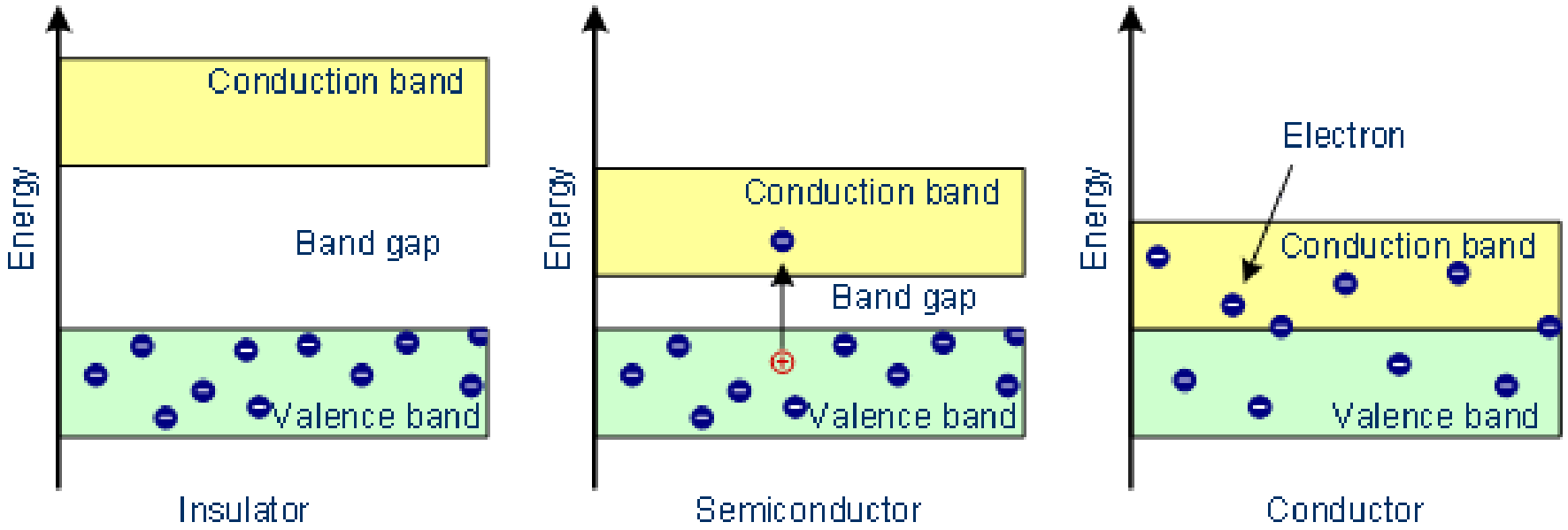
The band model

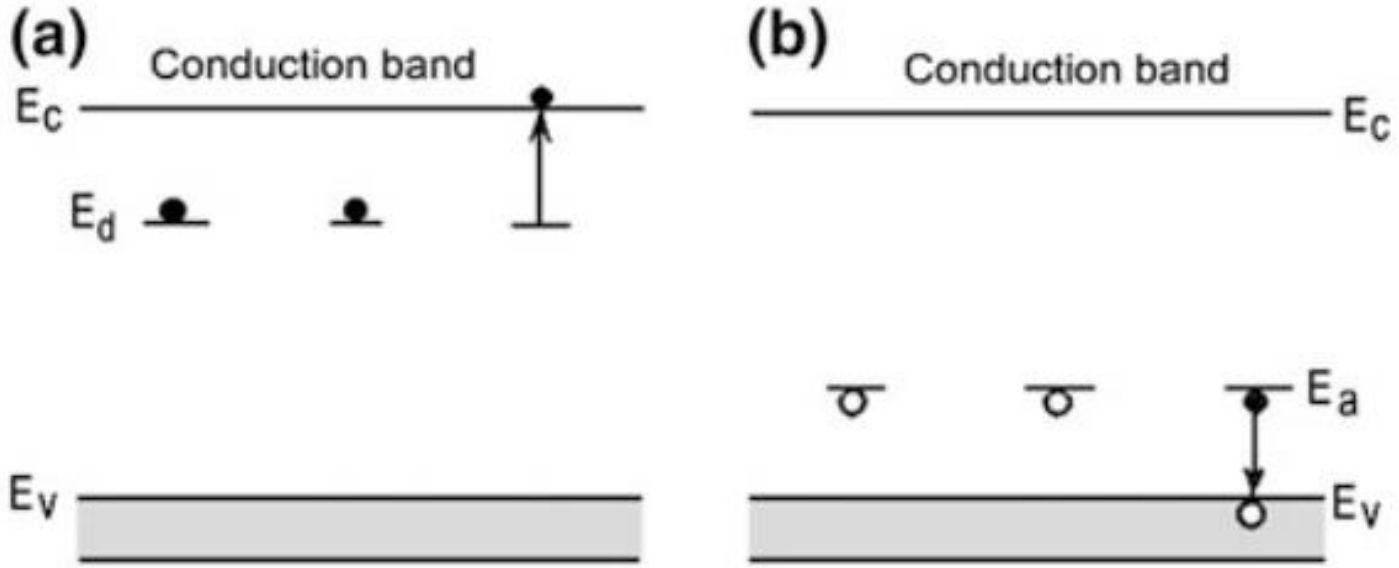
In conductors, the valence band is either not fully occupied with electrons, or the filled valence band overlaps with the empty conduction band. In general, both states occur at the same time, the electrons can therefore move inside the partially filled valence band or inside the two overlapping bands. In conductors there is no band gap between the valence band and conduction band.

In insulators the valence band is fully occupied with electrons due to the covalent bonds. The electrons can not move because they're "locked up" between the atoms. To achieve a conductivity, electrons from the valence band have to move into the conduction band. This prevents the band gap, which lies in-between the valence band and conduction band. Only with considerable energy expenditure (if at all possible) the band gap can be overcome; thus leading to a negligible conductivity.



Types of Semiconductors

The energy bands of the donor and acceptor atoms are shown to lie between Ec and Ev. It was stated that an electron cannot have energy states in this region; hence the name 'forbidden band'. This may appear contradictory. It may be clarified that the energy range from Ev to Ec is forbidden for the electrons of the host crystals and not for the impurity electrons.



Energy level diagram of a semiconductor containing a donor impurities at energy level Ed and (b) acceptor impurities at energy level Ea