N-21
Intermolecular Forces

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Target: I can identify the types of IMFs present in a molecule, and can use that to make predictions about the properties of a molecule.

Link to YouTube Presentation: https://youtu.be/6JedE3a9LrI

Vocabulary

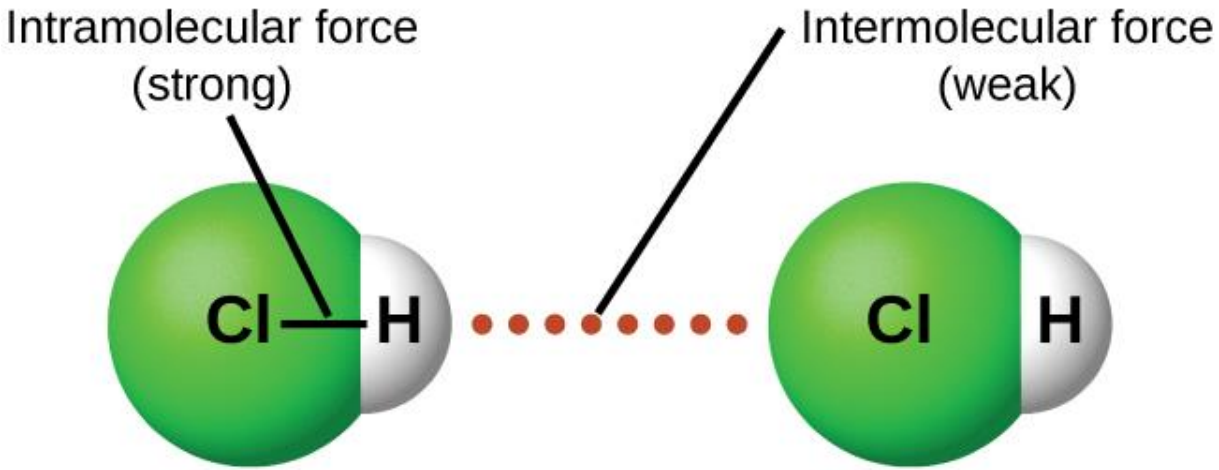
INTRAmolecular Forces

Forces holding together the atoms **INSIDE** a molecule or compound.

Types: Ionic forces, covalent forces

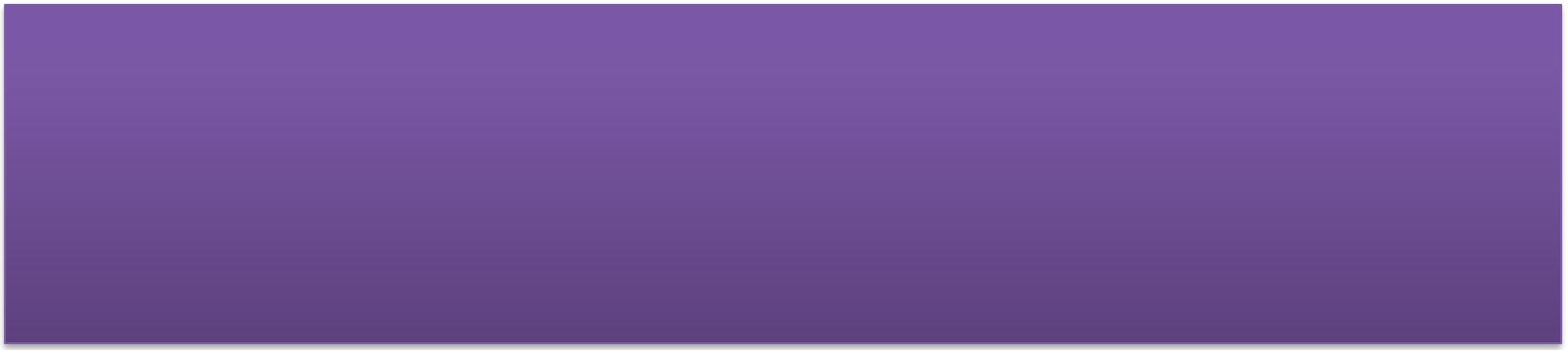
INTERmolecular Forces

Attractions or repulsions which act **between neighboring molecules**



Types of IMFs

INTER molecular forces (forces between neighboring molecules)



INTER molecular forces (forces between neighboring molecules)

