**WATER AS A SOLVENT**

Many substances, such as household sugar, dissolve in water. That is, their molecules separate from each other, each becoming surrounded by water molecules. When a substance dissolves in a liquid, the mixture is termed a solution. The dissolved substance (in this case sugar) is the solute, and the liquid that does the dissolving (in this case water) is the solvent. Water is an excellent solvent for many substances because of its polar bonds.

**ACIDS**

Substances that release hydrogen ions into solution are called acids.

\[
\text{HCl (hydrochloric acid)} 
\rightarrow 
\text{H}^+ + \text{Cl}^- 
\]

Many of the acids important in the cell are only partially dissociated, and they are therefore weak acids—for example, the carboxyl group (–COOH), which dissociates to give a hydrogen ion in solution:

\[
\text{–COOH} \rightarrow \text{H}^+ + \text{–COO}^- 
\]

Note that this is a reversible reaction.

**HYDROGEN ION EXCHANGE**

Positively charged hydrogen ions (H\(^+\)) can spontaneously move from one water molecule to another, thereby creating two ionic species:

\[
\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^- 
\]

Since the process is rapidly reversible, hydrogen ions are continually shuttling between water molecules. Pure water contains a steady-state concentration of hydrogen ions and hydroxyl ions (both 10\(^{-7}\) M).

**BASES**

Substances that reduce the number of hydrogen ions in solution are called bases. Some bases, such as ammonia, combine directly with hydrogen ions.

\[
\text{NH}_3 + \text{H}^+ \rightarrow \text{NH}_4^+ 
\]

Other bases, such as sodium hydroxide, reduce the number of H\(^+\) ions indirectly, by making OH\(^-\) ions that then combine directly with H\(^+\) ions to make H\(_2\)O.

\[
\text{NaOH} \rightarrow \text{Na}^+ + \text{OH}^- 
\]

Many bases found in cells are partially dissociated and are termed weak bases. This is true of compounds that contain an amino group (–NH\(_2\)), which has a weak tendency to reversibly accept an H\(^+\) ion from water, increasing the quantity of free OH\(^-\) ions.

\[
\text{–NH}_2 + \text{H}^+ \rightleftharpoons \text{–NH}_3^+ 
\]