

## Nucleophiles, Electrophiles, and Leaving Groups

Nucleophiles, electrophiles and leaving groups are the key players in mechanisms (in addition to acids and bases). Here are their definitions.

**Nucleophiles** Literally, a "nucleus lover," a species looking for a nucleus which is a positive charge. *Nucleophiles have electrons which they are willing to use to make new bonds to electrophiles. In other words, they are Lewis bases.* They may or may not be negatively charged. Many of them have lone pairs but not all. Nucleophilicity increases going down the periodic table, so for example RSH is more nucleophilic than ROH. Some nucleophiles are also Brønsted bases, which can complicate their behavior (e.g.  $\text{HO}^-$  vs.  $\text{H}_2\text{O}$ , both of which are oxygen nucleophiles but one is a strong base too).

**Electrophiles** Literally, a "electron lover," a species looking for electrons. *Electrophiles are able to accept electrons in the form of a new bond from a nucleophile. In other words, they are Lewis acids.* Therefore electrophiles must have an atom with an empty/available orbital to accept the new electrons/bond. Sometimes you can only see this empty orbital via a resonance form: compare  $\text{H}^+$  to  $\text{H}_2\text{C}=\text{O}^+\text{H}$ ; the latter species is electrophilic on carbon not oxygen. Sometimes the empty orbital is not completely apparent, as it is formed and filled as the reaction proceeds (primarily the  $\text{S}_{\text{N}}2$  mechanism).

**Leaving Groups** Literally what it says: a group that leaves a molecule. Sometimes they depart on their own, sometimes they get a bit of help. *Good leaving groups are conjugate bases of strong acids.*