(a) Some biologically important atoms and their valences

Carbon (valence: 4) | Hydrogen (valence: 1) | Oxygen (valence: 2) | Nitrogen (valence: 3)

(b) Some simple organic molecules with single bonds

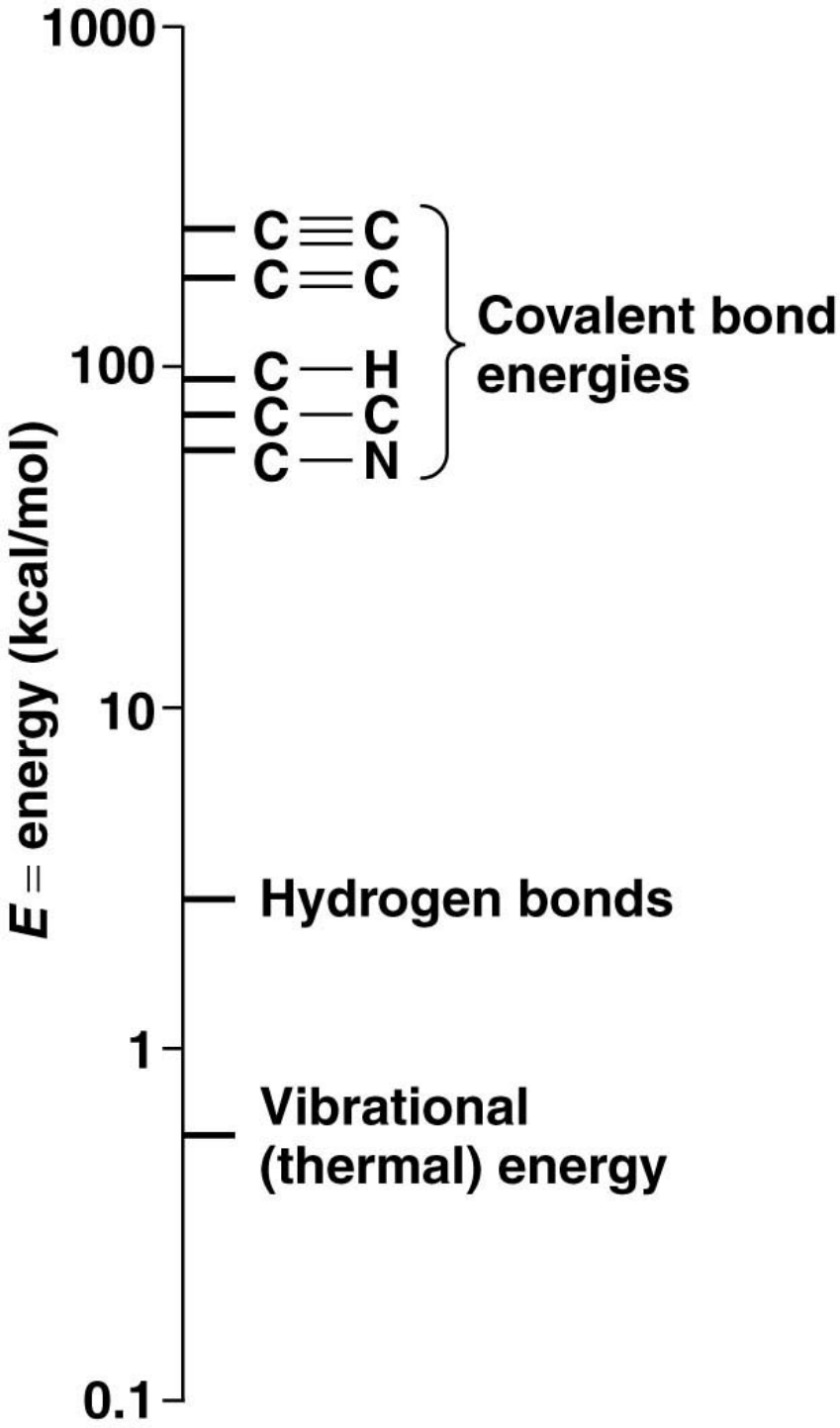
Methane (CH_4) | Ethanol ($CH_3 — CH_2OH$) | Methylamine ($CH_3 — NH_2$)

