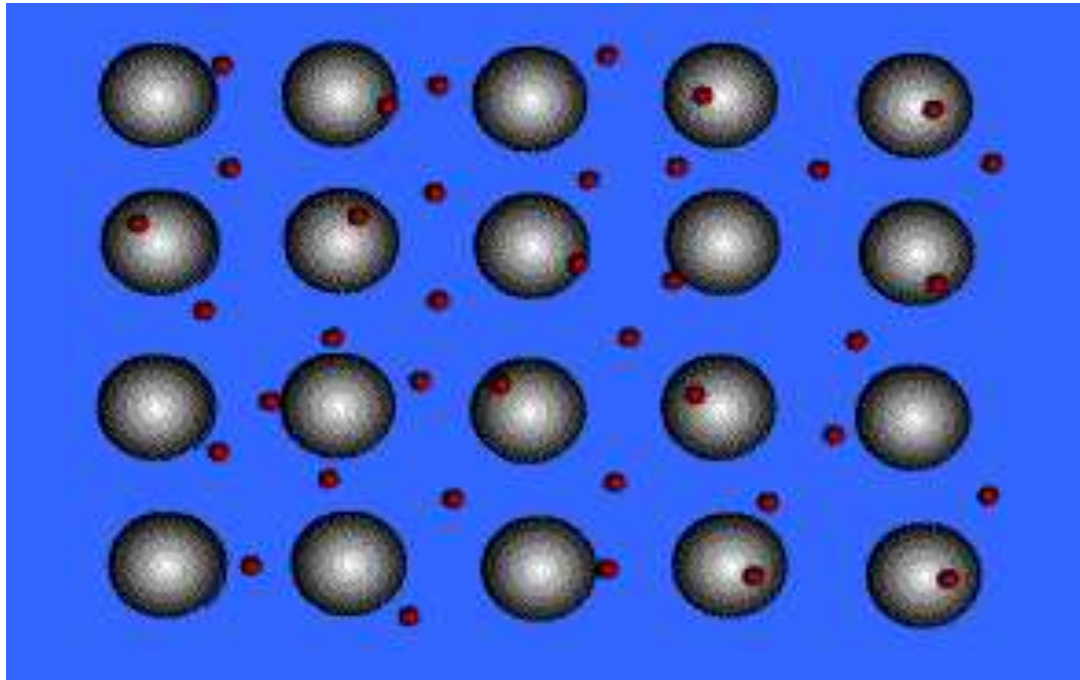
**Conduction Band**

**Band Gap**

**Valence Band**

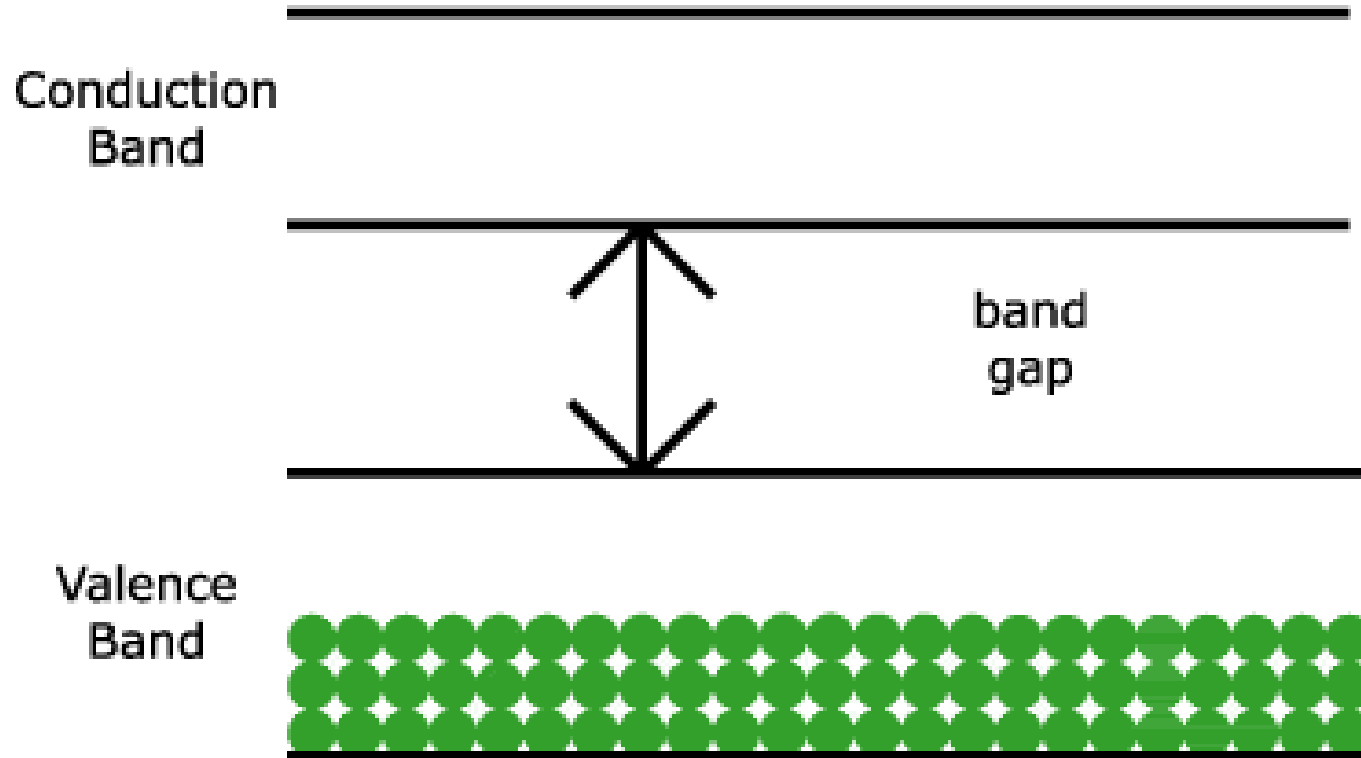
*LongIslandExchange.com*

# Conductors



*In a conductor, electrons can move freely among these orbitals within an energy band as long as the orbitals are not completely occupied.*

