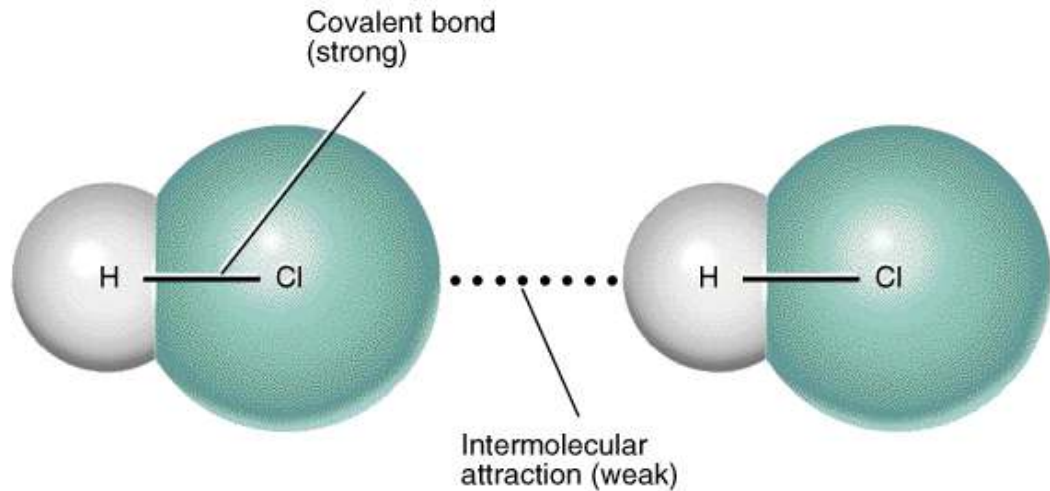


# Intermolecular Forces Notes

# Intermolecular Forces

- Intermolecular Forces: attraction *between* molecules
- Much weaker than chemical bonds



# Strength of Forces

- STRONGEST

- Covalent Bonds (400 kcal)
- Hydrogen Bonding (12-16 kcal)
- Dipole-Dipole Interactions (0.5-2 kcal)
- London Dispersion Forces (<1 kcal)

- WEAKEST

- kcal = kilocalorie (unit of energy stored in chemical bonds)

# London/Van der Waals

- London Dispersion Forces:

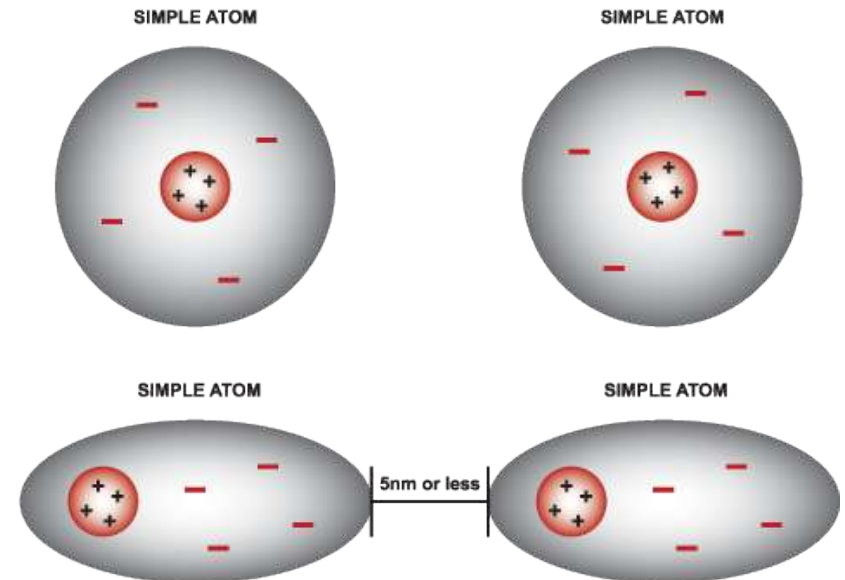
- Attraction due to the constant motion of electrons
  - Will cause temporary concentration of charge on one side of an atom/molecule
- Exist between ALL molecules

