

CHEM 101

# Intermolecular Forces



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## States of Matter

The fundamental difference between states of matter is the strength of the intermolecular forces of attraction

-The distance between particles

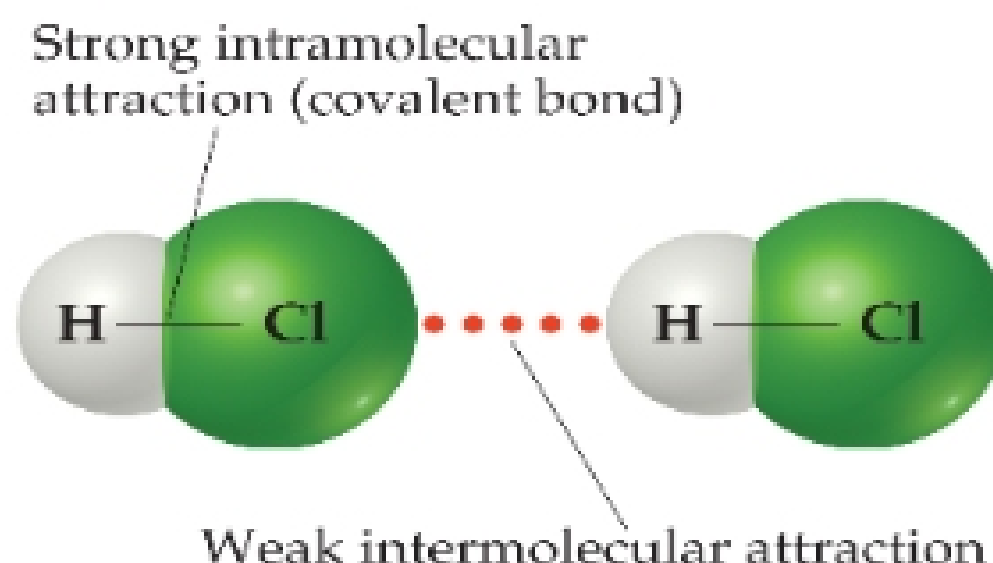
- Strong forces bring molecules closer together
- Solids and liquids are referred to as the condensed phases.

## Intermolecular Forces

Intermolecular forces describe the forces between atoms of separate molecules.

The strength of the intermolecular force governs whether a substance is a gas, liquid or solid.

## Intermolecular Forces



The intermolecular attractions between molecules are not nearly as strong as the intramolecular attractions (bonds) that hold compounds together

-Intermolecular attraction due to dipoles or attraction between ions and molecule

Many physical properties reflect intermolecular forces, like boiling points, melting points, viscosity, surface tension, and capillary action.

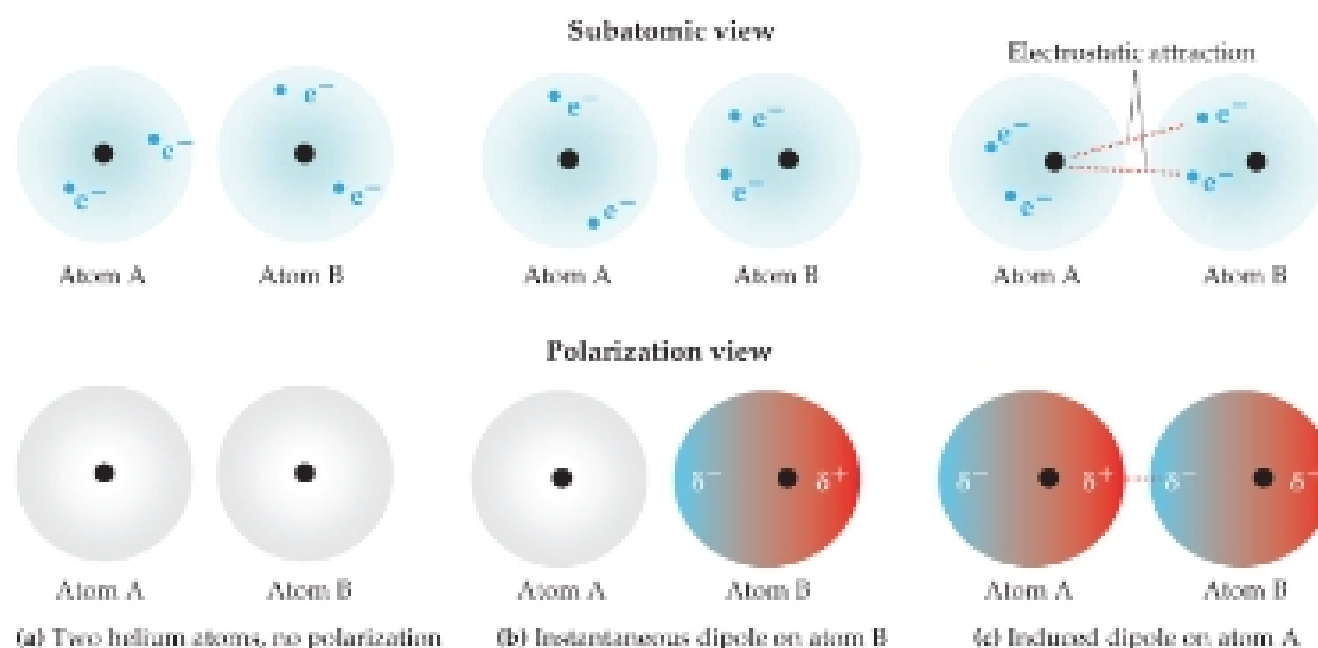
## Types of Intermolecular Force

Weakest to strongest forces

- Van der Waals forces
  - dispersion forces (or London dispersion forces) all molecules polar and non-polar
  - dipole-dipole forces neutral polar molecules
- Hydrogen bonding (a special dipole-dipole force) lone pair
- Ion-dipole forces pole molecules

## London Dispersion Forces

- Present in all molecules (polar and non-polar)
- Dispersion forces involve an alignment of induced dipoles. If the e- density of an atom moves to one side of the nucleus, a temporary dipole is created.
  - The tendency of an e- cloud to distort is called its polarizability
  - Induced dipole: dipole that creates dipoles in adjacent molecules creating attraction between the molecules.



Factors that affect the amount of dispersion force in a molecule:

- Number of e- present in an atom (more e-, more dispersion force) Force increases with increase in **Molar mass (Mm)**
- Shape of molecules with similar masses: force increases with **linearity**.

## Polarizability & Boiling Point

If something is easier to polarize, it has a lower boiling point.

Remember: This means less intermolecular force (smaller molecule: lower molecular weight, fewer e-).