London Dispersion < Dipole-dipole < Hydrogen bonding

WEAKEST

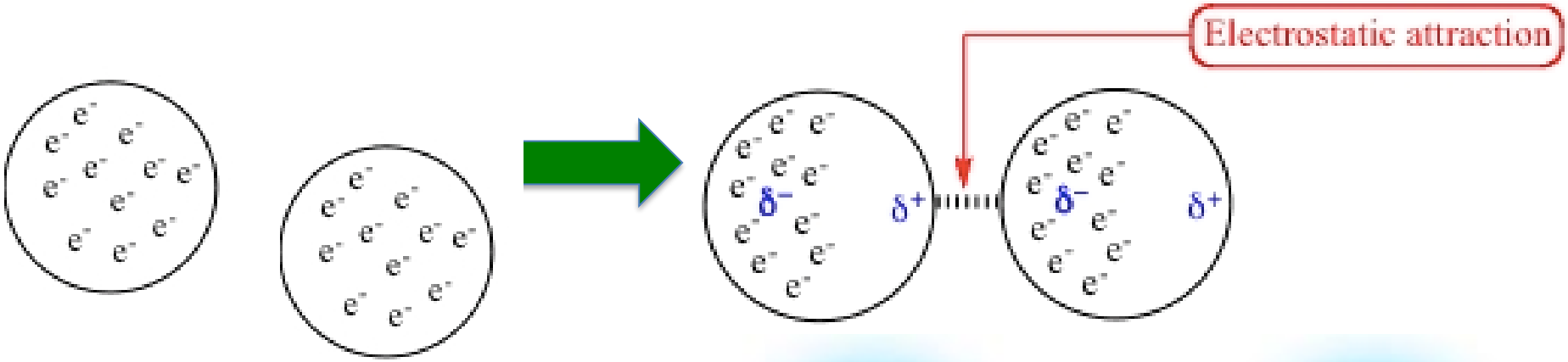
STRONGEST

"Van der Waals Forces" are London Dispersion Forces and Dipole-Dipole Forces added together

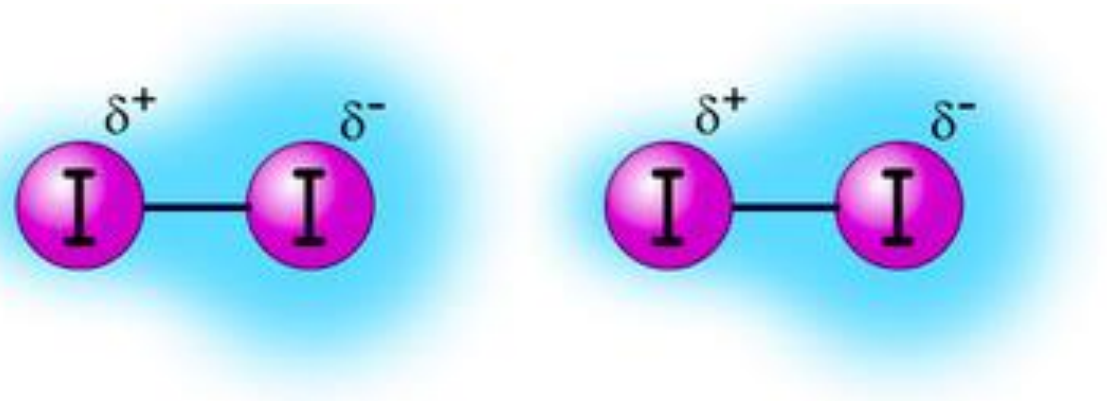
London Dispersion Forces

VERY WEAK and TEMPORARY!!!!

Caused by **temporary unequal** electron distribution that makes weak and temporary dipoles. Also called "instantaneous dipole"



Example I_2



London Dispersion Forces Continued…

EVERYTHING HAS LONDON DISPERSION FORCES BECAUSE EVERYTHING HAS ELECTRONS!

"Bigger" molecules will have more LDFs – more surface area/volume to get temporary unequal electrons

