Lewis acids and bases

Definition of Lewis acids and bases:
→A Lewis acid is an electron pair acceptor. (we write A)
→A Lewis base is an electron pair donator. (we write IB, where "I" is the lone pair)

A comparison of the acid and base definition of Lewis with the definition given by Brønsted shows the advantage of the Lewis definition. According to Brønsted an acid is a proton donator. With the definition given by Lewis we can say that a proton is always an electron pair acceptor and therefore a Lewis acid. Hence a Brønsted acid will always donate a Lewis acid. The great advantage of the Lewis-definition is, that it can also be applied to aprotic systems.

Molecules with an incomplete octet can be a Lewis acid. Examples are the BF_3 and the $AlCl_3$ molecules. $AlCl_3$ dimerises to Al_2Cl_6, where the $AlCl_3$ acts as Lewis acid (the Al-atom) and as Lewis base (one of the chlorines of the molecules, respectively).
Metal cations can also be a Lewis acid. It is obvious to see that they can accept an electron pair.
Molecules with a complete octet can act as Lewis acid as well. These molecules have to rearrange their valence electrons to accept an additional electron pair. An example for this type is the reaction of CO_2 and OH^-.
$CO_2 + OH^- \rightarrow HCO_3^-$
Molecules that can expand their valence shell can also accept additional electron pairs and can therefore be a Lewis acid. An example is the formation of the $[SiF_6]^{2-}$-complex:
$SiF_4 + 2\ F^- \rightarrow [SiF_6]^{2-}$.

There are three fundamental types of reaction for Lewis acids and bases:

→ **complex-formation:**
A + IB → A-B
Here two molecules react to one. All examples above are of this type.

→ **displacement reaction:**
A-B + IB' → IB + A-B'
At this type of reaction one base drives out another base from the molecule. An example is the following reaction:
$(H_3C)_2O\text{-}BF_3 + NH_3 \rightarrow (H_3C)_2O + F_3B\text{-}NH_3$
Also remarkable is that all Brønsted transfer reactions are of this type. An example would be the dissociation of HCl:
$HCl + H_2O \rightarrow Cl^- + H_3O^+$
But it is also possible, that one acid drives out another acid from the molecule:
B-A + A' → A'-B + A
An example for this type is the reaction of ammonium chloride and BF_3:
$NH_4Cl + BF_3 \rightarrow F_3B\text{-}NH_3 + HCl$

→ **metathesis reaction:**
A-B + A'-B' → A-B' +A'-B
A metathesis reaction is an interchange of partners. An example is the following reaction:
$(H_3C)_3SiI + AgBr \rightarrow (H_3C)_3SiBr + AgI$