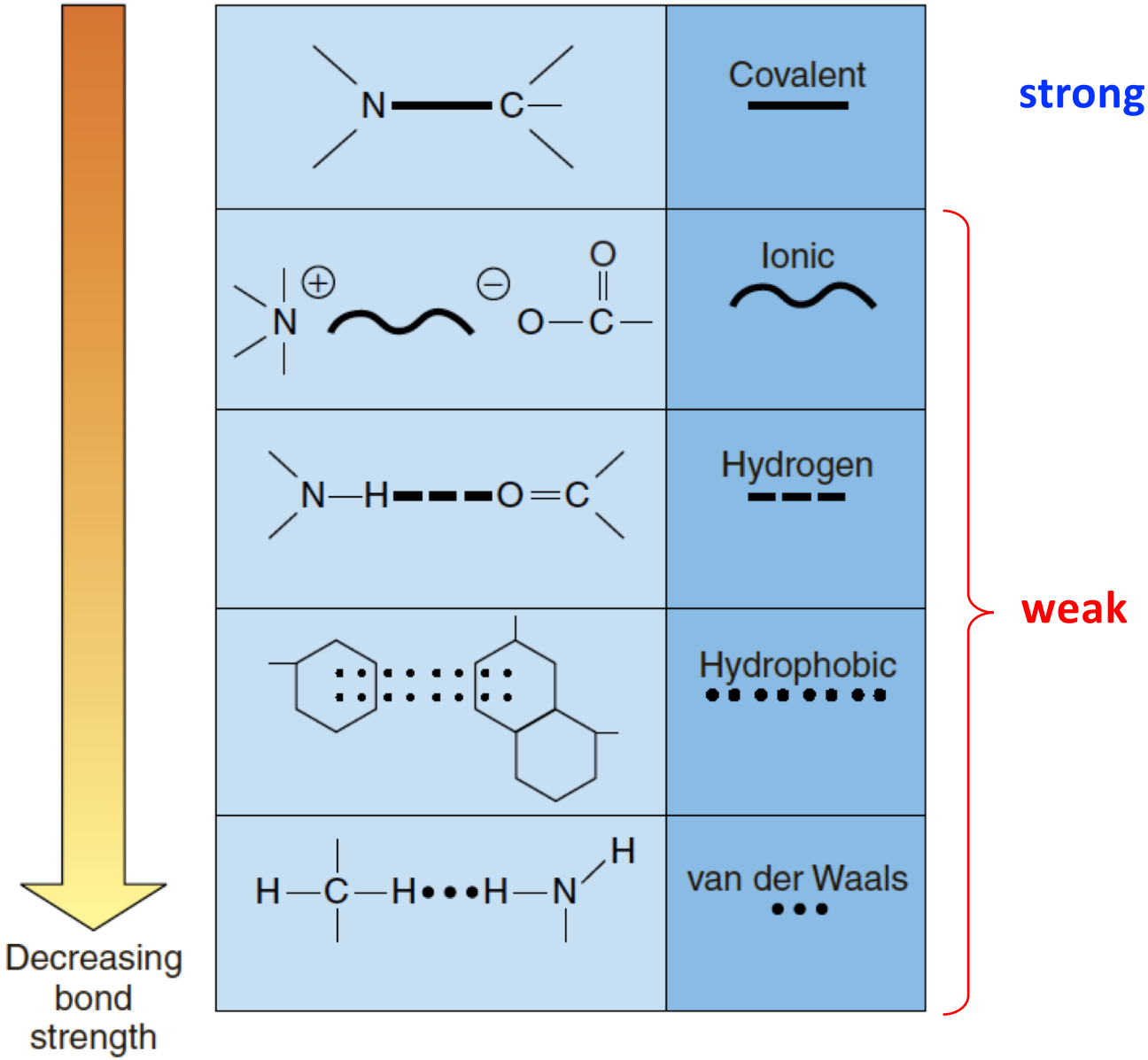
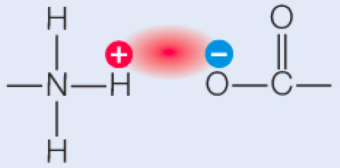
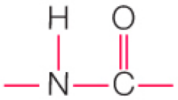
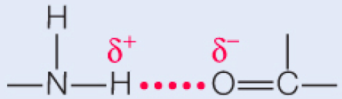
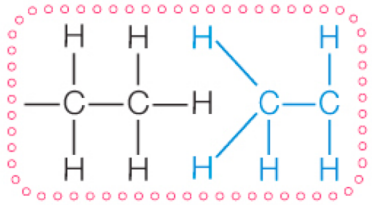
5 types of interatomic / intermolecular interactions



5 types of interatomic / intermolecular interactions

Name	Basis of interaction	Structure	Bond energy[a]	
Ionic attraction	Attraction of opposite charges		3–7	
Covalent bond	Sharing of electron pairs		50–110	70
Hydrogen bond	Attraction between H (δ^+) and a strongly electronegative atom		3–7	7
Hydrophobic interaction	Interaction of nonpolar substances in the presence of polar substances (especially water)		1–2	
van der Waals interaction	Interaction of electrons of nonpolar substances		1	

[a]Bond energy is the amount of energy (Kcal/mol) needed to separate two bonded or interacting atoms under physiological conditions.