# Conductors

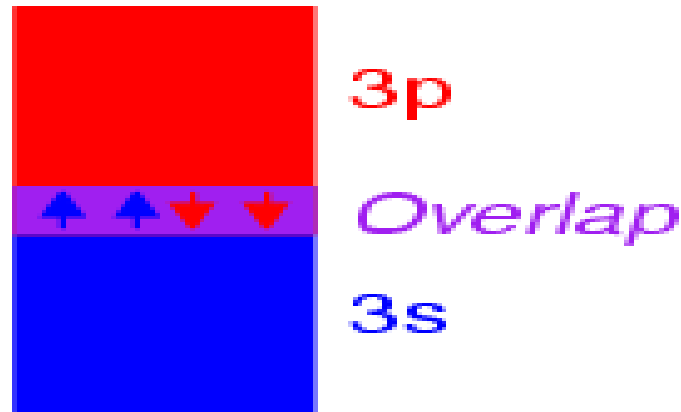


*In conductors, the valence band is empty.*



# Conductors

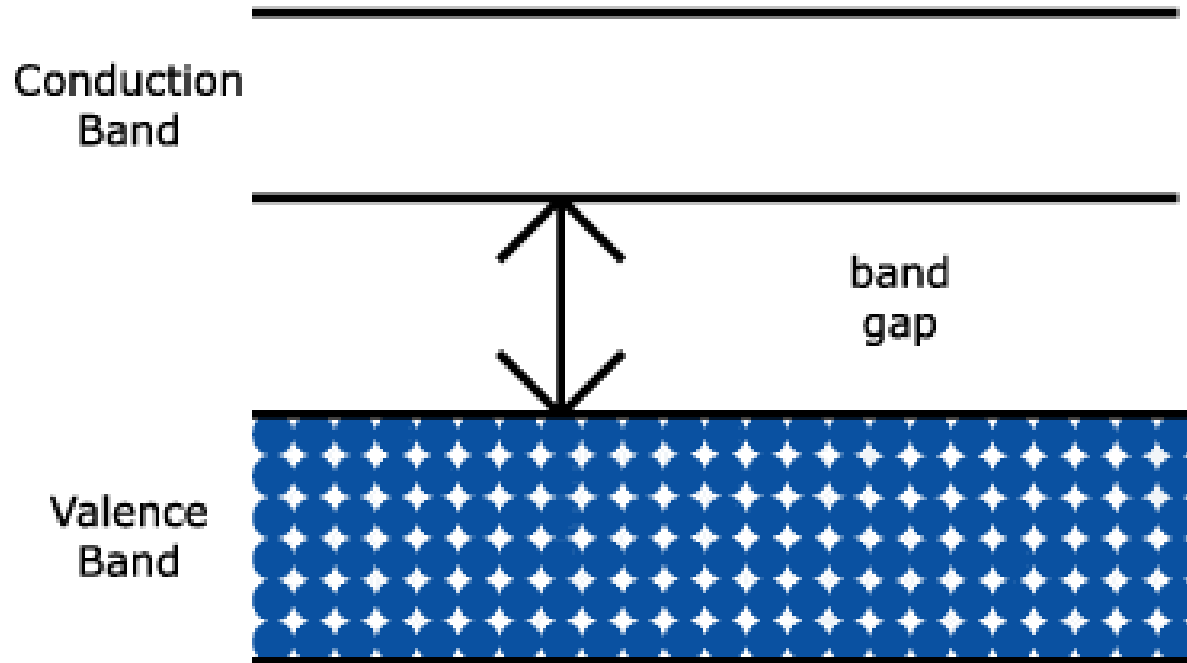
*Overlap permits  
electrons to freely  
drift between bands*



**Multitudes of atoms  
in close proximity**

***Also in conductors, the energy gap is nonexistent or  
relatively small.***

# Insulators



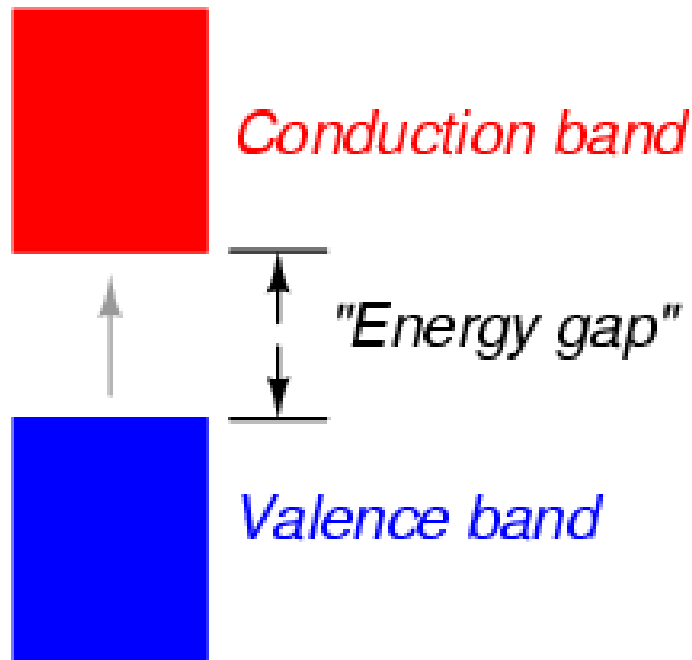
*In insulators, the valence band is full.*





