

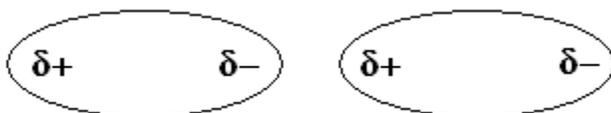
Quick note: Ionic interactions and covalent bonds are intramolecular forces – it takes a huge amount of energy to break these.

Example: The BP of NaCl is 1413°C

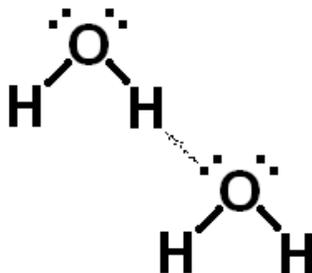
Intermolecular forces:

Interactions that hold the particles in a covalent substance together. There are three types of intermolecular forces that we need to consider.

- **Dipole-dipole forces:** Interactions in which polar molecules stick to each other like little magnets.



- The more polar the molecule, the stronger the attraction!
- **Hydrogen bonds:** A very strong dipole-dipole force that occurs when the lone pair electrons on O, F, or N interacts strongly with a hydrogen atom bonded to O, F, or N.
- Essentially, these bonds are so polar that the lone pair electrons on one molecule want to stick to the very positive hydrogen atoms on another molecule.



- The more hydrogen bonding that a molecule can do, the stronger this force is.
- Water has a MP of 0°C , while methanol has a MP of -98°C .

- **London Dispersion Forces (also called Van der Waals' forces):** When nonpolar molecules are attracted to one another via temporarily induced dipoles.

1. Essentially, nonpolar molecules stick together magnetically – like polar molecules. How can this work?



Initially, the electrons in two molecules are distributed randomly. δ^- δ^+



Random motions sometimes cause the electrons on one atom to bunch up on one side of the molecule



When another molecule comes close to it, its electrons align with it and they attract.

2. The bigger the molecules, the stronger the force (because, after all, there are more electrons to become unbalanced and interact with each other).
 - Neon has a MP of -249° , while F_2 has a MP of -220° C and methane has a MP of -183° C.

Why are intermolecular forces important?

- **The stronger the intermolecular force, the higher the melting and boiling points.**
- **Intermolecular forces cause surface tension in a liquid.**
 - Definition: Surface tension is the energy needed to increase the surface area of a liquid – the higher the surface tension, the harder it is for something to push through the surface of a liquid.
 - Stronger intermolecular forces cause the surface molecules to hold together more tightly, making the surface tension higher.
 - This is why some things that are heavier than water (i.e. water bugs, leaves, etc) don't fall through.
- **Intermolecular forces cause capillary action.**
 - Capillary action: The tendency of some liquids to rise when placed in a small tube – this explains why putting one edge of a paper towel will eventually cause the whole towel to get wet.
 - This happens because water molecules want to grab the surface of the walls of the tube with their intermolecular forces more than they want to grab each other. This causes them to move up the sides of the tube (away from each other).
 - This causes the meniscus.
- Ranking of intermolecular forces (strongest to weakest):
 1. Hydrogen bonding
 - Example: The BP of water is 100° C.
 2. Dipole-dipole forces
 - Example: The BP of H_2S is -59.6° C.
 3. London dispersion forces
 - Example: The BP of methane is -161.5° C.