C_8H_{18} will have more LDFs than C_3H_8

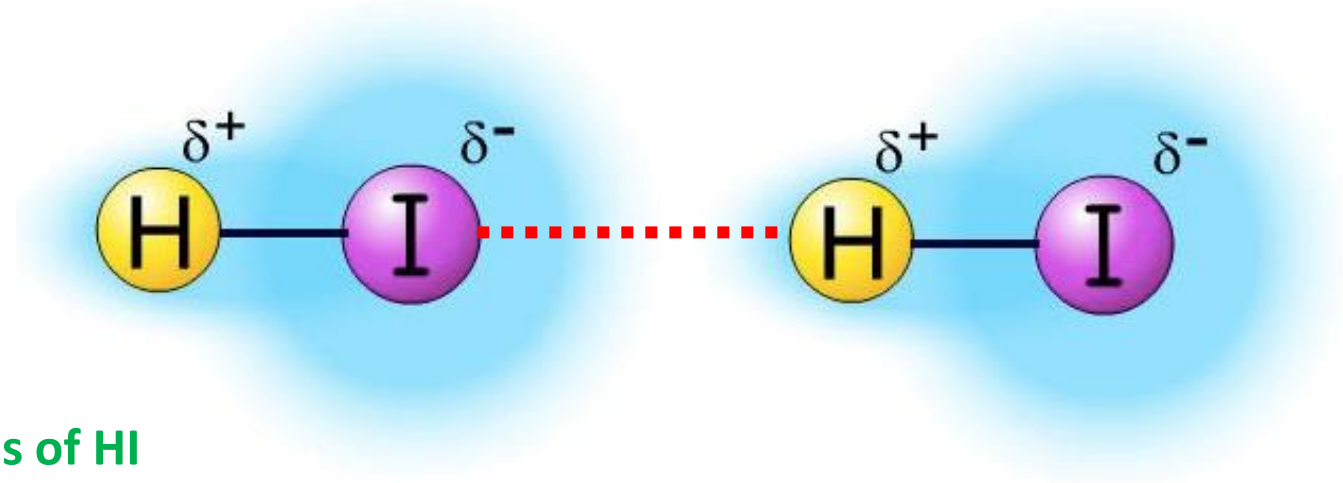
Dipole - Dipole

ONLY OCCURS IN POLAR MOLECULES

Partially negative portion of one polar molecule

attracted to

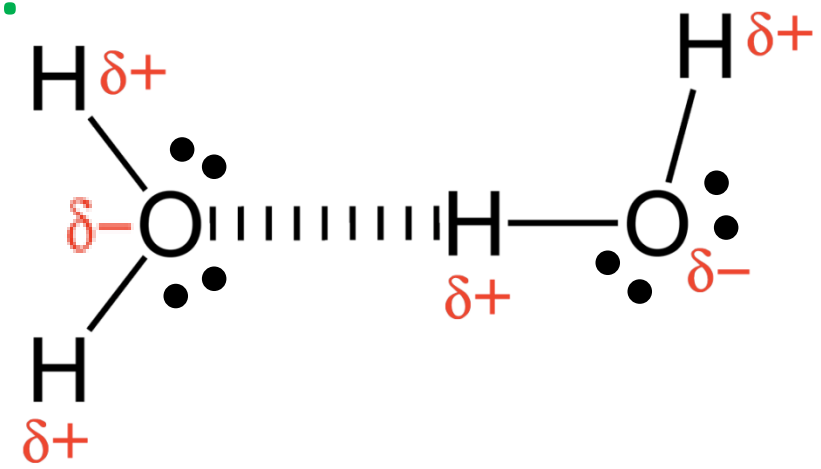
Partially positive portion of the second polar molecule



Example:
2 molecules of HI

Hydrogen Bonding

A TYPE OF DIPOLE-DIPOLE!
(Strongest Kind of IMF!)



Must have:

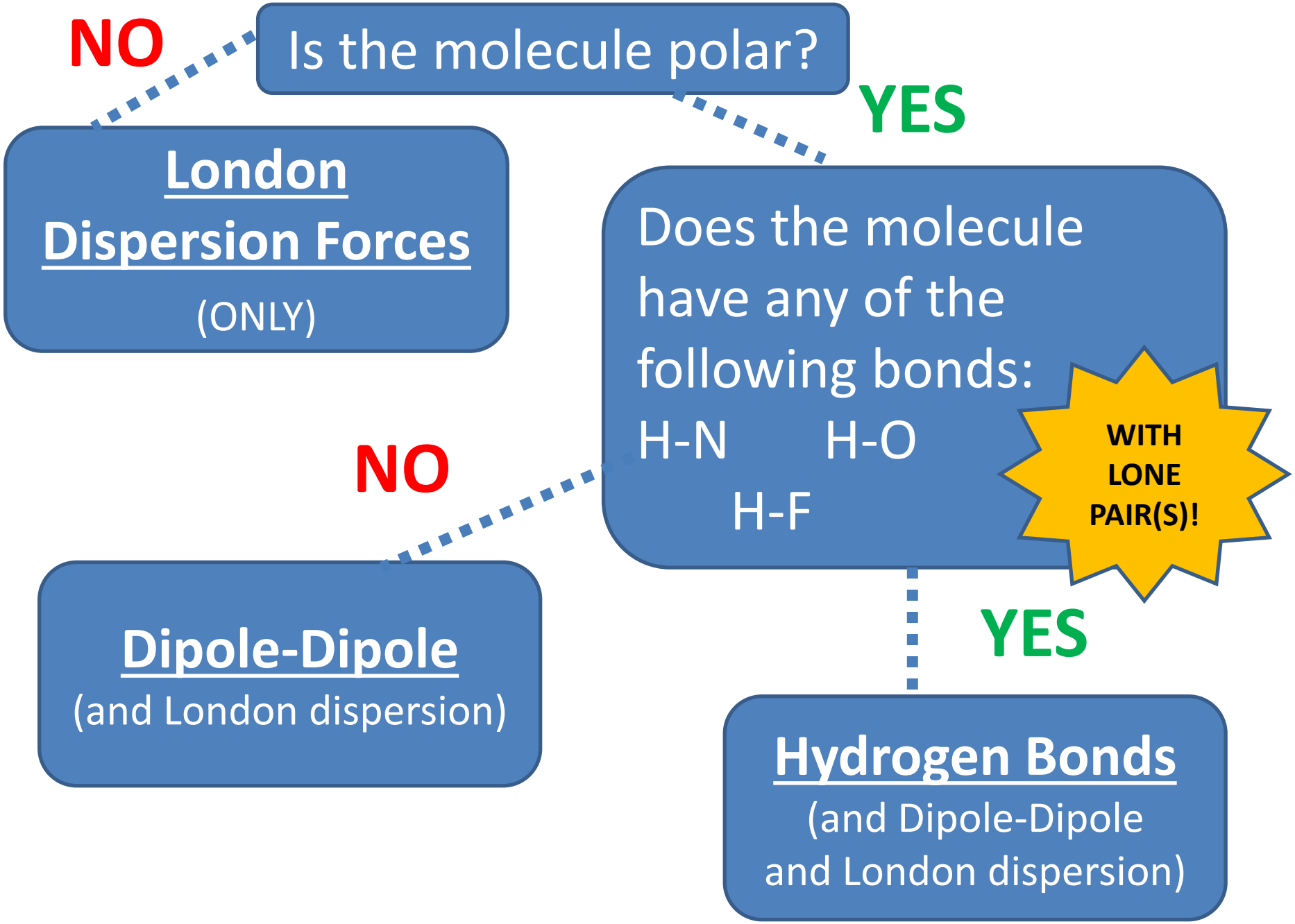
"H-NOF:"