(Hillis concept 2.2)

Covalent bonds and Ionic Bonds

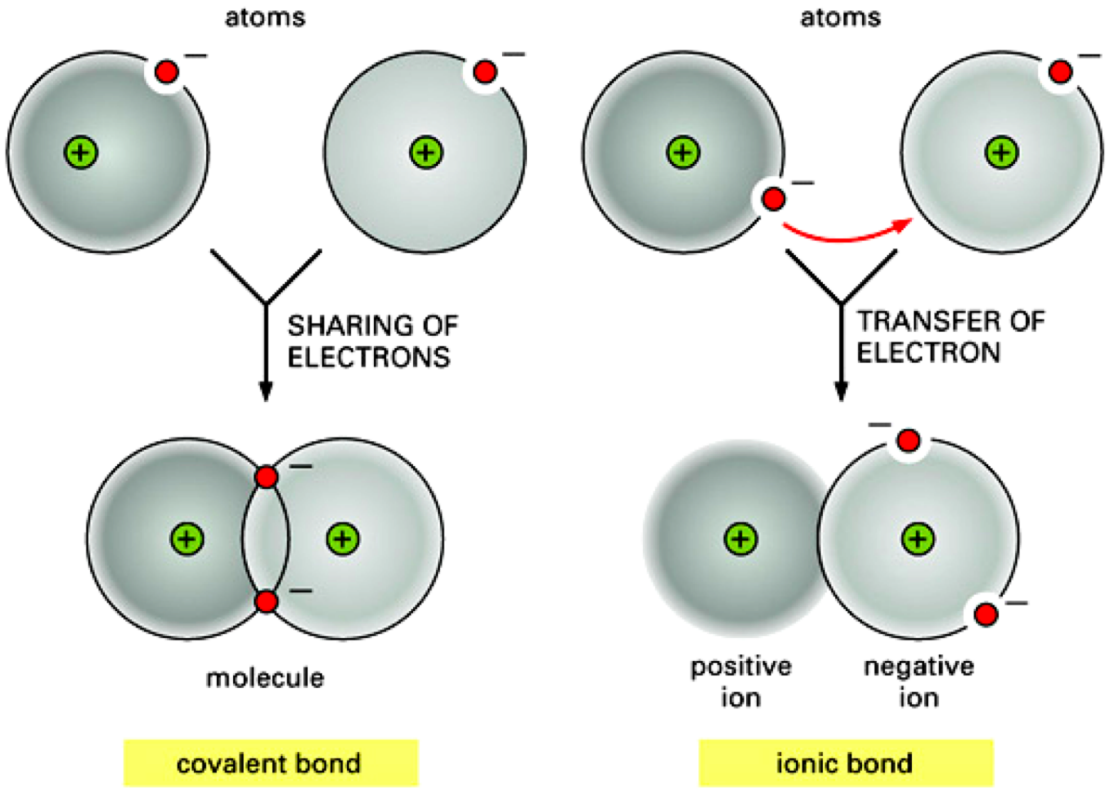


Figure 2.6 Essential Cell Biology, 2/e. (© 2004 Garland Science)

-> 2 atoms share electrons

-> 1 electron is donated by one atom to another atom (salts; cation and anion)

Geometry of covalent bonds

- defined orientation of bonds
- particular 3D geometry of molecule
- Bond strength:
  -> energy needed to break the bond
  -> covalent bonds: strong

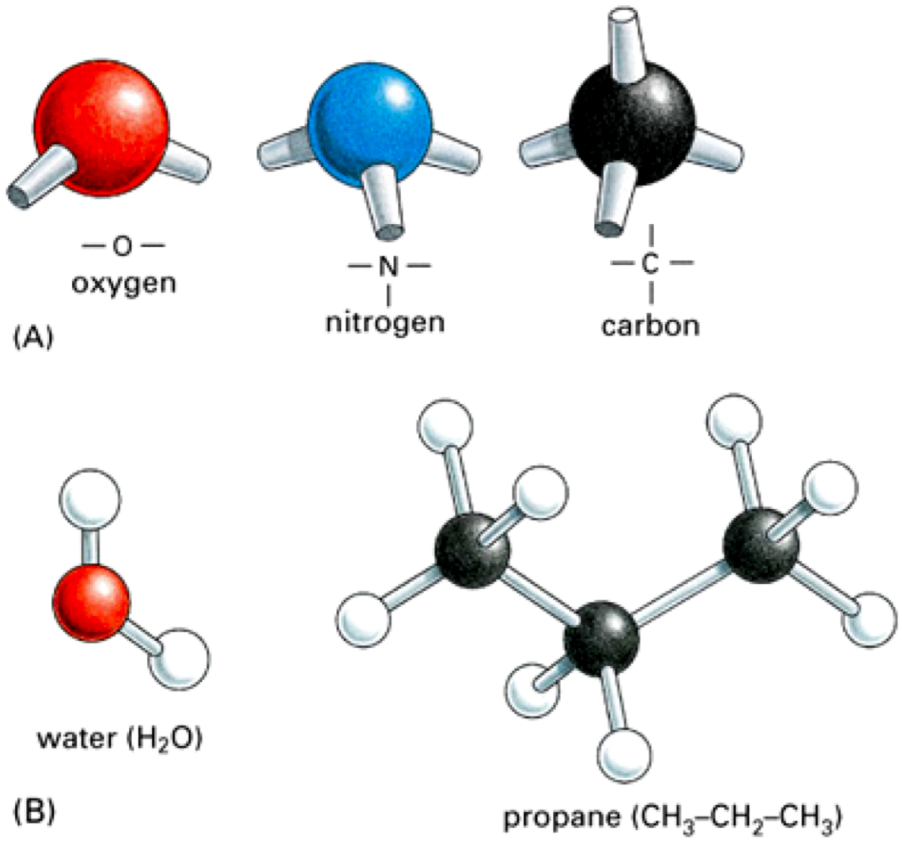
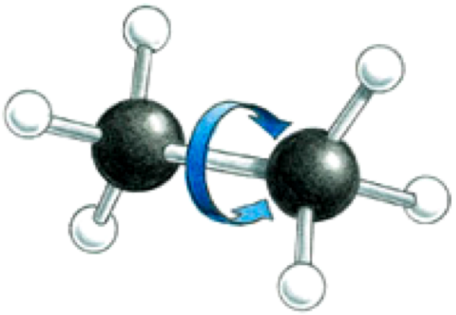
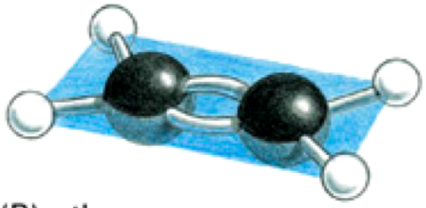


