

7.1: Hydrogen Bonding and the Properties of Water

Water is an amazing solvent, and has remarkable physical and chemical properties that make it the essential ingredient to life as we know it. The special properties of water come from the fact that the elements hydrogen and oxygen have differing electronegativities. In [Chapter 3](#) we learned that covalent bonds formed between atoms of differing electronegativity are polarized. Because electronegativity is a measure of how strongly a given atom attracts electrons to itself, the atom in the covalent bond with the highest electronegativity will tend to draw the bonding electrons towards itself, resulting in a bond that is electron-rich on one end and electron-poor on the other. Covalent bonds that are polarized are said to have a **dipole**, where the term **dipole moment** refers to the direction and magnitude of the charge separation.

Consider water. The electronegativities of hydrogen and oxygen are 2.20 and 3.44, respectively. That means that in each covalent bond, the electrons will be attracted towards the oxygen, leaving the hydrogen electron-poor. In [Chapter 3](#), we used a calculated electrostatic potential map to visualize the electron density around molecules. The map for water is shown to the left and is colored using red to indicate a high electron density and blue to show electron-poor regions. Because electrons carry a negative charge, this also means that the red regions of the molecule are anionic (negative) and that the blue regions are cationic (positive).

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