ATTRACTION BETWEEN:

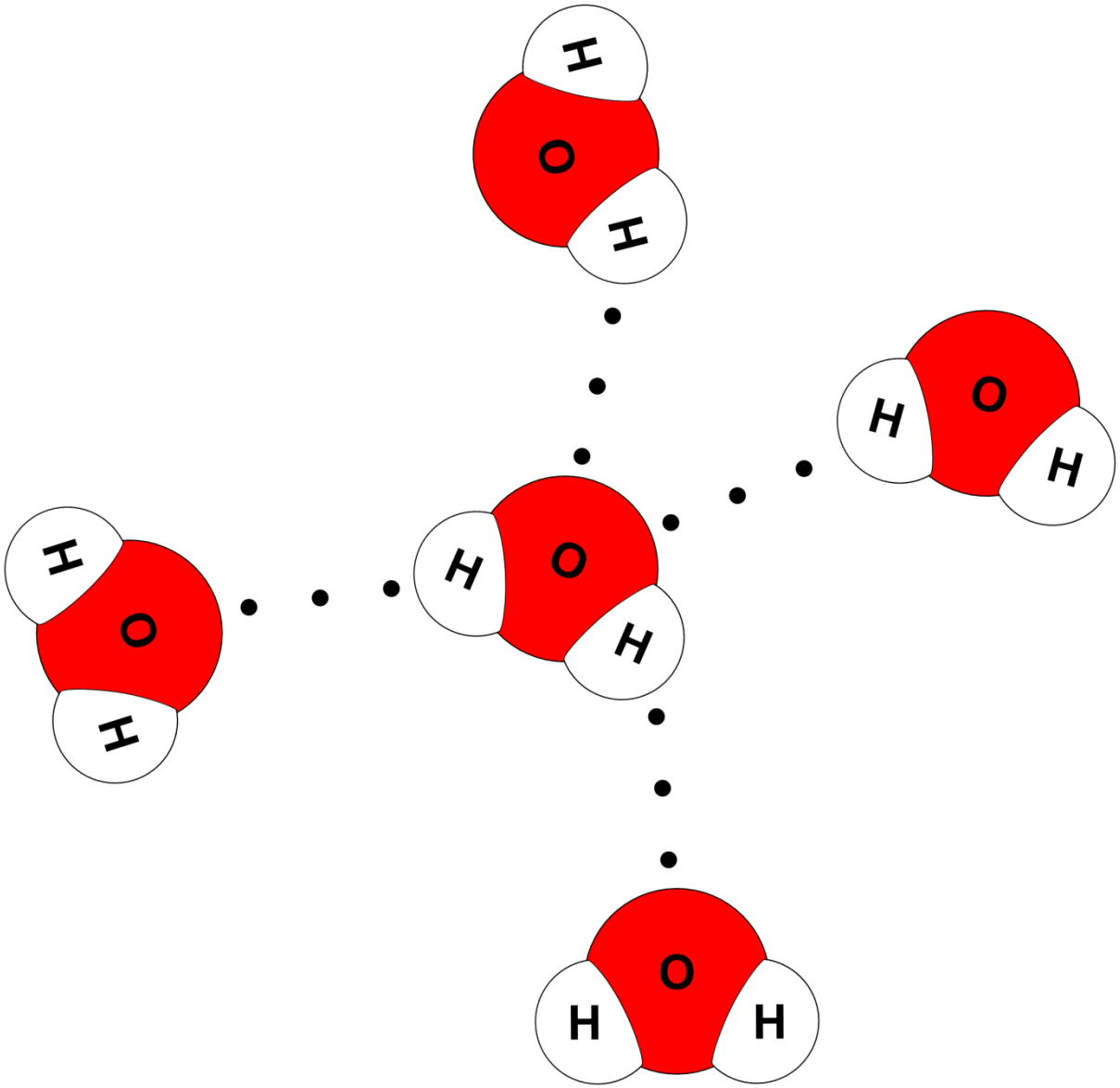
the partially negative part of a *lone pair* on an N, O, or F, atom