Figure 2-10 Essential Cell Biology, 2/e. (© 2004 Garland Science)

Single bonds, double bonds



(A) ethane



(B) ethene

single bond
- by 1 pair of electrons
- can rotate

double bond
- by 2 pairs of electrons
- rigid
- shorter

Figure 2.11 Essential Cell Biology, 2/e. (© 2004 Garland Science)

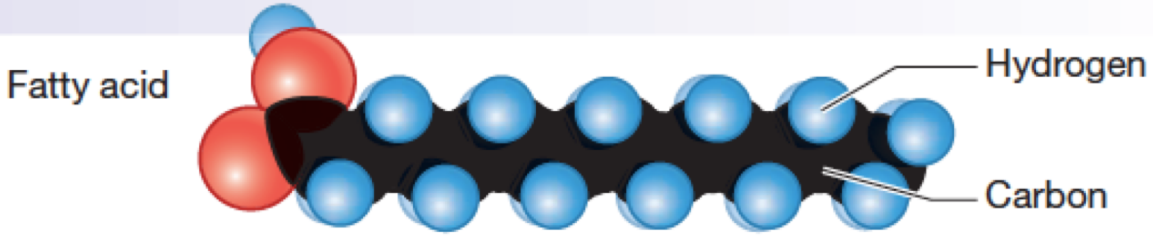
Molecules can be **polar** or **nonpolar**

Covalent Bonds

Covalent bonds result when atoms share electrons. These bonds require the most energy to make or break.

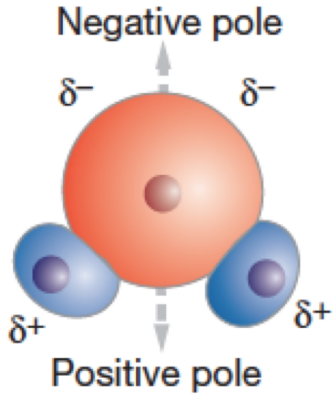
(a) Nonpolar Molecules

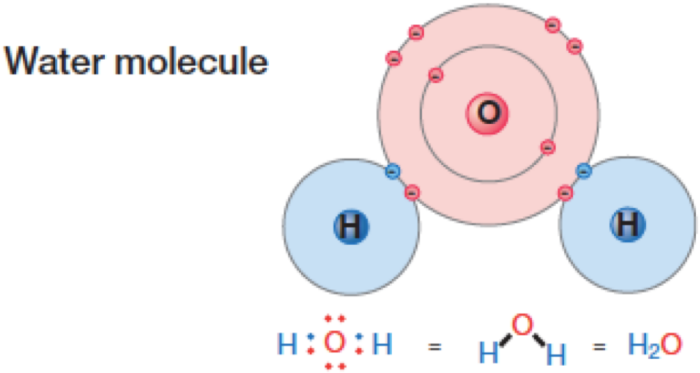
Nonpolar molecules have an even distribution of electrons. For example, molecules composed mostly of carbon and hydrogen tend to be nonpolar.



(b) Polar Molecules

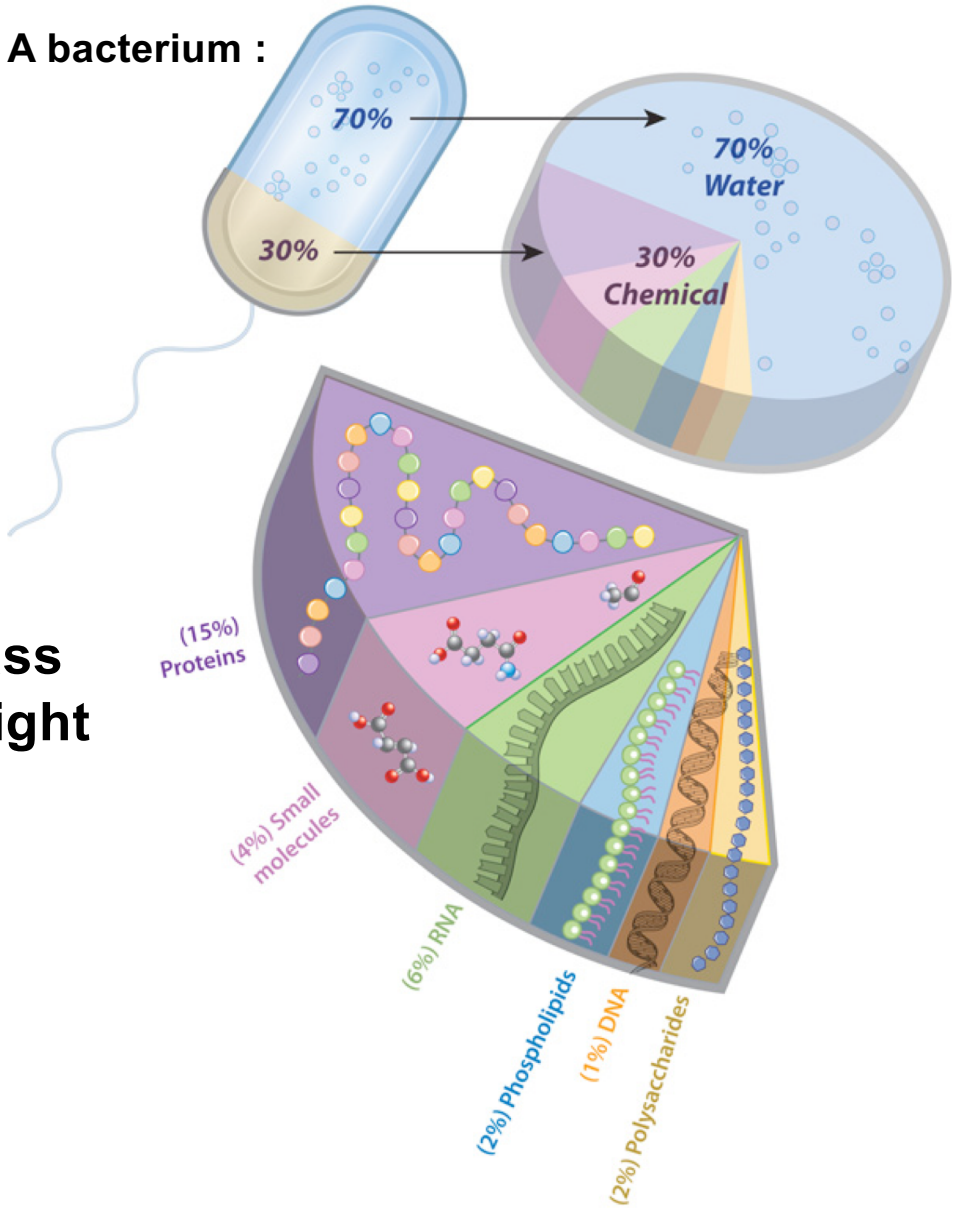
Polar molecules have regions of partial charge (δ^+ or δ^-). The most important example of a polar molecule is water.