(c) Some simple molecules with double bonds

Ethylene ($CH_2 = CH_2$) | Carbon dioxide (CO_2)

(d) Some simple molecules with triple bonds

Molecular nitrogen (N_2) | Hydrogen cyanide (HCN) | Acetylene ($CH \equiv CH$)



$CH_3 — CH_3$

Ethane

$CH_3 — CH_2 — CH_3$

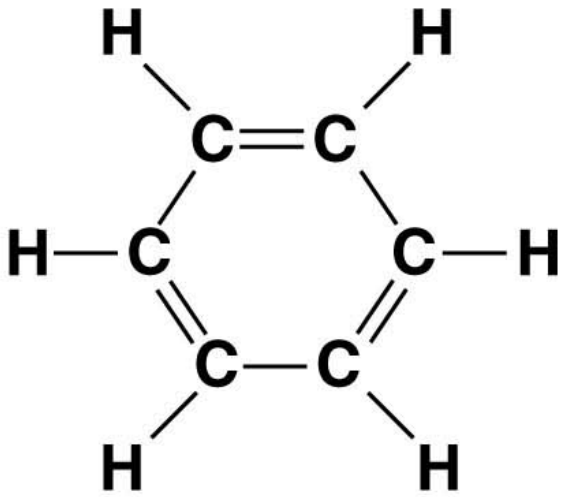
Propane

$CH_2 = CH_2$

Ethylene

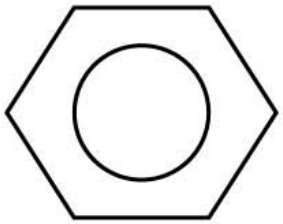
$CH \equiv CH$

Acetylene

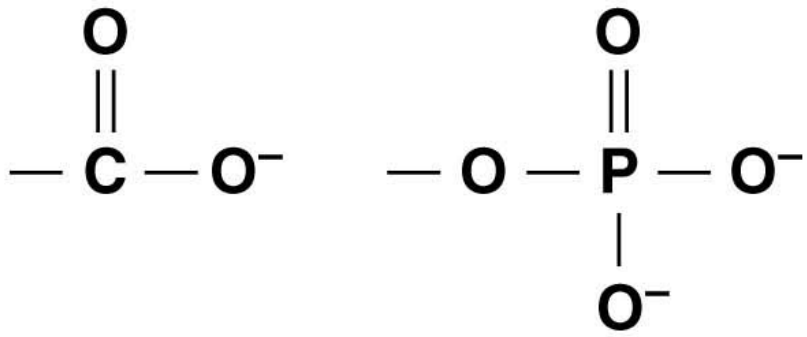