Hydrogen end of an O-H, N-H, or F-H bond

− +


Is the molecule polar?
NO
YES
London Dispersion Forces
(ONLY)
Does the molecule have any of the following bonds:
H-N H-O
H-F
WITH LONE PAIR(S)!
NO
YES
Dipole-Dipole
(and London dispersion)
Hydrogen Bonds
(and Dipole-Dipole and London dispersion)

Properties due to Intermolecular Forces


H
O
H
H
O
H
H
O
H
H
O
H
H
O
H

Some properties that relate to intermolecular forces

<table>
<tr><td>Boiling point
Melting point
Viscosity
Surface tension</td><td colspan="2">When you increase IMFs
Properties increase too!
More forces=higher props</td></tr>
<tr><td rowspan="2">Miscibility
(Mixing)</td><td colspan="2">“Like dissolves like”</td></tr>
<tr><td>Polar
with polar</td><td>Non-polar
with non-polar</td></tr>
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Special Examples of IMFs

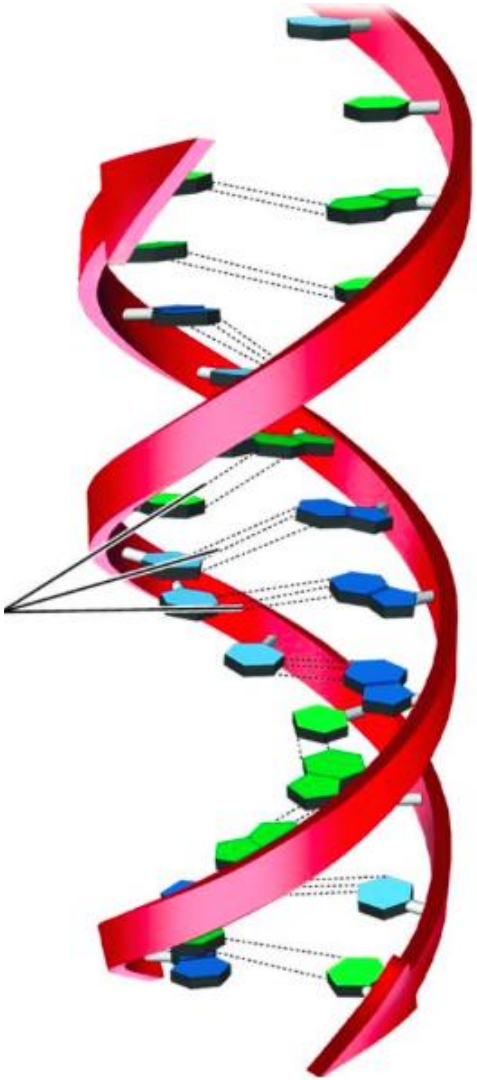
Important Example of H-Bonding

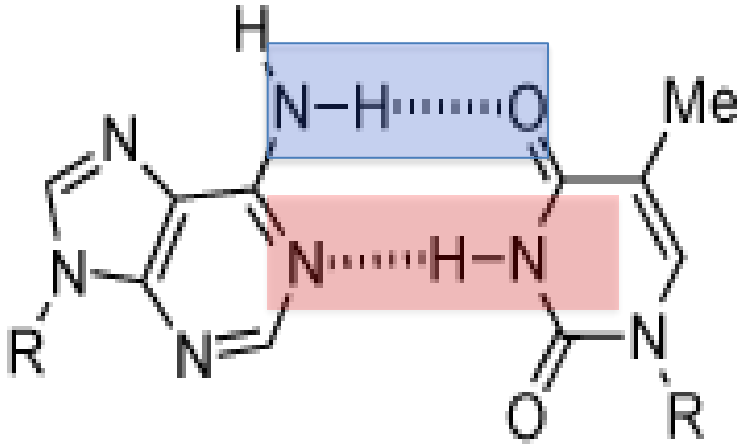
DNA Alpha helix shape-

Nucleic acids “bond” A to T and C to G

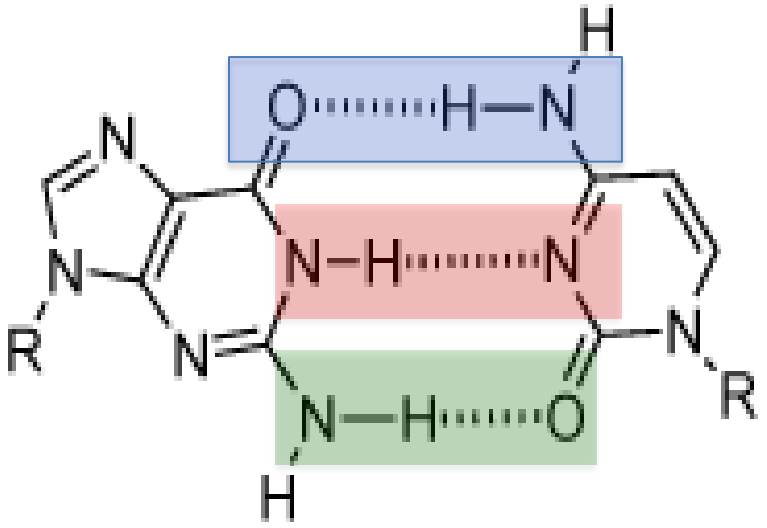
Generic DNA picture

H bonds



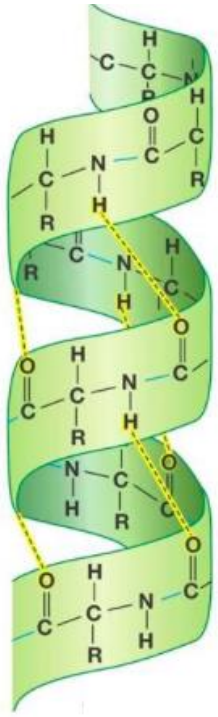


A·T base pair

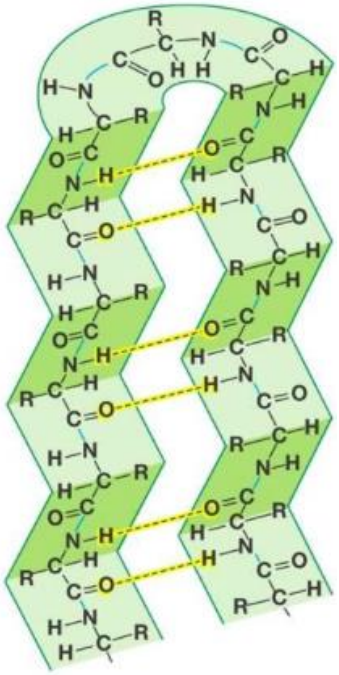


G·C base pair

H bonding in protein shapes



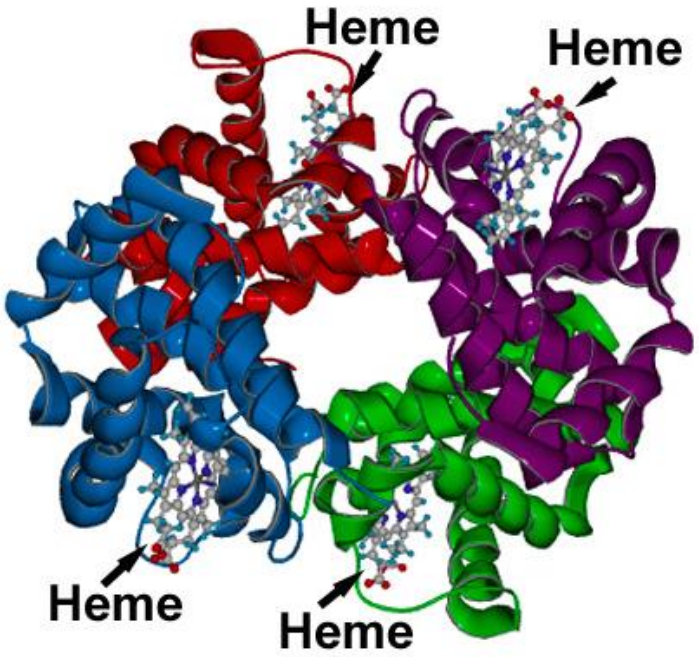
Alpha helix



Beta sheets

Proteins – chain of amino acids

Secondary structures: beta sheets and alpha helix



Hemoglobin protein

Bulk Solids

Interactions in solids

COMBINATION OF:

intramolecular AND intermolecular forces in a "large" or "bulk" scale

3 TYPES

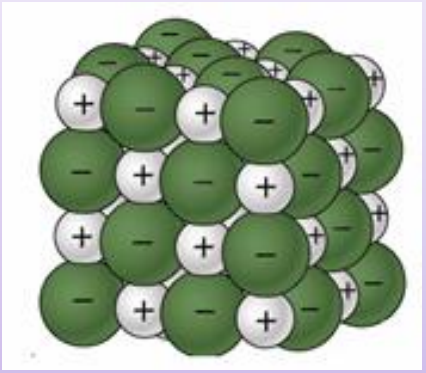
Metallic *(weakest)*
Ionic Lattice *(middle)*
Network covalent *(strongest)*