1.1

A bacterium :



Water is the most abundant molecule in living organisms

Proteins :
~15% of cell mass
~50% of dry weight

Covalent bonds can be **polar** or **nonpolar**

Element	Electronegativity
Oxygen (O)	3.4
Chlorine (Cl)	3.2
Nitrogen (N)	3.0
Carbon (C)	2.6
Phosphorus (P)	2.2
Hydrogen (H)	2.2
Sodium (Na)	0.9
Potassium (K)	0.8

Δ electronegativity $\geq 0.5 \rightarrow$ polar

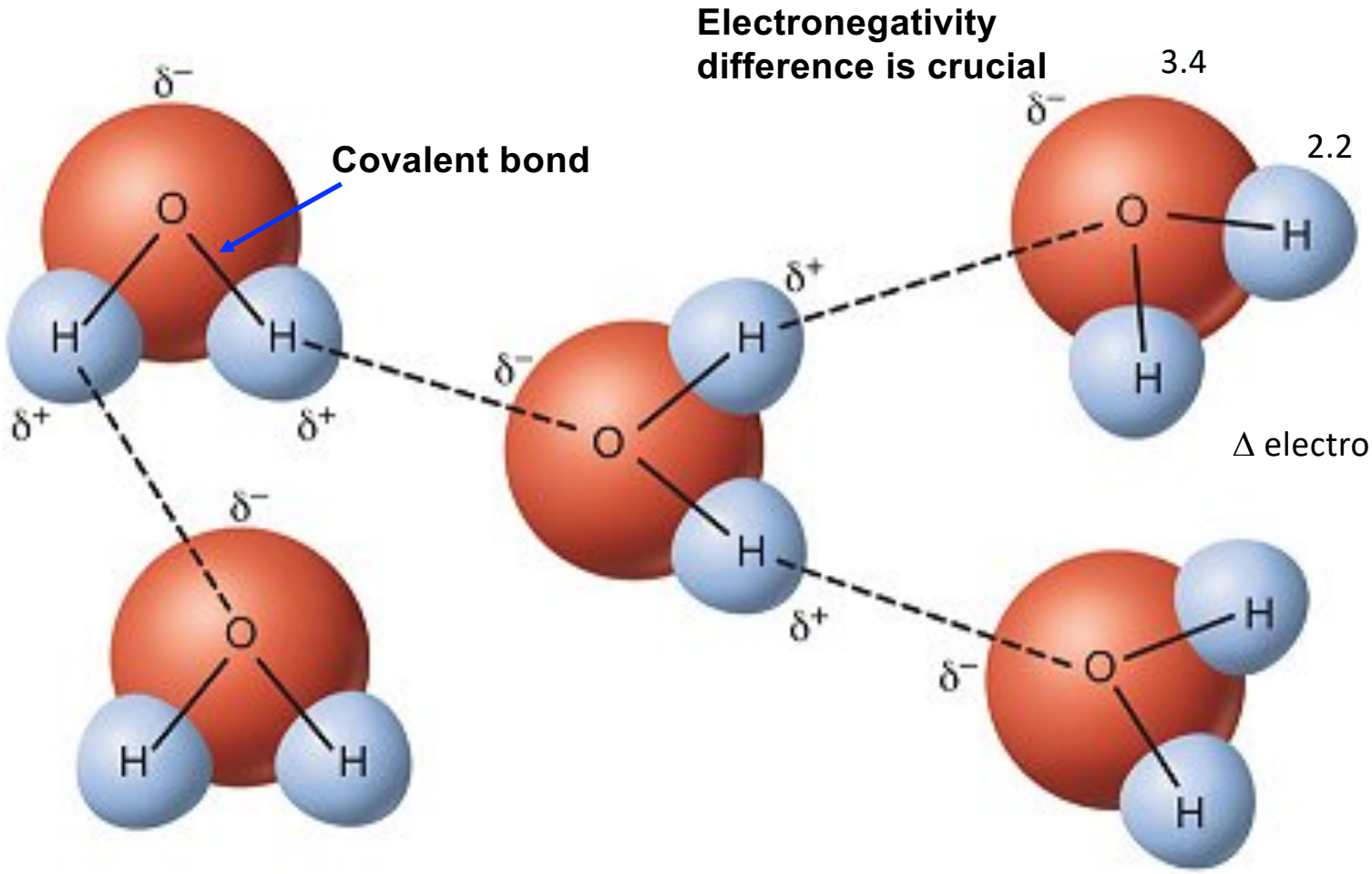
Δ electronegativity $< 0.5 \rightarrow$ non polar

