Intermolecular Forces

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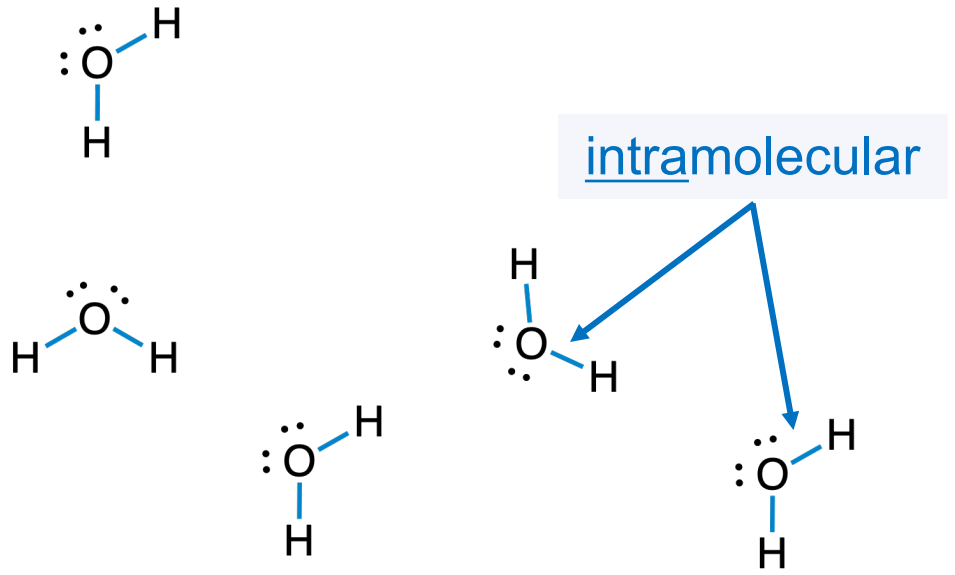
Introduction

Thus far, we have looked at intramolecular forces, which are the forces that hold or bond together atoms within in molecules.

In this regard, we have considered the Lewis model, VSEPR theory, valence bond (hybridization) theory, and molecular orbital theory to analyze chemical structures, molecular geometries, and the properties of molecules.



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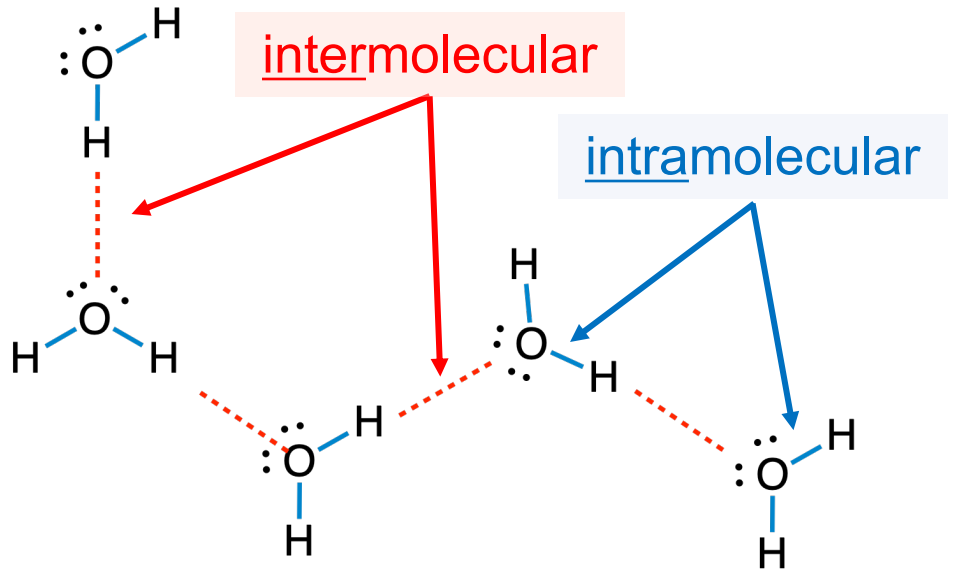
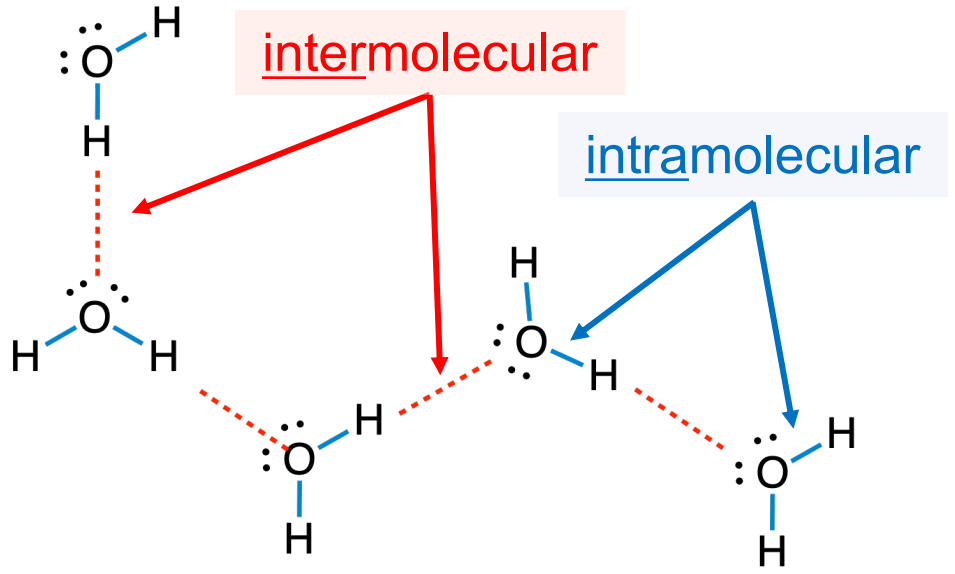