Bulk solids have very high melting/boiling points because there are so many inter and intra molecular forces holding the atoms close together

IONIC LATTICE

ions stack in an ordered fashion to form crystals

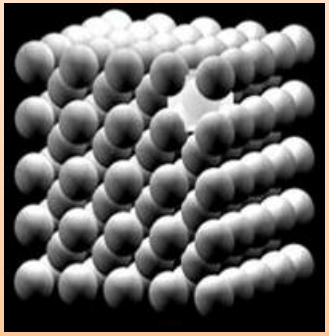
Example: NaCl



METALLIC

Metal ions stack in an ordered fashion held together by the “sea of electrons” and the positive metal ions

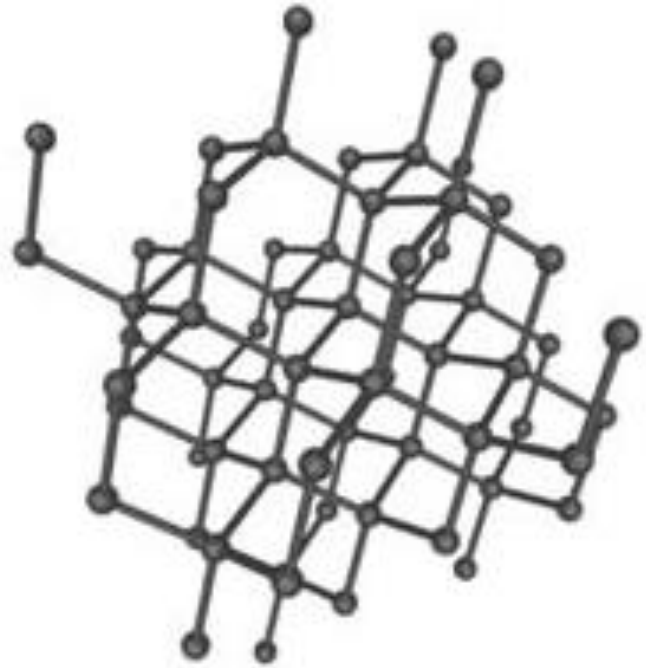
Example: Fe



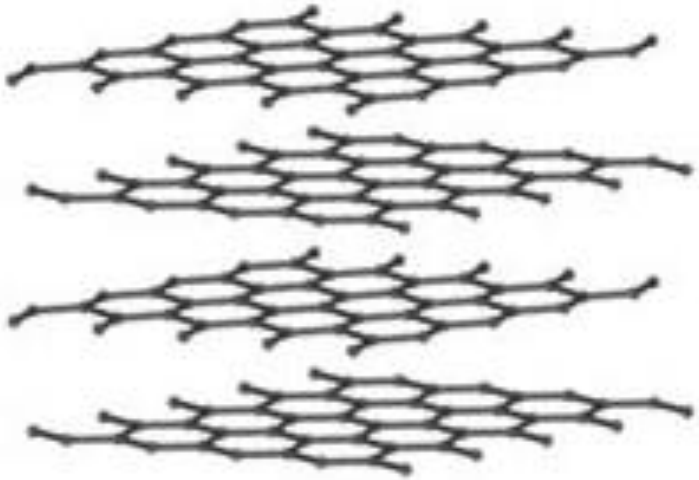