Δ electronegativity = 0.4

$$\overset{2.6}{C} — \overset{2.2}{H}$$

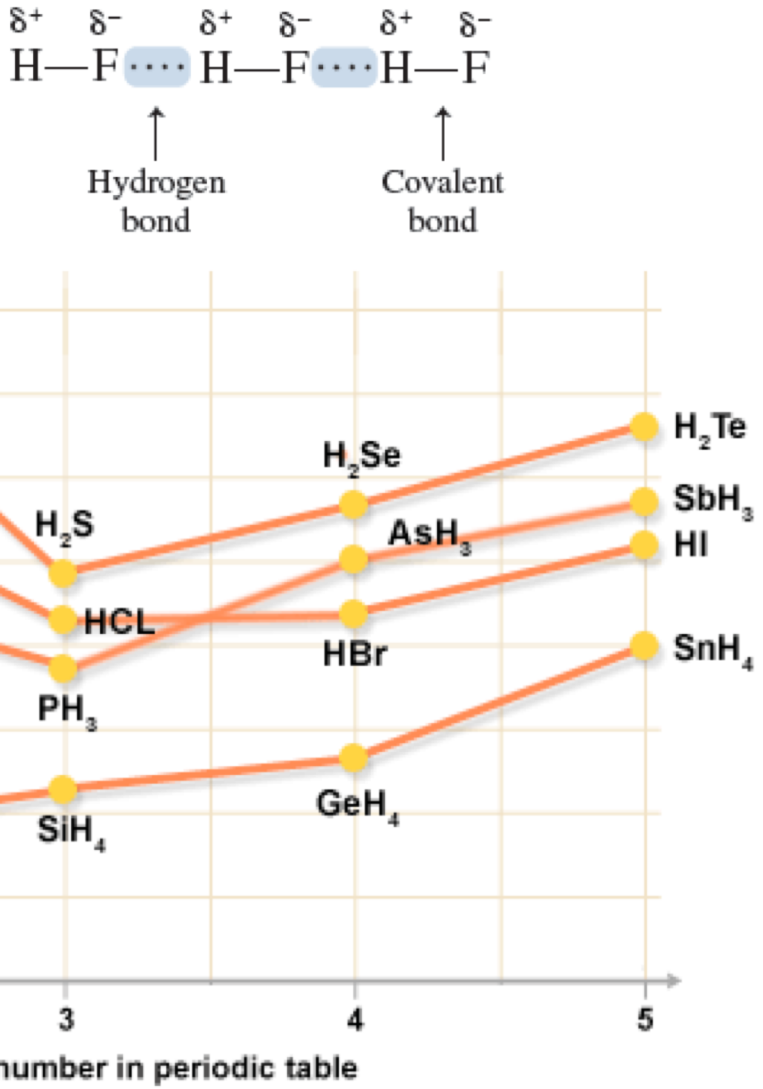
Hydrogen bonds govern many properties of water.

État liquide



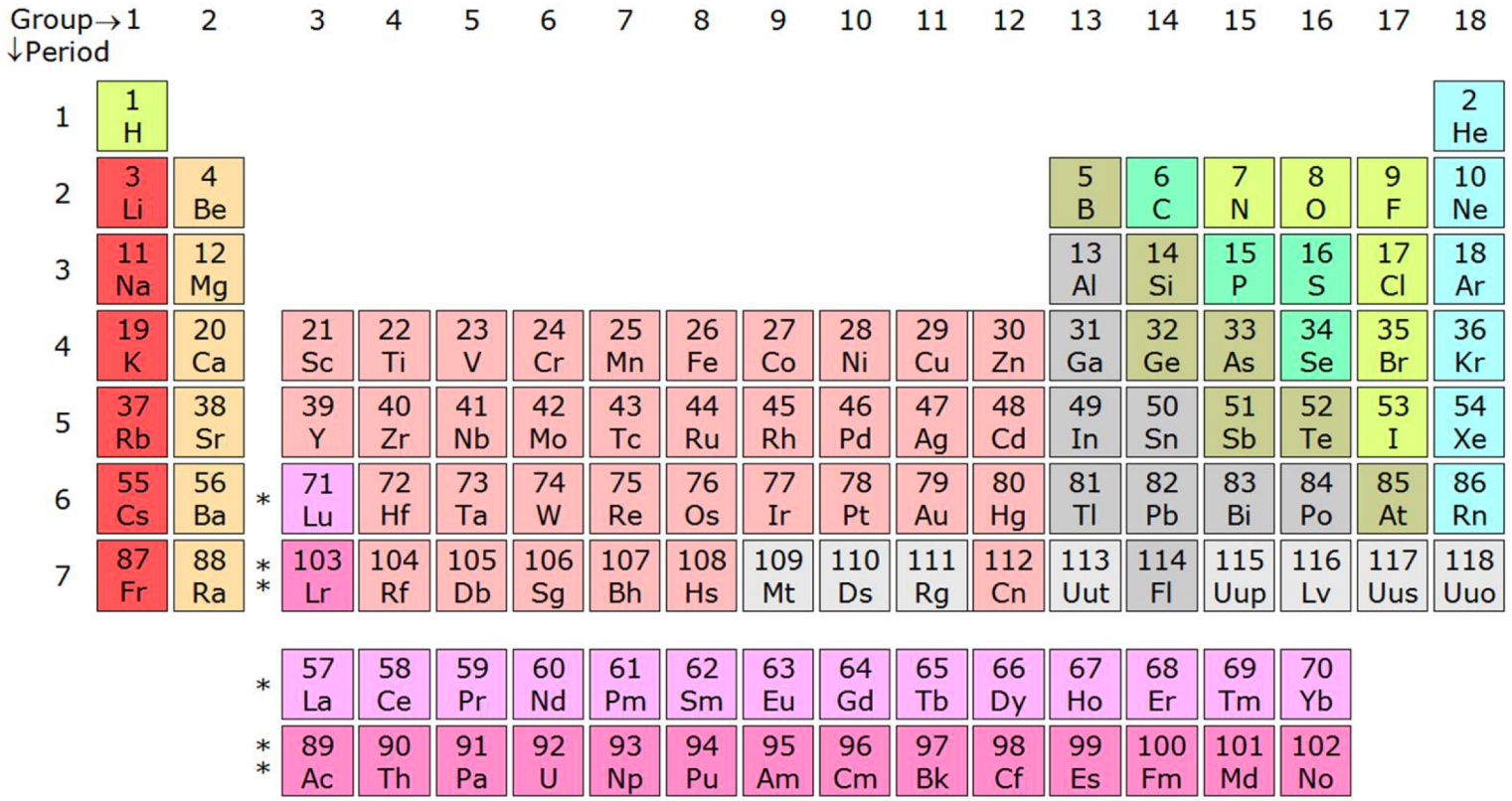
hydrogen bonds form between a donor and an acceptor