VAN DER WAALS' FORCES (VDW)  
DIAGRAM

KEY

+ POSITIVE NUCLEUS

— NEGATIVE CHARGED ELECTRON CLOUD

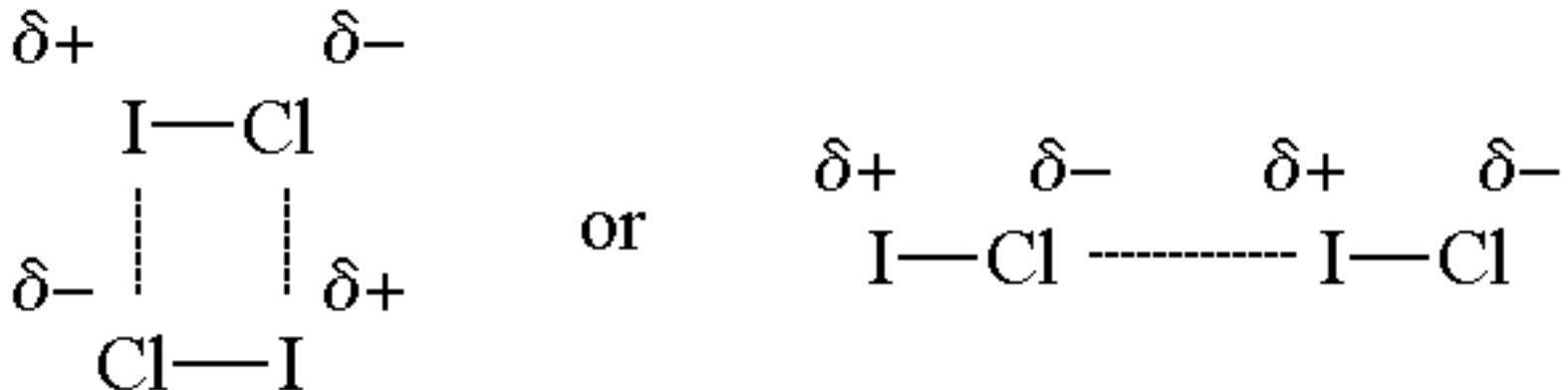


When two atoms come within 5 nanometers of each other, there will be a slight interaction between them, thus causing polarity and a slight attraction.

# Dipole

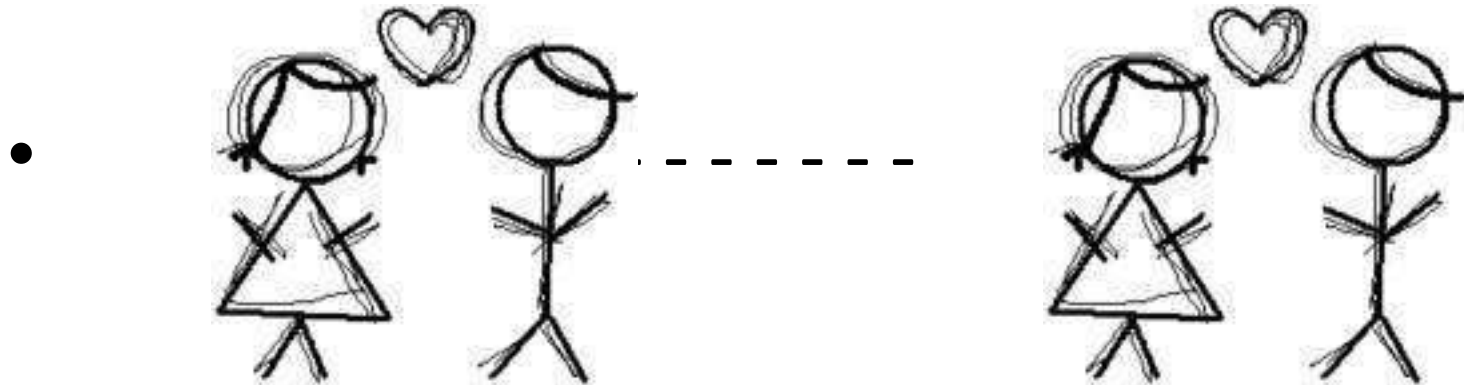
- Dipole-dipole:
  - Attraction between polar molecules

The squiggly symbol  
means a partial charge.