NETWORK COVALENT

covalently bonded atoms in a continuous network

Example: Carbon

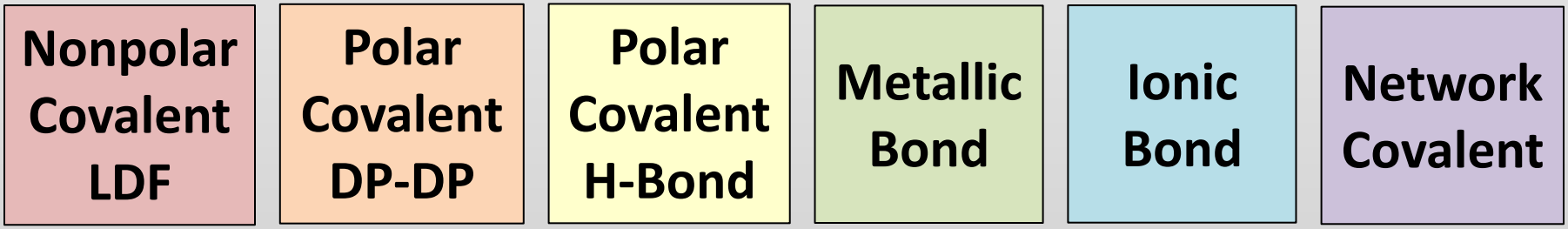


DIAMONDS



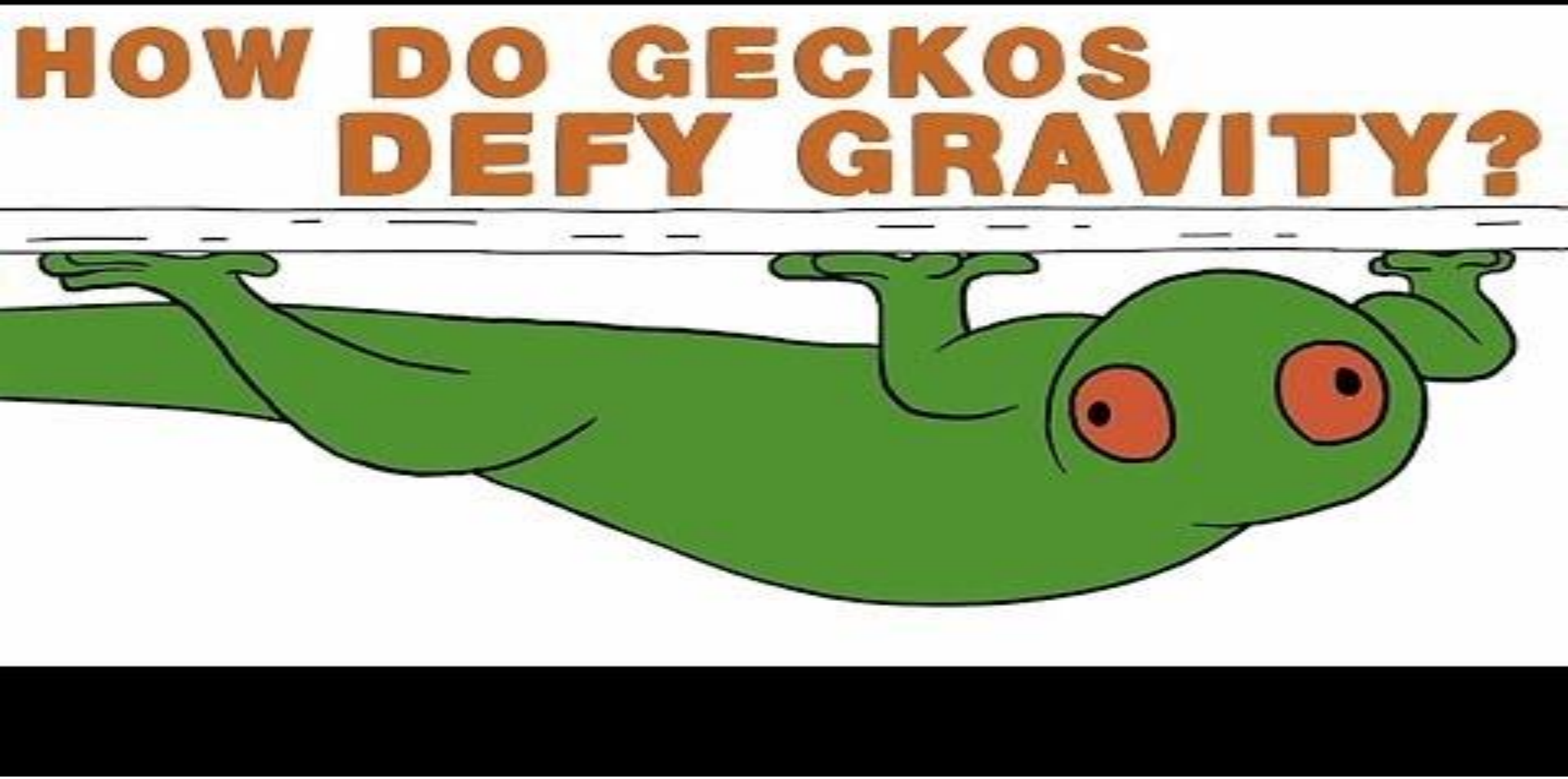
GRAPHITE

Overall Ranking



Weakest
Least
IMFs

Strongest
Most
IMFs



Geckos

https://www.youtube.com/watch?v=YeSuQm7KfaE&feature=youtu.be

Crash Course - Liquids

https://www.youtube.com/watch?v=BqQJPCdmIp8&feature=youtu.be

Link to YouTube of this Presentation

https://youtu.be/6JedE3a9LrI