Hydrogene bonds and boiling point

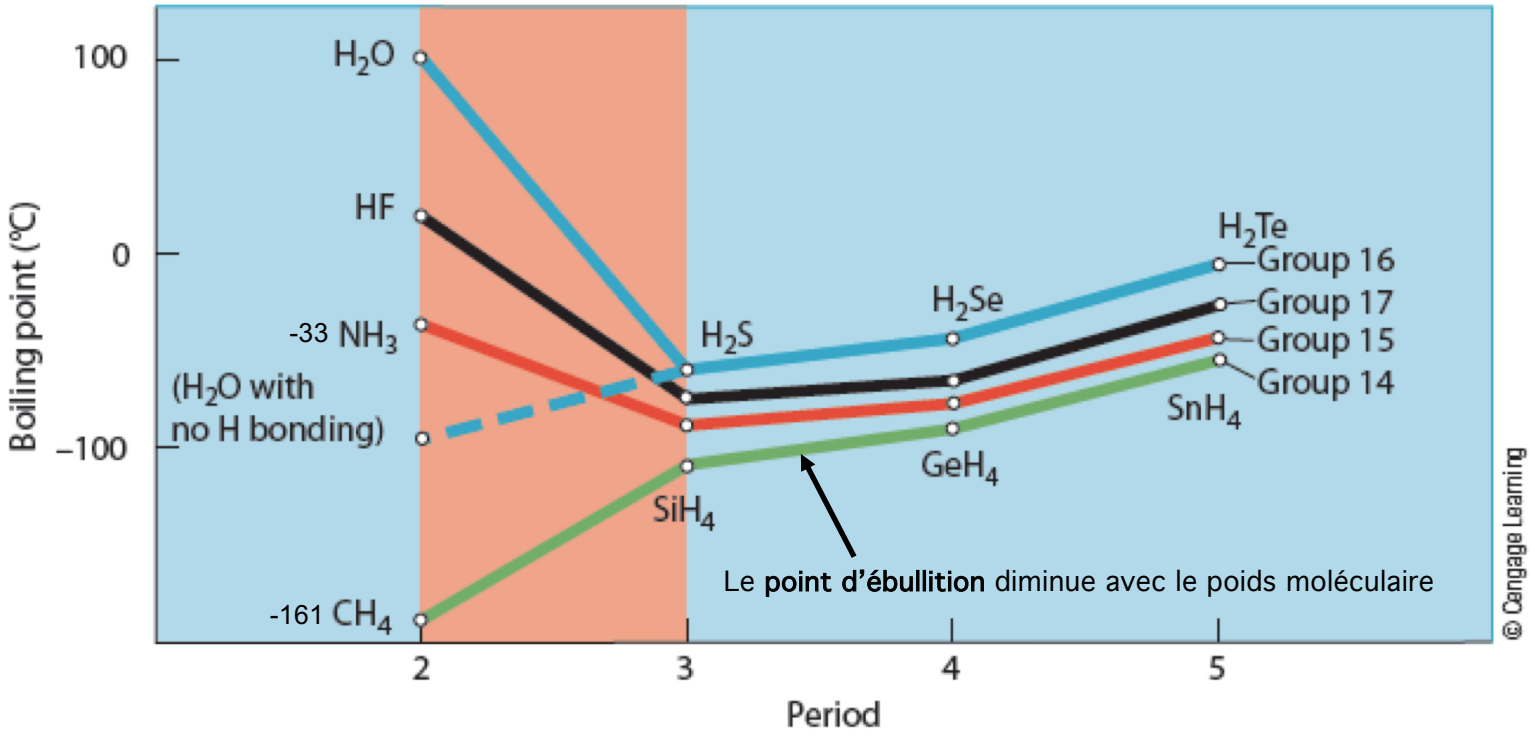


http://www.bbc.co.uk/bitesize/higher/chemistry/energy/bsp/revision/4/

Simplified periodic table



Hydrogene bonds and boiling point



In the absence of hydrogen bonds, the boiling point of water would be around -100 °C.