OR

OR



Benzene



Carboxyl

Phosphate

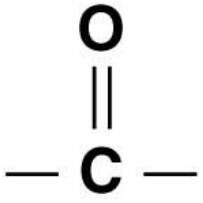
Negatively charged groups

Amino

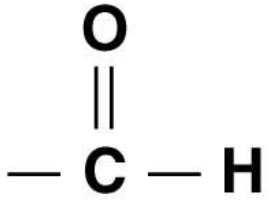
Positively charged group

Hydroxyl

Sulfhydryl

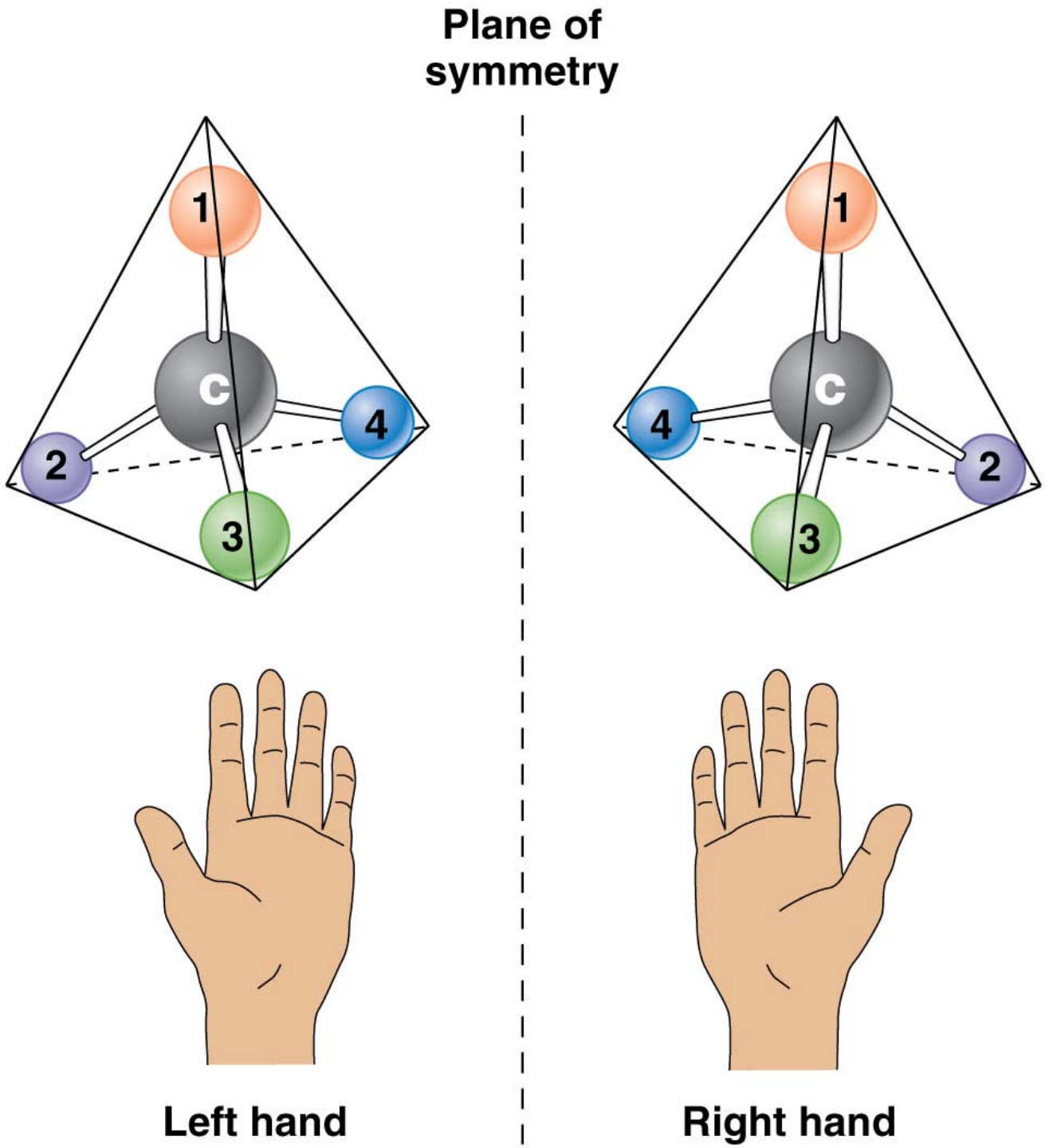


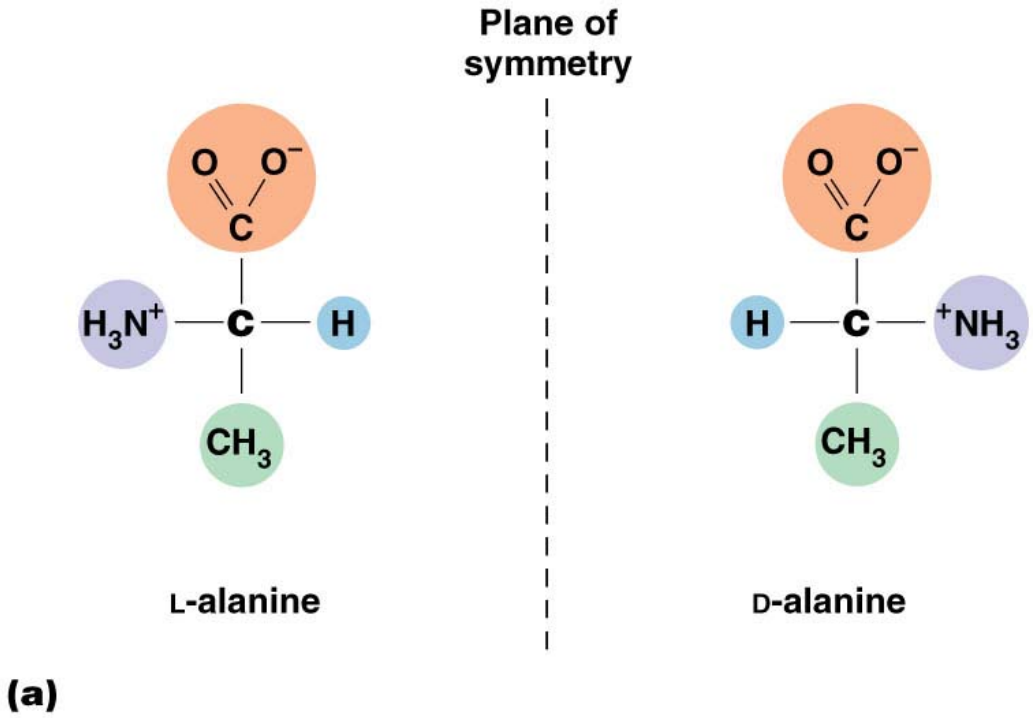
Carbonyl



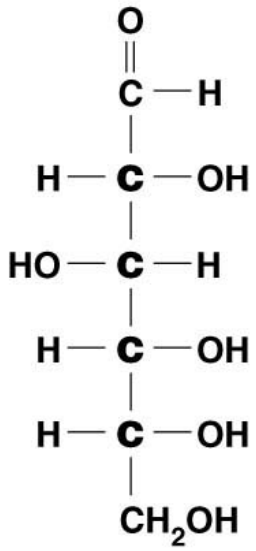
Aldehyde

Neutral but polar groups



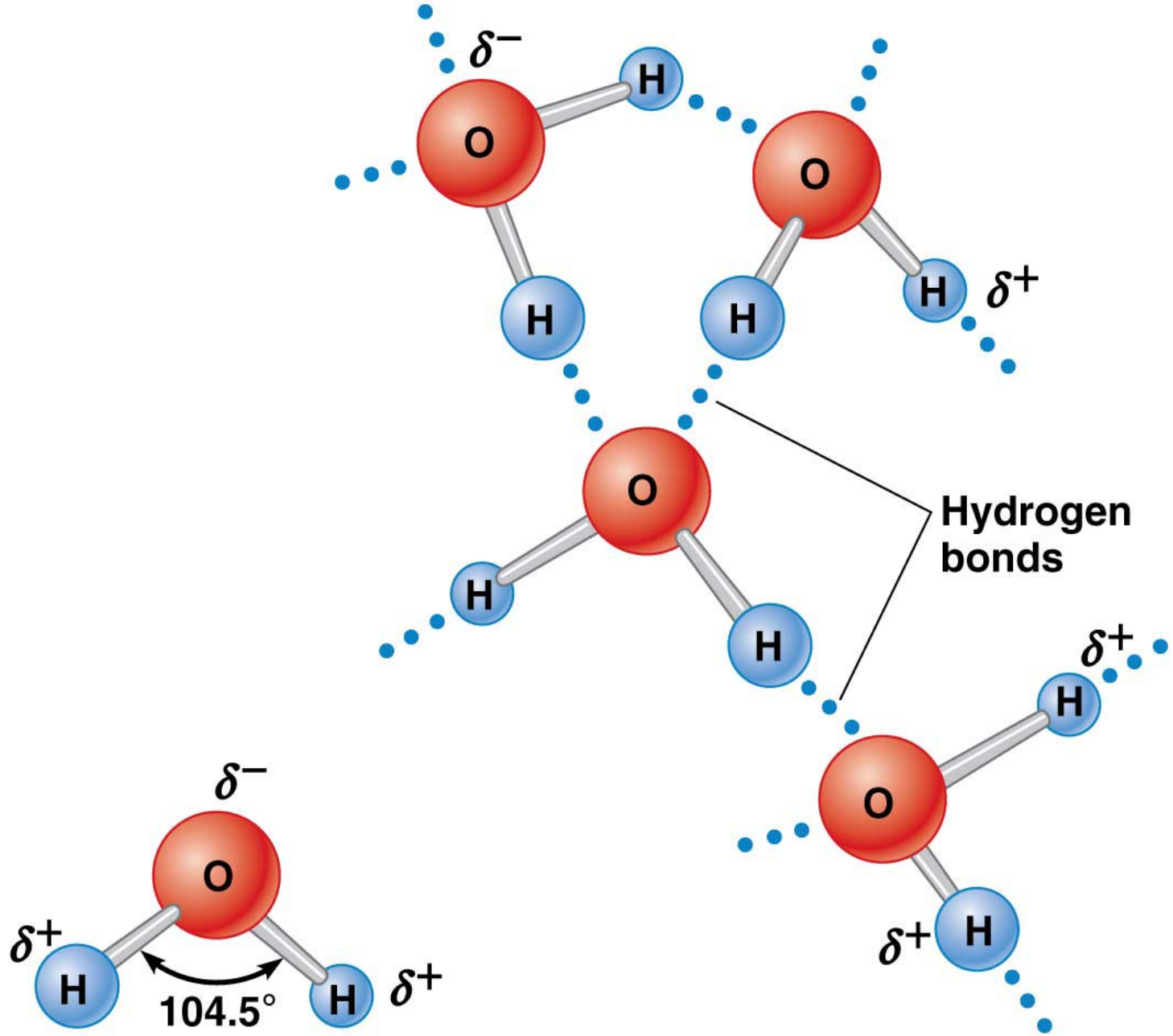


(a)