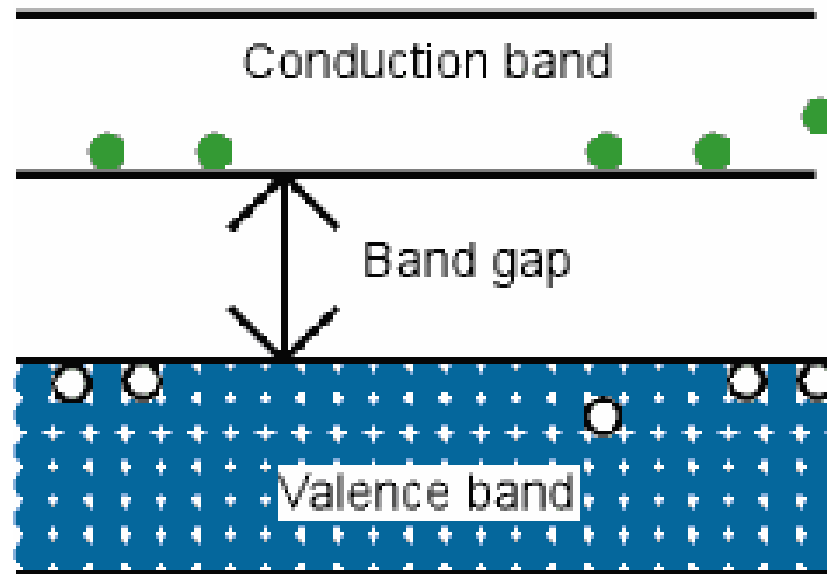


# Insulators



***Also in insulators, the energy gap is relatively large.***

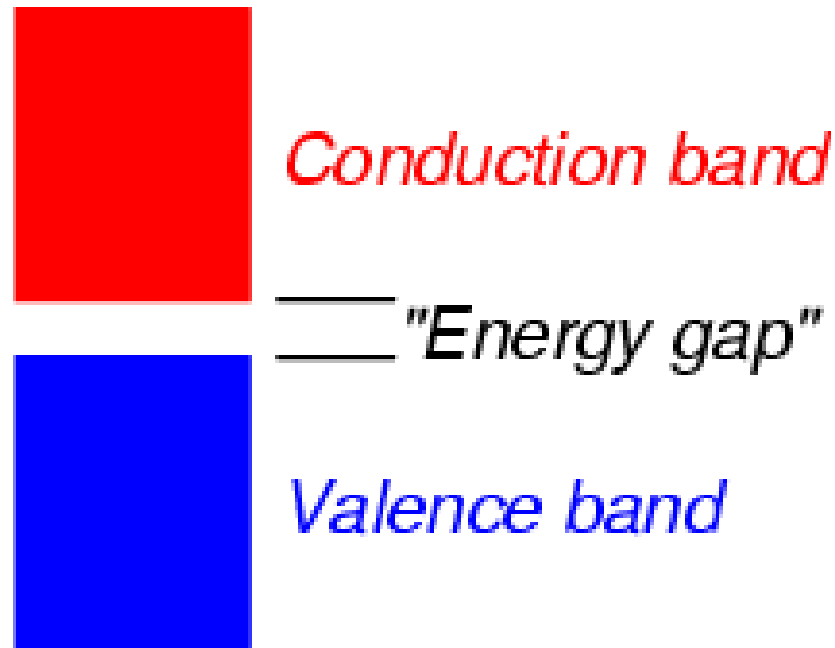
# Semiconductors



***In semiconductors, the valence band is full but the energy gap is intermediate.***

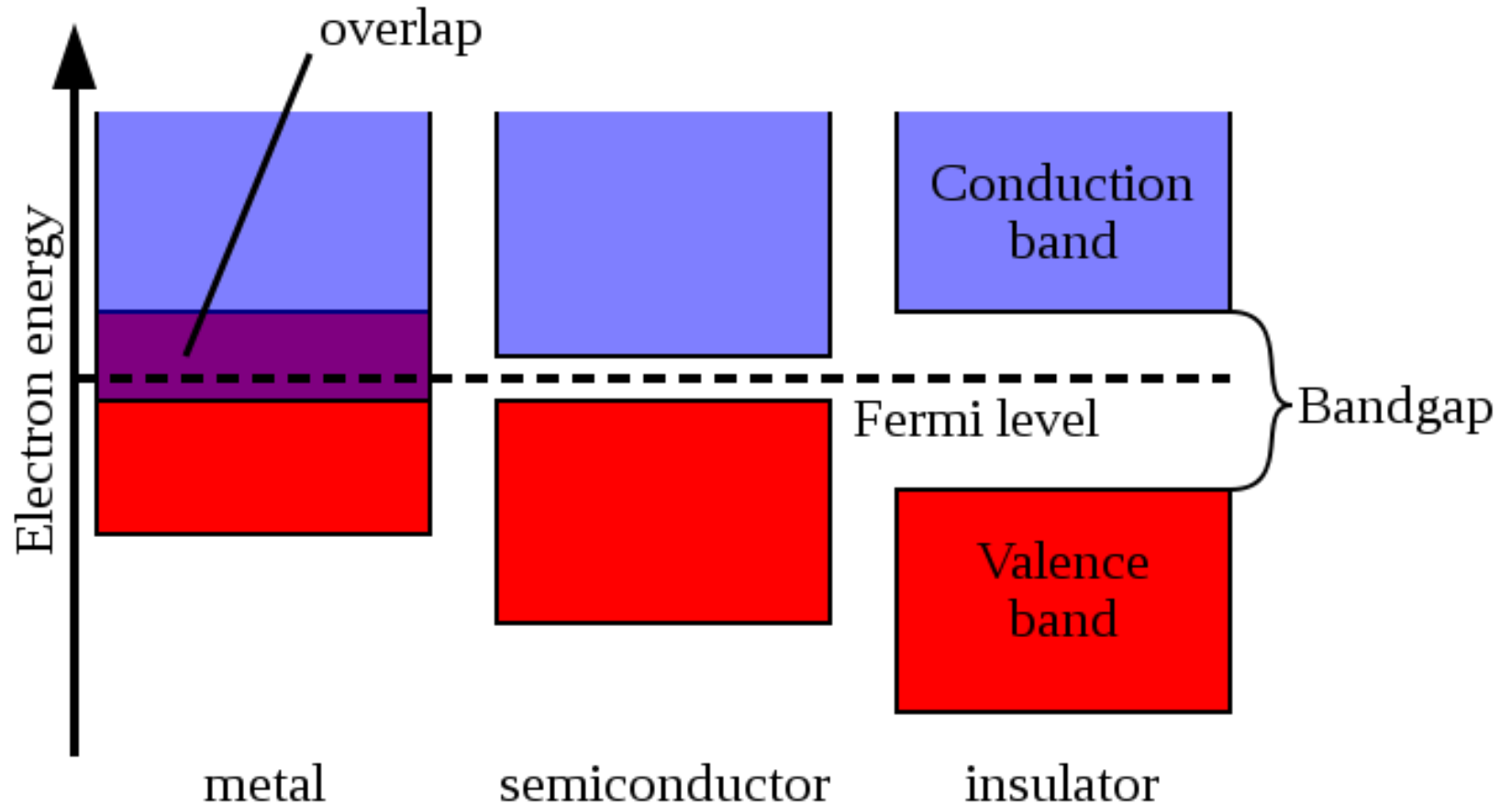


# Semiconductors



***Only a small leap is required for an electron to enter the Conduction Band.***

# Band Diagrams



# Quick Quiz (Poll 1)

The conduction band

- A. Is always above the forbidden energy level
- B. Is the region of free electrons
- C. Concentrates holes for the flow of current
- D. Is a range of energies corresponding to the energies of the free electrons

# Quick Quiz (Poll 2)

In semiconductor the forbidden energy gap lies

- A. Just below the conduction band
- B. Just above the conduction band
- C. Either above or below the conduction band
- D. Between the valence band and conduction band

## Quick Quiz (Poll 3)

**A semiconductor has generally ..... valence electrons.**

a)2

b)3

c)6

d)4