1.2

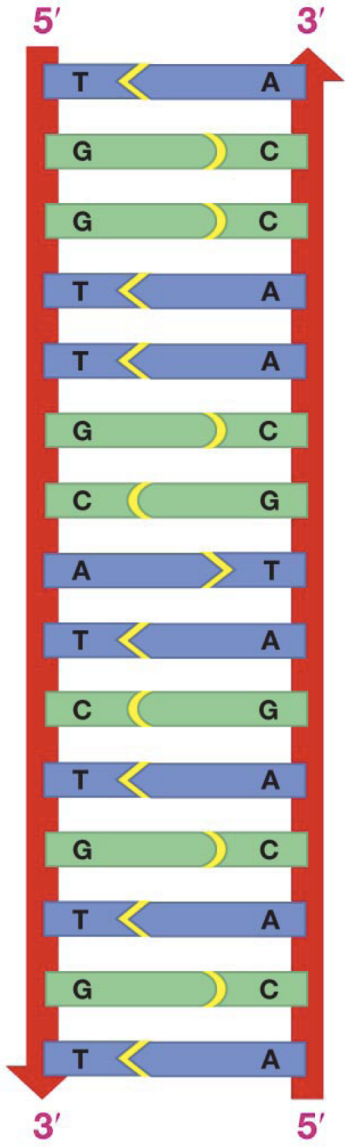
DNA
simplified drawings

Base pairing :

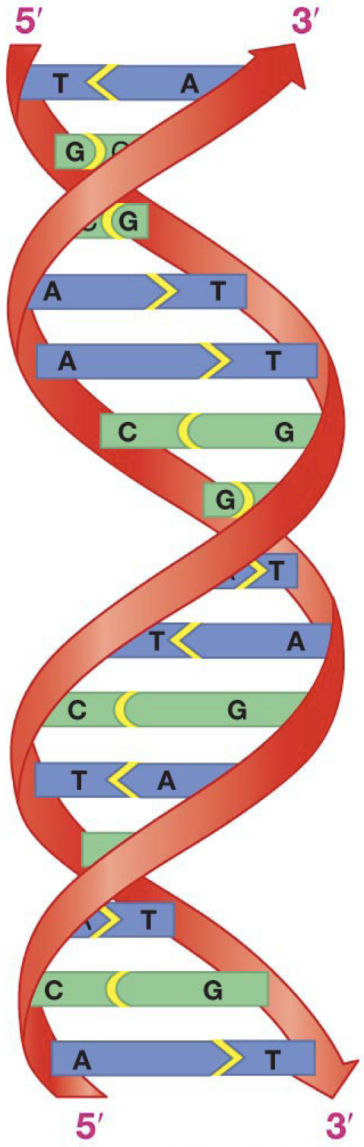
A = T

C ≡ G

Hydrogen bonds
2 between A and T
3 between C and G



lader



double helix

Base pairing :