We will now explore intermolecular forces, the forces between molecules, which often give rise to many physical properties of substances.

Strength in number

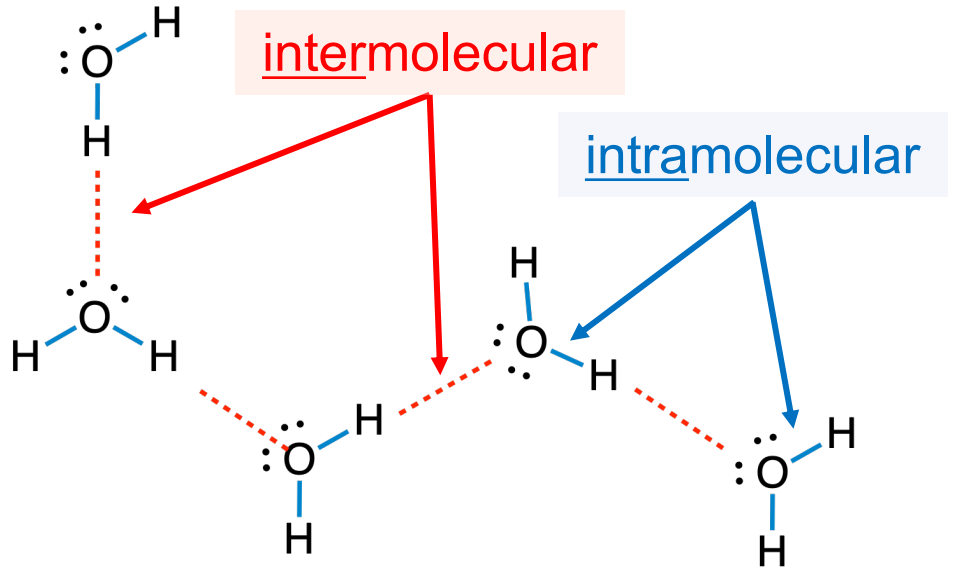
Intramolecular forces are typically very *strong* and act over fairly *short distances* (think about the general length of a bond).



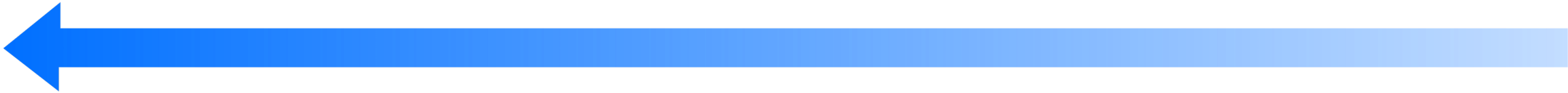
Strength in number

Intramolecular forces are typically very *strong* and act over fairly *short distances* (think about the general length of a bond).

