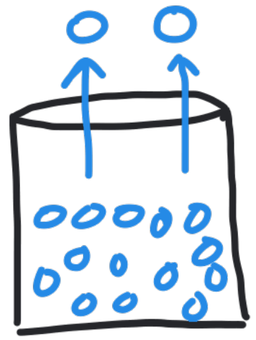
Non-Covalent Interactions



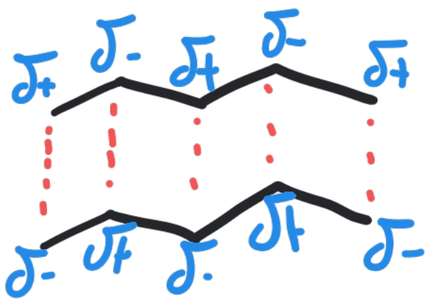
Intermolecular Forces

- non-covalent
- "hold" molecules together
- Stronger IMF = Higher bp & higher mp

Weaker IMF → Stronger IMF

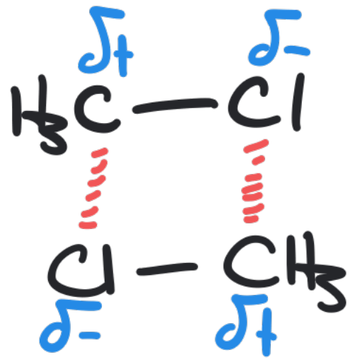
van Der Waals (London Forces)

- Exist in all molecules
- caused by slight temporary dipoles in a molecule



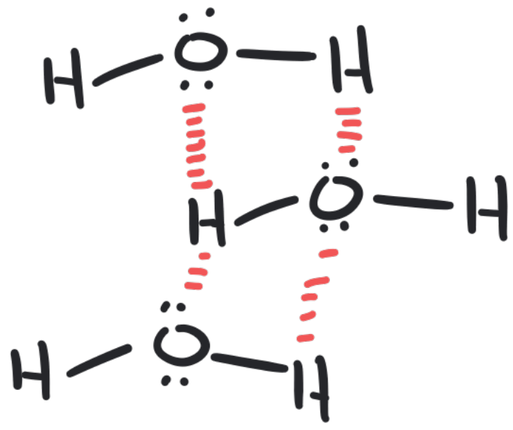
Dipole-Dipole Interactions

- attractive forces between molecule with permanent dipoles.



Hydrogen Bonding

- Exist in molecules with -OH, -NH or F-H bonds.



Ionic Bonds

NaCl

$Na^{\oplus}$ $Cl^{\ominus}$

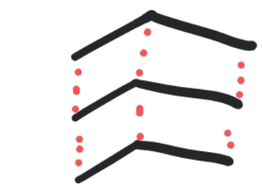
Crystal lattice

Van Der Waals Forces

VDW forces ↑ with ↑ surface area

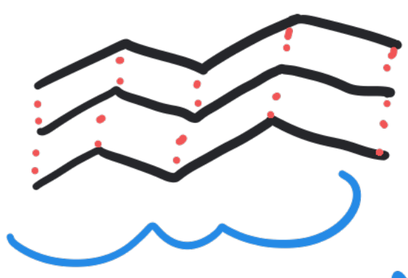
Branching ↓ surface area and ↓ VDW forces

*Stronger IMF = Higher BP and MP



bp
-42°C

vs



bp
36°C

larger surface area
= greater contact
= Higher BP

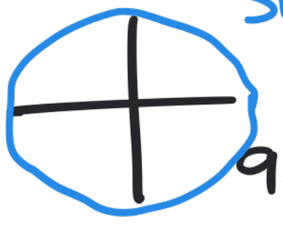
36°C

vs

Smaller S.A.