A = T

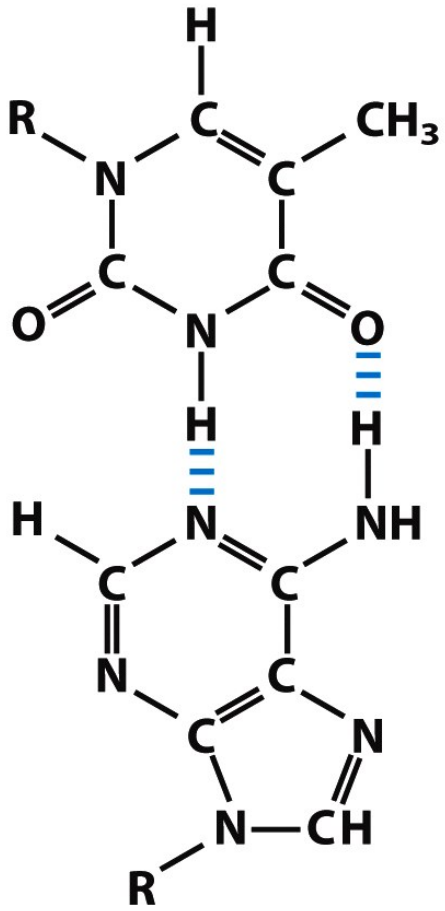
C ≡ G

Hydrogen bonds

2 between A and T

3 between C and G

Between complementary bases of DNA



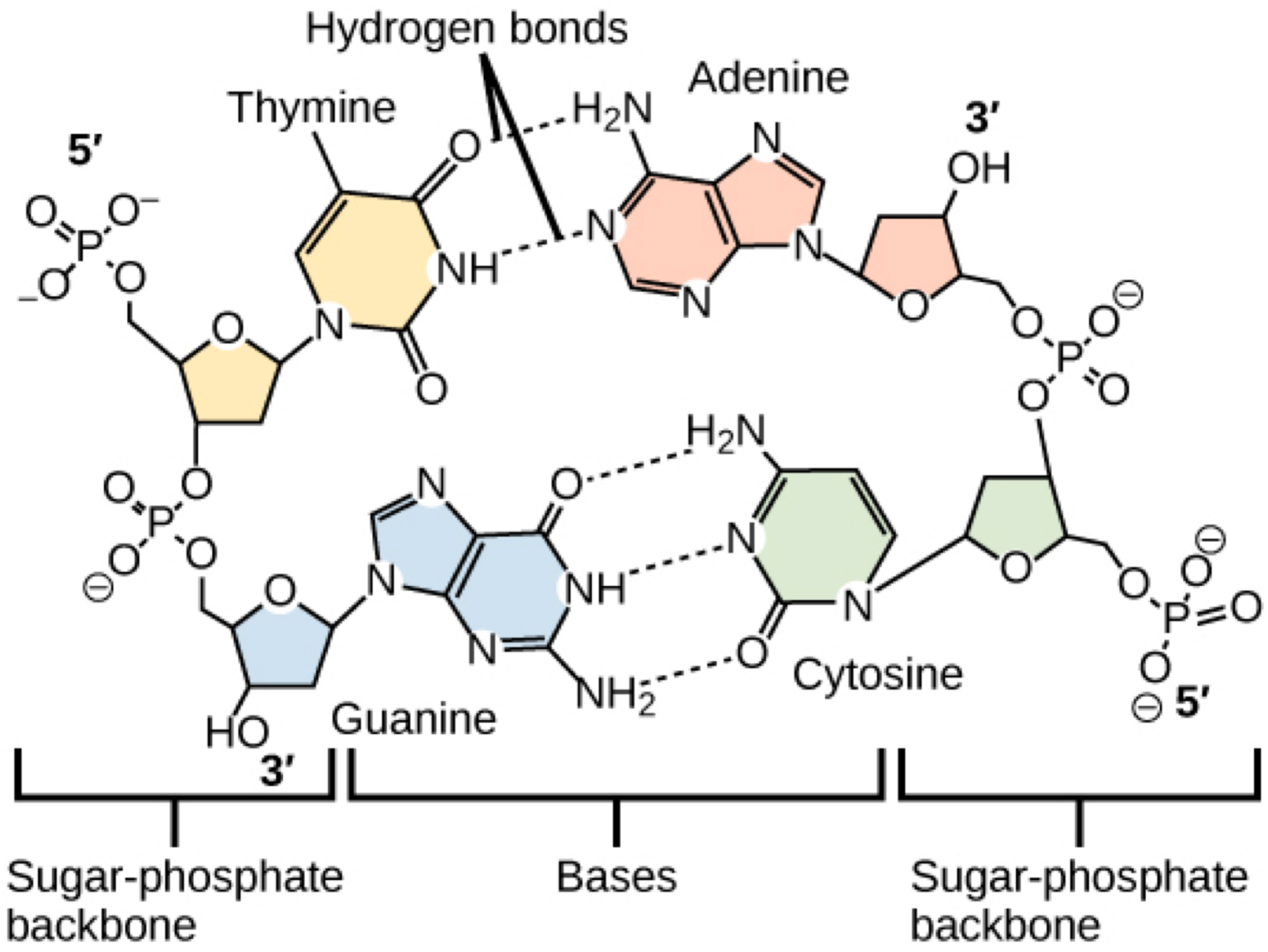
Thymine

Adenine

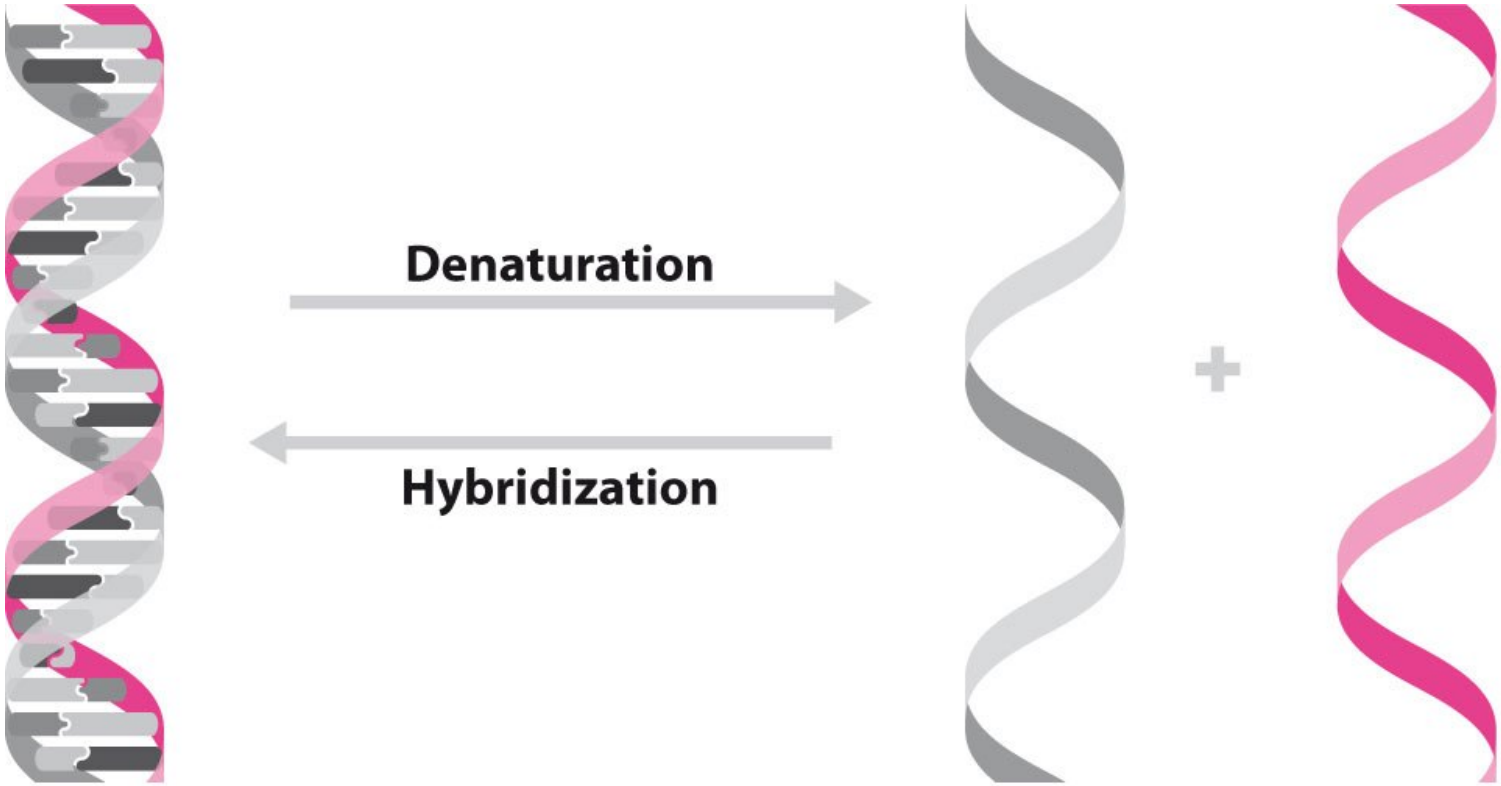
hydrogen bonds between 2 bases

Figure 2-4 part 4

Lehninger Principles of Biochemistry, Fifth Edition


Hydrogen bonds
Thymine
Adenine
5′
3′
OH
H_2N
NH
N
O
H_2N
NH
NH_2
Cytosine
Guanine
HO
3′
5′
Sugar-phosphate backbone
Bases
Sugar-phosphate backbone

Definitions : terms to know



double helix