Intermolecular forces are typically *weaker* and act over *larger distances*. While individually weaker than intramolecular forces, intermolecular forces are quite strong due to the *large number of interactions* (consider that we are often working with an Avogadro's number of molecules).



INTERMOLECULAR FORCES (IMFS): TYPES AND STRENGTHS



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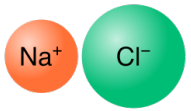

- Only for ionic compounds
- No other IMFs

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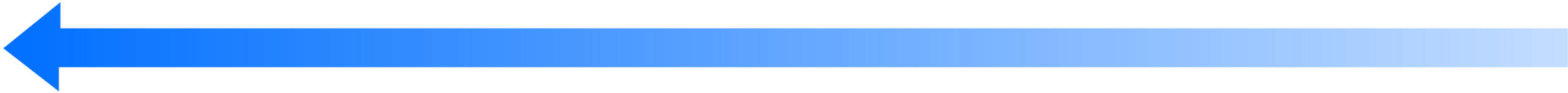

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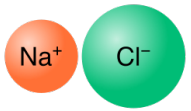

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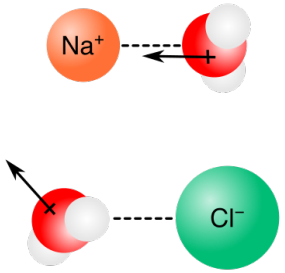

- IMF between an ionic compound and a polar molecule

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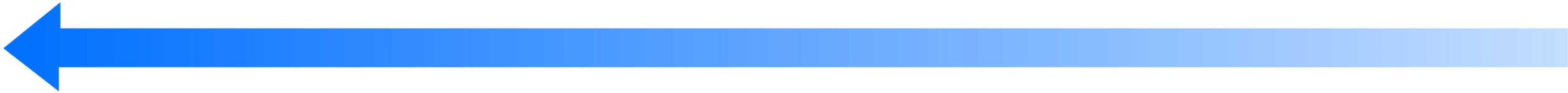

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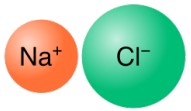

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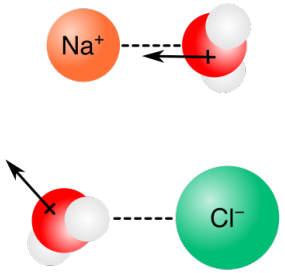

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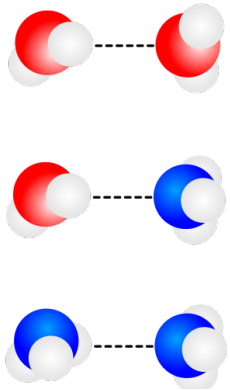
HYDROGEN BONDING



- IMF between two polar molecules
- **H** *bonded* to N, O, or F atom
- **H** *near* another N, O, or F atom

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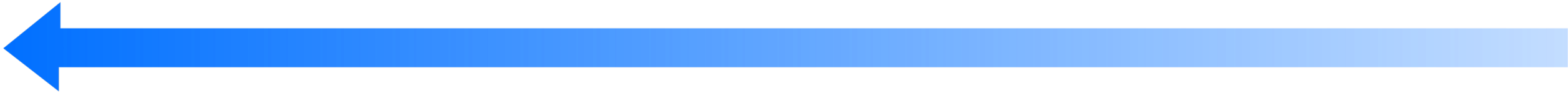

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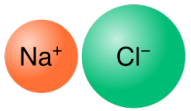

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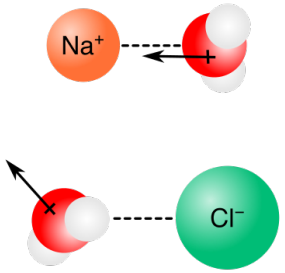

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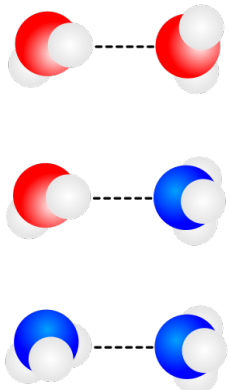

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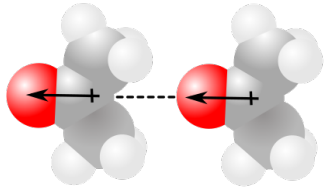

