**Hydrogen bonding**, interaction involving a [hydrogen](https://www.britannica.com/science/hydrogen) [atom](https://www.britannica.com/science/atom) located between a pair of other atoms having a high [affinity for electrons](https://www.britannica.com/science/electron-affinity); such a bond is weaker than an [ionic bond](https://www.britannica.com/science/ionic-bond) or [covalent bond](https://www.britannica.com/science/covalent-bond) but stronger than [van der Waals forces](https://www.britannica.com/science/van-der-Waals-forces). Hydrogen bonds can exist between atoms in different [molecules](https://www.britannica.com/science/molecule) or in parts of the same molecule. One atom of the pair (the donor), generally a [fluorine](https://www.britannica.com/science/fluorine), [nitrogen](https://www.britannica.com/science/nitrogen), or [oxygen](https://www.britannica.com/science/oxygen) atom, is covalently bonded to a hydrogen atom (―FH, ―NH, or ―OH), whose [electrons](https://www.britannica.com/science/electron) it shares unequally; its high [electron affinity](https://www.britannica.com/science/electron-affinity) causes the hydrogen to take on a slight positive charge. The other atom of the pair, also typically F, N, or O, has an unshared electron pair, which gives it a slight negative charge. Mainly through electrostatic attraction, the donor atom effectively shares its hydrogen with the acceptor atom, forming a bond. Because of its extensive hydrogen bonding, [water](https://www.britannica.com/science/water) (H2O) is [liquid](https://www.britannica.com/science/liquid-state-of-matter) over a far greater range of temperatures that would be expected for a molecule of its size. Water is also a good [solvent](https://www.britannica.com/science/solvent-chemistry) for ionic [compounds](https://www.merriam-webster.com/dictionary/compounds) and many others because it readily forms hydrogen bonds with the solute. Hydrogen bonding between [amino acids](https://www.britannica.com/science/amino-acid) in a linear [protein](https://www.britannica.com/science/protein) molecule determines the way it folds up into its functional [configuration](https://www.britannica.com/science/configuration). Hydrogen bonds between nitrogenous bases in [nucleotides](https://www.britannica.com/science/nucleotide) on the two strands of [DNA](https://www.britannica.com/science/DNA) ([guanine](https://www.britannica.com/science/guanine) pairs with [cytosine](https://www.britannica.com/science/cytosine), [adenine](https://www.britannica.com/science/adenine) with [thymine](https://www.britannica.com/science/thymine)) give rise to the double-helix structure that is crucial to the transmission of [genetic](https://www.britannica.com/science/genetics) information.

When hydrogen is covalently bonded to a highly electronegative atom, such as fluorine, chlorine, oxygen, or nitrogen, the H atom has a partial positive charge, written Hδ+. Hδ+ is physically very small, so the density of charge on it is unusually high. Imagine another negative or electronegative atom, say on a different molecule, approaches the Hδ+; there will be mutual attraction, resulting in a particularly strong dipole-dipole attraction. This attraction is called a hydrogen bond. In general, hydrogen bonds are weaker than ionic and covalent bonds, but are stronger than van der Waals forces. van der Waals forces < hydrogen bonds < ionic and covalent bonds

Every water molecule can be hydrogen bonded to as many as four other water molecules. In water at room temperature, the average number of hydrogen bonds per water molecule is 3.6.

The random thermal movement of molecules ensures that the lifetime of any individual hydrogen bond in water is short, averaging only 10 picoseconds. However, the time to form a new bond is even shorter.

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**Hydrogen Bonding  
in Ammonia and Hydrogen Fluoride**

Fluorine and nitrogen are the most electronegative elements in their periodic table groups, and hydrogen bonding is observed in hydrogen fluoride and ammonia.

As in the case of water, hydrogen fluoride and ammonia's melting and boiling points are higher than the hydrides of heavier elements in their groups.

