Table **L** Common Bases: **$NH_{3\ (aq)}$** = "ammonia water"

According to Arrhenius, Bases $\xrightarrow{H_2O}$ $OH^-_{(aq)}$

How does ammonia do this?? We need an alternate theory to explain A/B behavior?

Aim: What is an alternate theory explain A/B behavior?

1st, take the H_2O out of the (aq) and react it with NH_3.

$$NH_3 + H_2O = NH_4^+ + OH^-$$

2nd, notice which species gains or loses H^+.

$$NH_3 + H_2O = NH_4^+ + OH^-$$

According to an alternate theory (aka Bronsted- Lowry Theory):

1) A/B reactions involve the **transfer of protons (H^+).** The species (substance) that donates (loses) an H^+ is the ACID; the species that accepts (gains) an H^+ is the BASE.

$$NH_3 + H_2O = NH_4^+ + OH^-$$

Base	**Acid**
gains **H^+**	loses **H^+**
proton	proton
acceptor	**donor**

(In this case, since the H_2O is more willing to donate a H^+ than accept a H^+, it acts as an acid. On the other hand, since the NH_3 is more willing to accept a H^+ than donate a H^+, it acts as a base)

2) Whether a substance acts as an acid or a base depends on what it reacts with. (In other words, A/B designations are relative.)

$$\underset{A}{NH_3} + \underset{B}{O^{-2}} = OH^- + NH_2^-$$

3) Since A/B reactions are reversible, in every A/B reaction there are two acids and two bases.

$$\underset{B}{NH_3} + \underset{A}{H_2O} \rightleftharpoons \underset{A}{NH_4^+} + \underset{B}{OH^-}$$

$$\underset{A}{NH_3} + \underset{B}{O^{-2}} \rightleftharpoons \underset{A}{OH^-} + \underset{B}{NH_2^-}$$

(NOTE: The direction favored by nature depends on the relative strengths of the acids and bases)

4) A **Conjugate A/B Pair** = is an acid/base couple that differ only by 1 H^+

-----Lose H^+-------->

<------Gain H^+ --------

ACID	**BASE**
NH_4^+	NH_3
OH^-	O^{-2}
H_3O^+	H_2O
HCl	Cl^-
HNO_3	NO_3^-
H_2SO_4	HSO_4^-
HCN	CN^-

Note: the charge changes because a hydrogen ion has a +1 charge; therefore, in going from the acid to the base, remove an H and subtract a +1 from the initial charge.

5) Amphiprotic – a specie that can gain or lose an H^+ depending upon what it reacts with. For example,

$$OH^- \text{ <---------- } H_2O \text{ ----------> } H_3O^+$$

Note: to be amphiprotic, it must have at least 1 H.