- IMF between two polar molecules
- Dipoles need to be oriented

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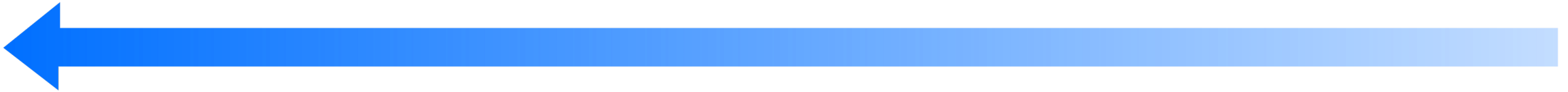

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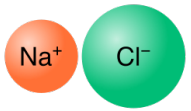

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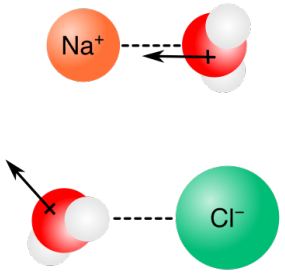

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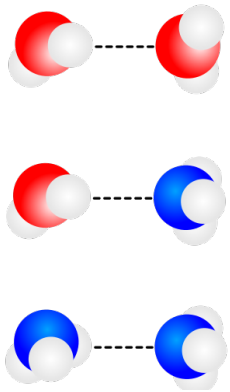

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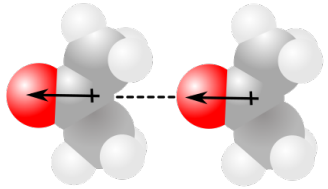

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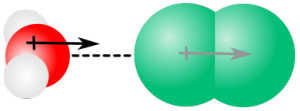

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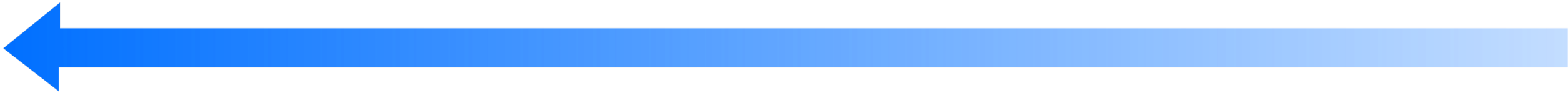

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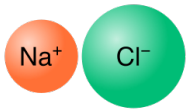

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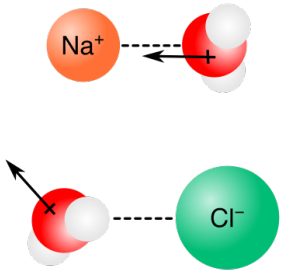

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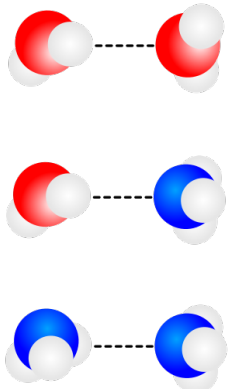

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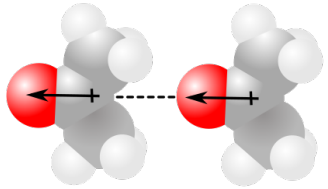

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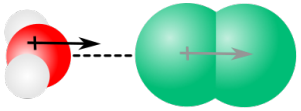
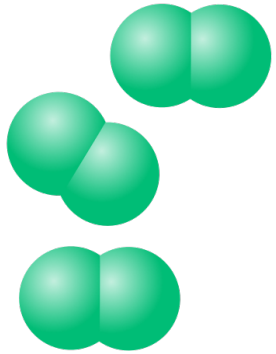


- IMF between a polar molecule and a nonpolar molecule

LONDON DISPERSION



- IMF between two nonpolar molecules
- Strength of dispersion forces proportional to mass and surface area
- More massive and more spread out molecules have stronger dispersion forces

INFLUENCE OF IMF TYPE/STRENGTH

Phases of matter: the stronger the intermolecular forces between molecules, the stronger the interactions between them.

STRONG IMFS	→	high melting point	high boiling point
WEAK IMFs	→	low melting point	low boiling point

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Solubility is determined by intermolecular forces between solute and solvent.

HAVE IMF	→	SOLUBLE
HAVE NO IMF	→	INSOLUBLE

Generally, polarity determines the IMFs and solubility.