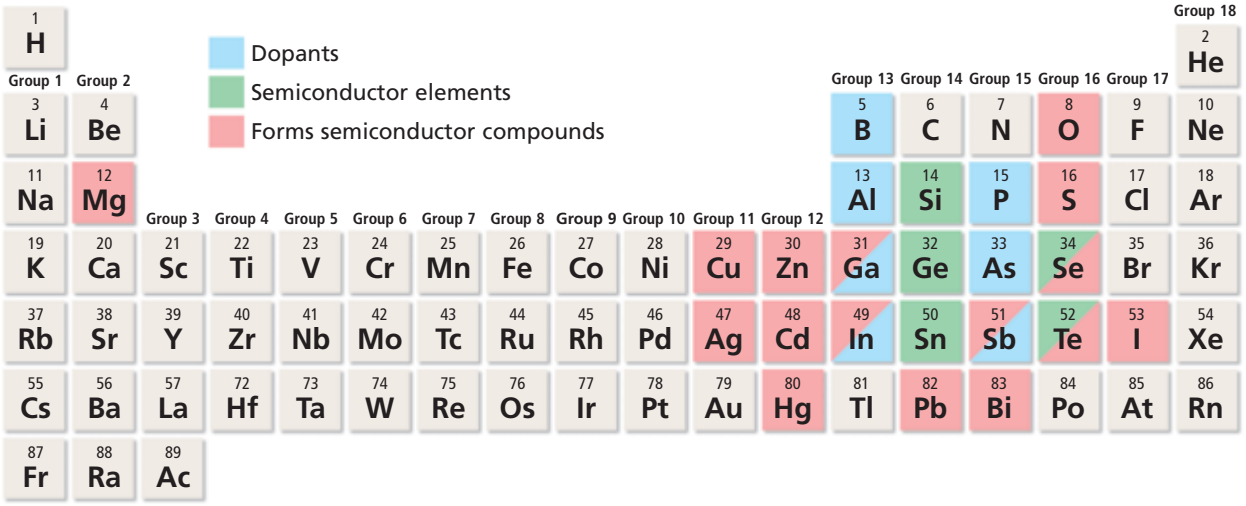
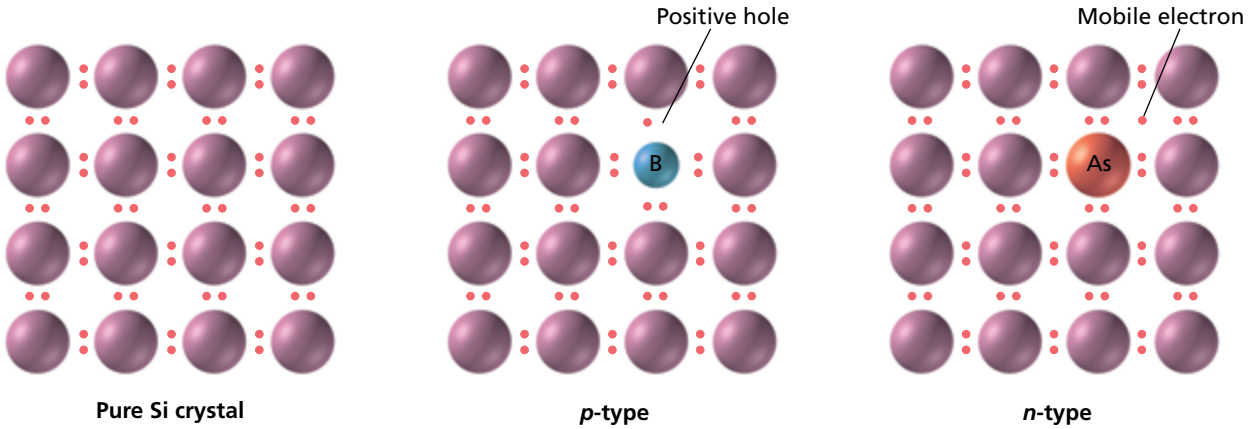


Semiconductor elements and dopants fall in the metalloid region of the periodic table. Semiconductor compounds often contain metals.

and a boron atom is a hole that a free electron can occupy. Because this hole "attracts" an electron, it is viewed as if it were positively charged. Semiconductors that are doped with boron, aluminum, or gallium are *p-type semiconductors,* the *p* standing for "positive." P-type semiconductors conduct electricity better than pure silicon because they provide spaces that moving electrons can occupy as they flow through the material.

Doping silicon with phosphorus or arsenic produces the opposite effect. When phosphorus is added to silicon, it forms four bonds to silicon atoms and has a nonbonding electron left over. This extra electron is free to move through the material when a voltage is applied, thus increasing its conductivity compared with pure silicon. These extra electrons have a negative charge. Therefore, the material is an *n-type semiconductor*. Compare these two types of semiconductors in the models below.



Each silicon atom in the pure crystal is surrounded by four pairs of electrons. The p*-type semiconductor model contains an atom of boron with a hole that an electron can occupy. The* n*-type semiconductor model contains an atom of arsenic, which provides the extra electron that can move through the crystal.*