28°C

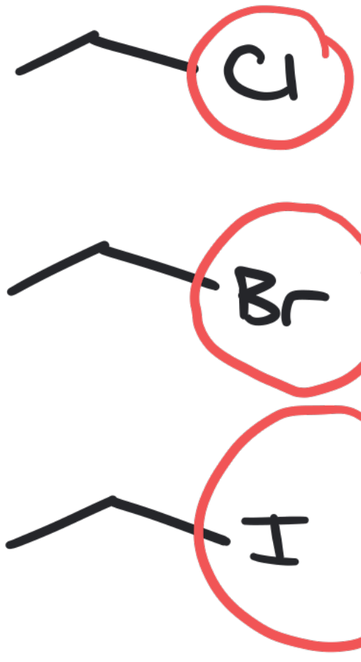
vs



Smallest S.A.

9.5°C

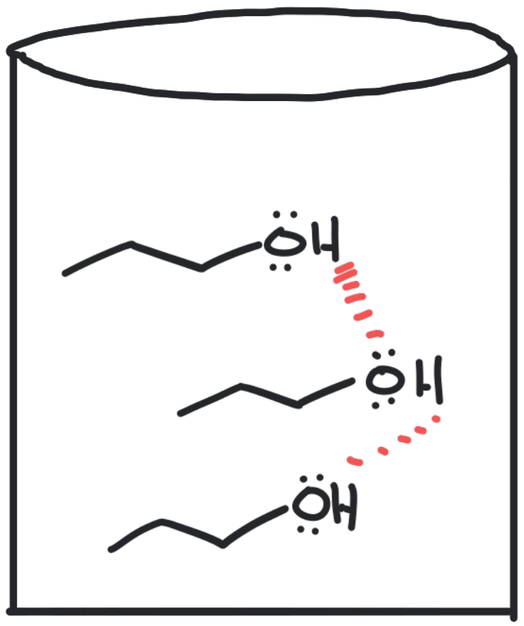
-37.7 °C

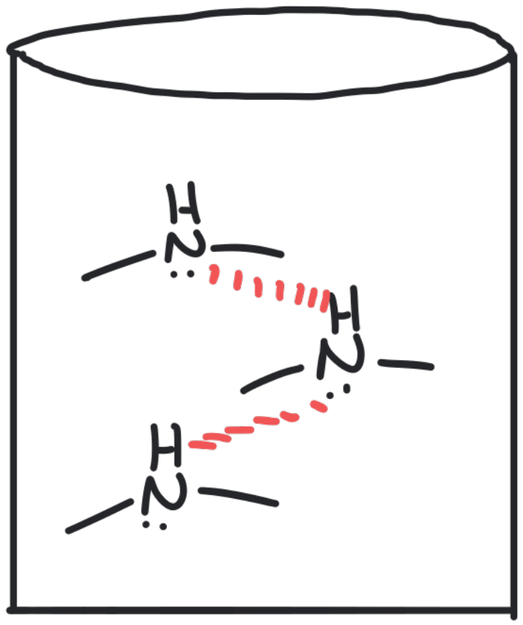


-2.3°C

Hydrogen Bonding

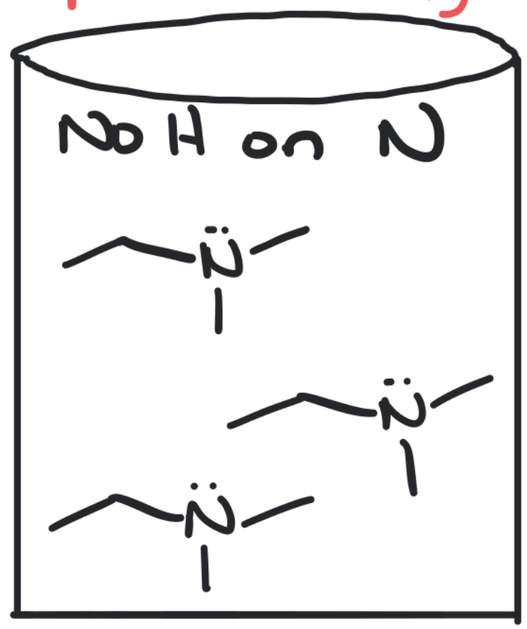
-OH -NH FH



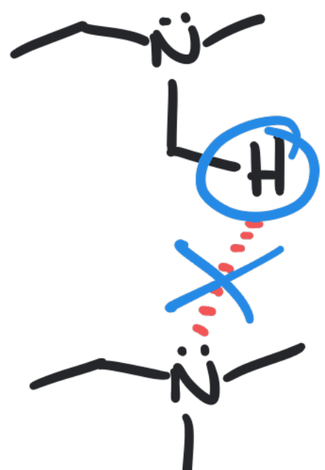


No H-bonding!

