7.3: Dissolution of Ionic Compounds

A simple ionic compound, such as sodium chloride (NaCl) consists of a sodium cation and a chloride anion. Because these are oppositely charge ions, they are strongly attracted to each other. This attraction is non-specific and the sodium cation would also be strongly attracted to *any* anion. When an ionic compound dissolves in water, the individual cations and anions are completely surrounded by water molecules, but these water molecules are not randomly oriented. A sodium cation in water will be surrounded by water molecules oriented so that the negative end of the molecular dipole is in contact with the sodium cation. Likewise, the waters surrounding the chloride anion are oriented so that the positive end of the molecular dipole contacts the anion.When arranged like this, the charged poles of the water molecules *neutralize*, and thus *stabilize* the charges on the ions.

The ability of water to interact with and stabilize charge particles goes well beyond the water molecules that actually touch the ion. Surrounding the inner water shell is another shell of waters that will orient themselves so that their dipoles bind to the exposed dipoles from the inner shell. As the subsequent layers of water surround each other, the positive charge from the cation is *dispersed* or spread out over the whole group of interacting molecules. The cluster then becomes effectively *neutral* allowing the charged ion to exist free in solution, removed from its counter-ion (the chloride). The dynamic collection of water molecules surrounding an ion in solution is referred to as the **solvation shell** and it is the ability of water to solvate and stabilize ions that makes water such an important solvent, both in chemistry and in biology.

In addition to ionic compounds, water will also dissolve and stabilize most molecules that are polar, that is, if they possess a molecular dipole. The organic compound, methyl propionate, contains a highly polar carbon-oxygen double bond. The electrostatic potential map in the figure clearly shows the resulting molecular dipole and methyl propionate is quite soluble in water; 6.2 grams of methyl propionate will dissolve in 100 mL of water. The organic molecule propane, does not possess a significant molecular dipole and is only very slightly soluble in water.