# An Analogy

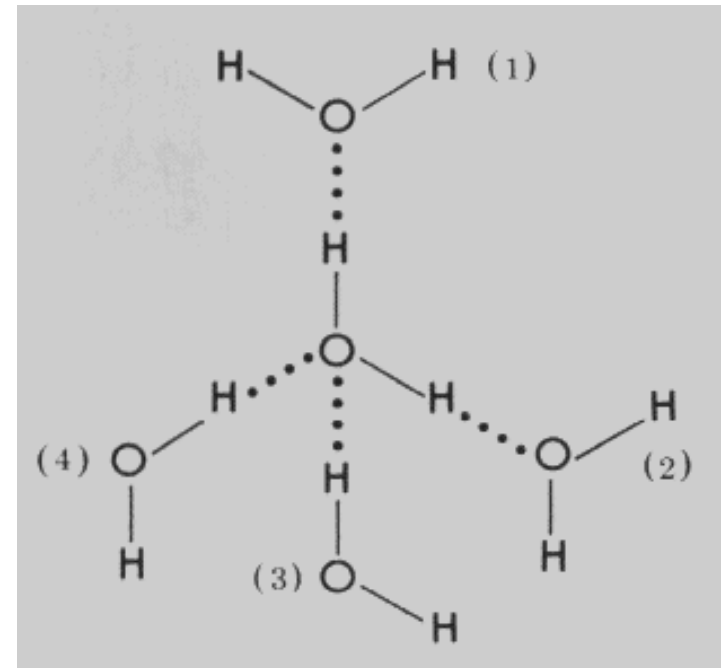
- Dipole-dipole attraction



- The two couples are very happy with each other, but the guy is attracted to the other girl.

# Hydrogen

- Hydrogen Bonding:
  - Stronger type of dipole-dipole interaction
  - Occurs only between molecules with lone pairs on center atom AND hydrogen bonded to F, O, or N
    - Hydrogen bonding is FON!



# Intermolecular Forces

Is the molecule polar?

Yes

No

Does the molecule have lone pairs on the center atom, with H bonded to F, O, or N?

London Dispersion Forces

Yes

No

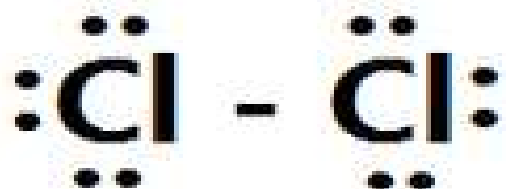
London Dispersion Forces  
Dipole-dipole  
Hydrogen bonding

London Dispersion Forces  
Dipole-dipole



# Intermolecular Forces Examples

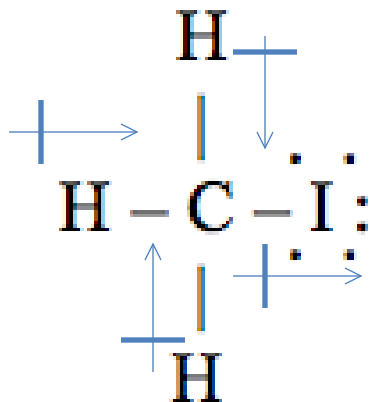
Cl<sub>2</sub>



- The molecule is **nonpolar**.
- This molecule has **London Dispersion Forces**.

# Intermolecular Forces Examples

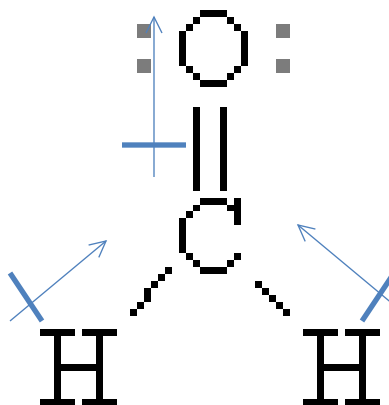
- $\text{CH}_3\text{I}$



- The molecule is **polar**.
- The central atom does not have lone pairs, and H is not bonded to F, O, or N.
- The molecule has **London and Dipole-dipole forces**.