No H on N



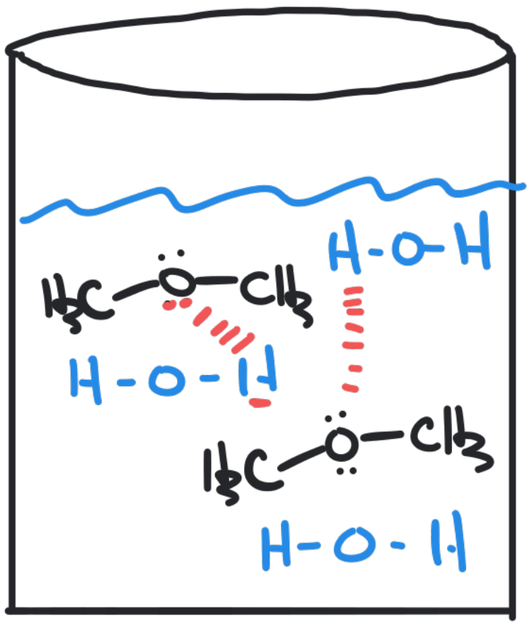
H must be attached to N, O, F

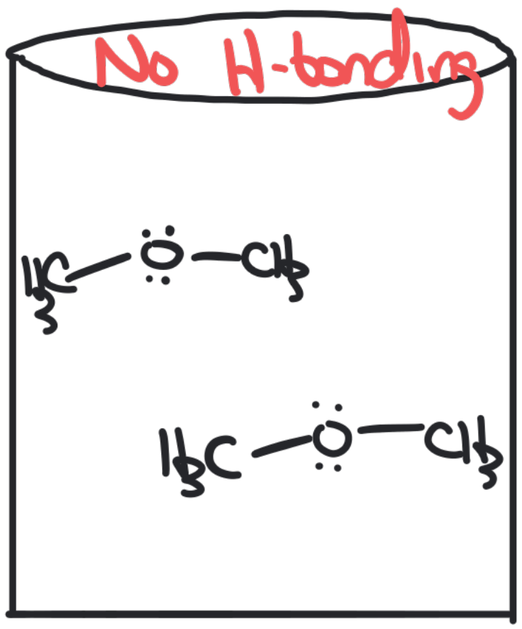


$H_3C-\ddot{O}-CH_3$

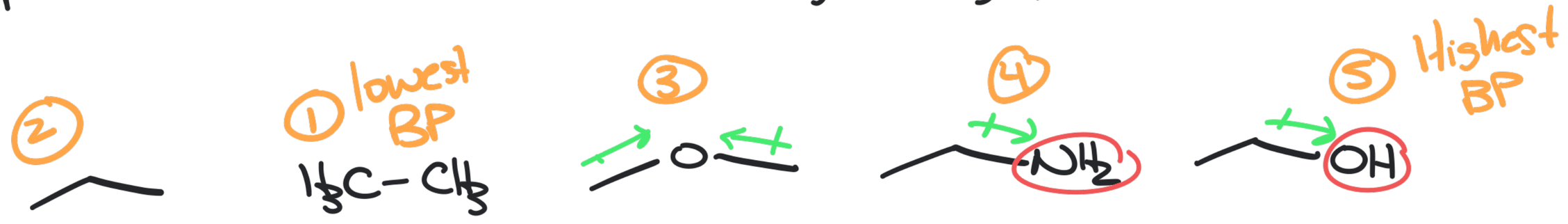
Can't H-bond with self

Can H-bond with water

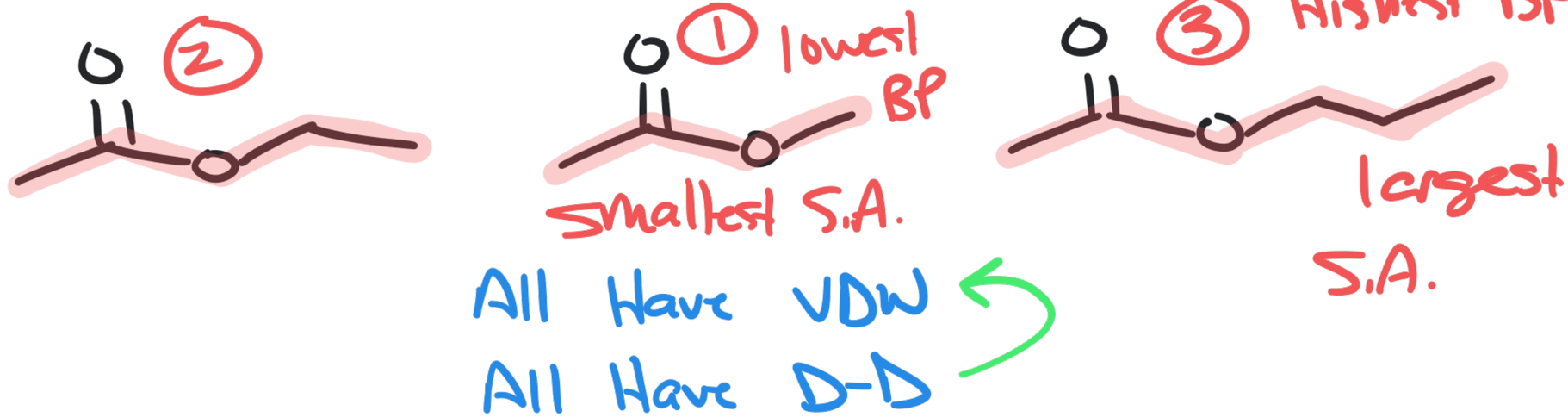




Example 1: Rank in order of increasing boiling point

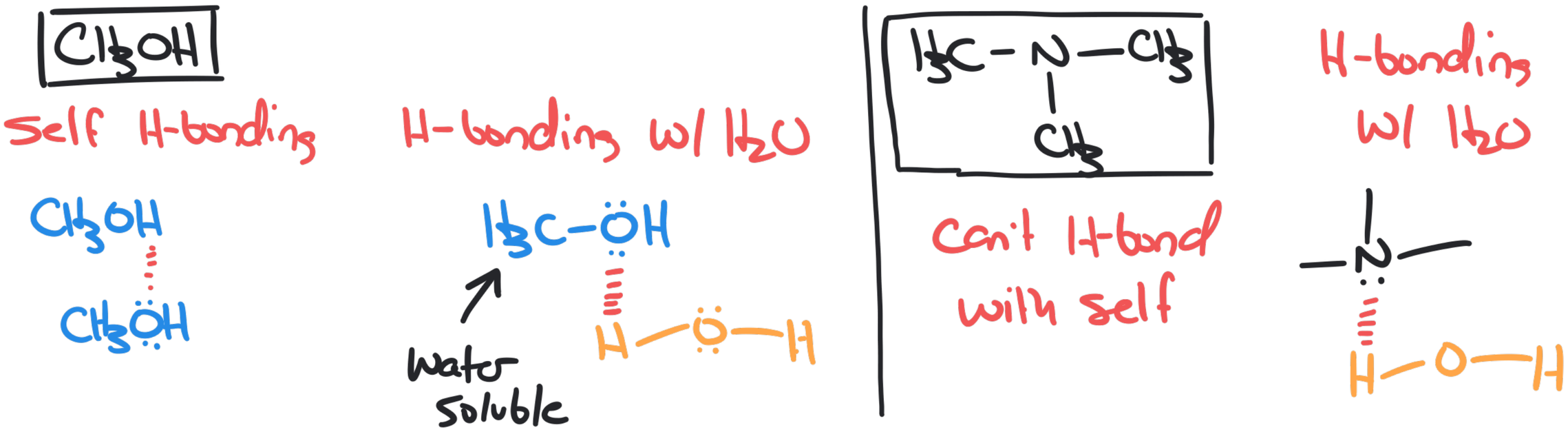