# Intermolecular Forces Examples

- $\text{CH}_2\text{O}$



- The molecule is **polar**.
- The central atom does not have lone pairs, and H is not bonded to F, O, or N.
- The molecule has **London** and **Dipole-dipole forces**.

# Intermolecular Forces Examples

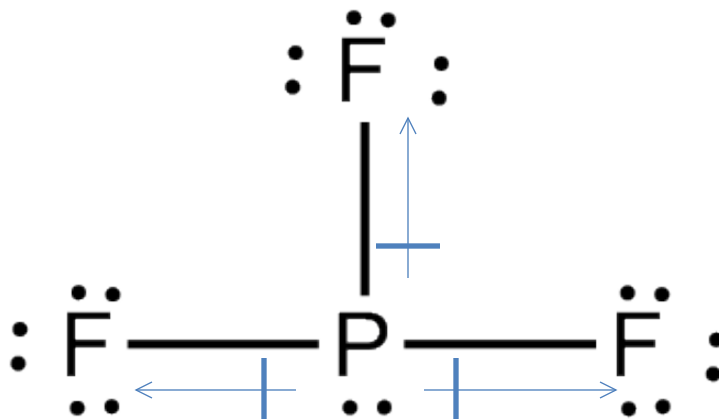
- $O_3$



- The molecule is **polar**.
- The central atom has a lone pair, but does not have H bonded to F, O, or N.
- The molecule has **London** and **Dipole-dipole forces**.

# Intermolecular Forces Examples

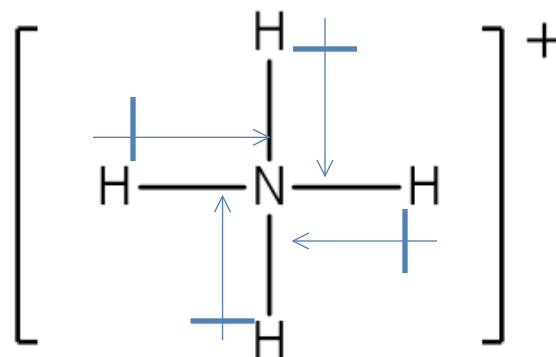
- $\text{PF}_3$



- The molecule is **polar**.
- The central atom has a lone pair, but does not have H bonded to F, O, or N.
- The molecule has **London** and **Dipole-dipole forces**.

# Intermolecular Forces Examples

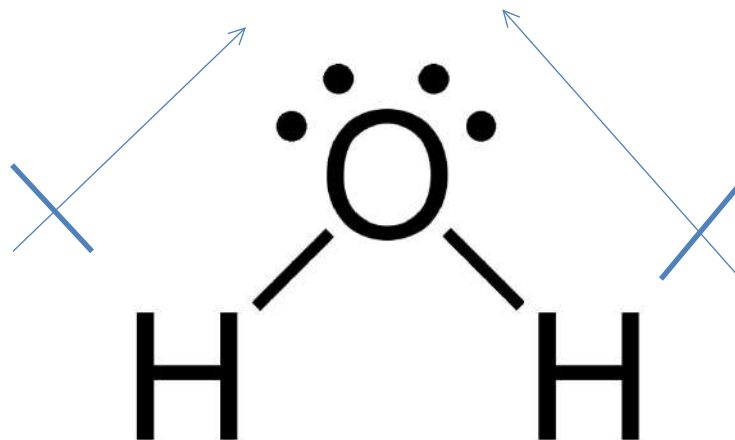
- $\text{NH}_4^+$



- The molecule is **nonpolar**...
- So even though H is bonded to N...
- This molecule has only **London Dispersion forces**.

# Intermolecular Forces Examples EXTRA

- $\text{H}_2\text{O}$



- The molecule is **polar**.
- There is a lone pair.
- Hydrogen is bonded to F, O, or N.
- This molecule has **London, Dipole-Dipole forces AND hydrogen bonding**.