Example 2: Rank in order of increasing BP

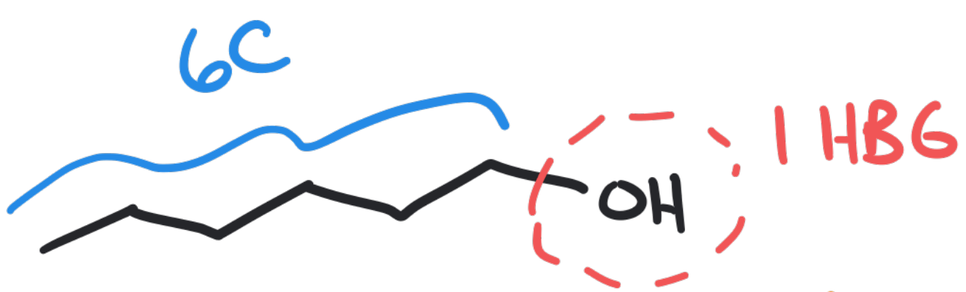


Solubility - like dissolves like

- Organic molecules contain many C's + H's } greasy
- Organic molecules tend to be soluble in organic solvents.
- Organic molecules may be H_2O soluble if you have enough H-bonding to overcome the C's and H's.
- Rule of 4 → for a molecule to be H_2O soluble, you need one H-bonding capable group for every 4 carbon atoms.



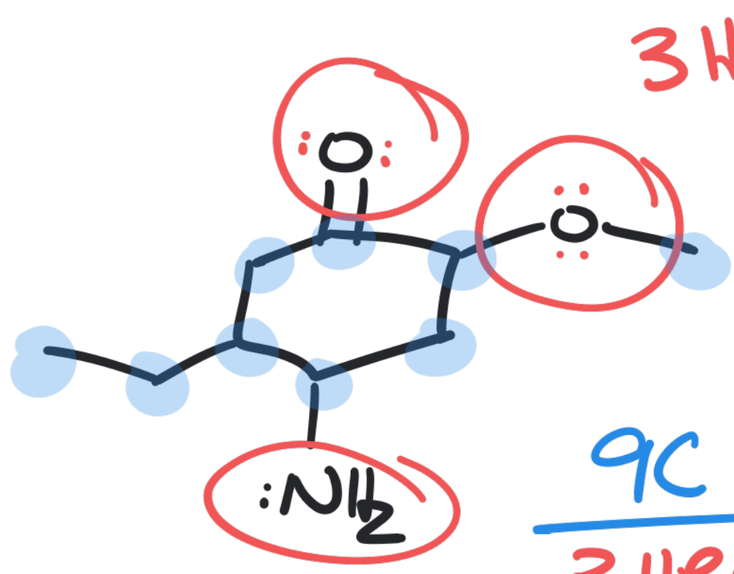
#C	> 4	Not	H_2O Soluble
# HBG	≤ 4	H_2O	Soluble



1 HBG

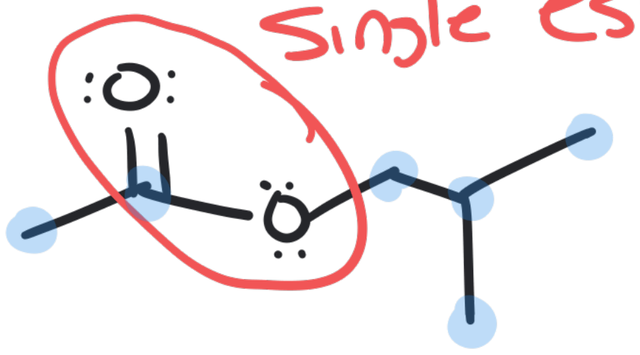
$\frac{6C}{1\ HBG} = 6$

Not H_2O Sol



H_2O Sol

$\frac{9C}{3\ HBG} = 3$



Single ester functional group = 1 HBG

$\frac{6C}{1\ HBG} = 6$

Not H_2O Sol