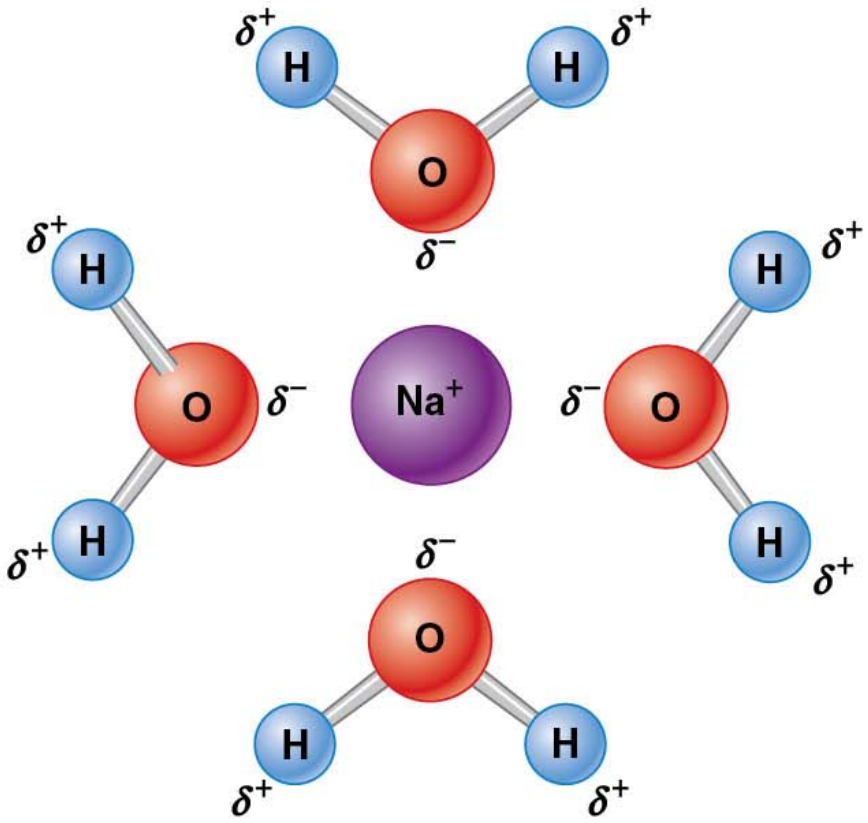
D-glucose

(b)

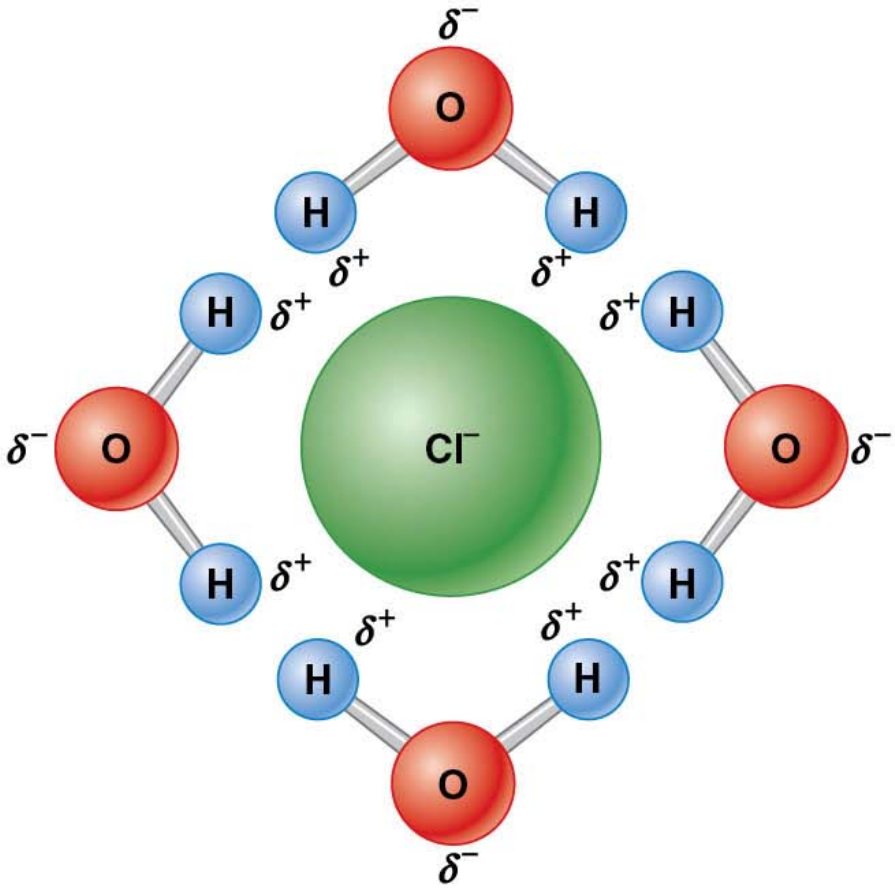


(a) Polarity of water molecule

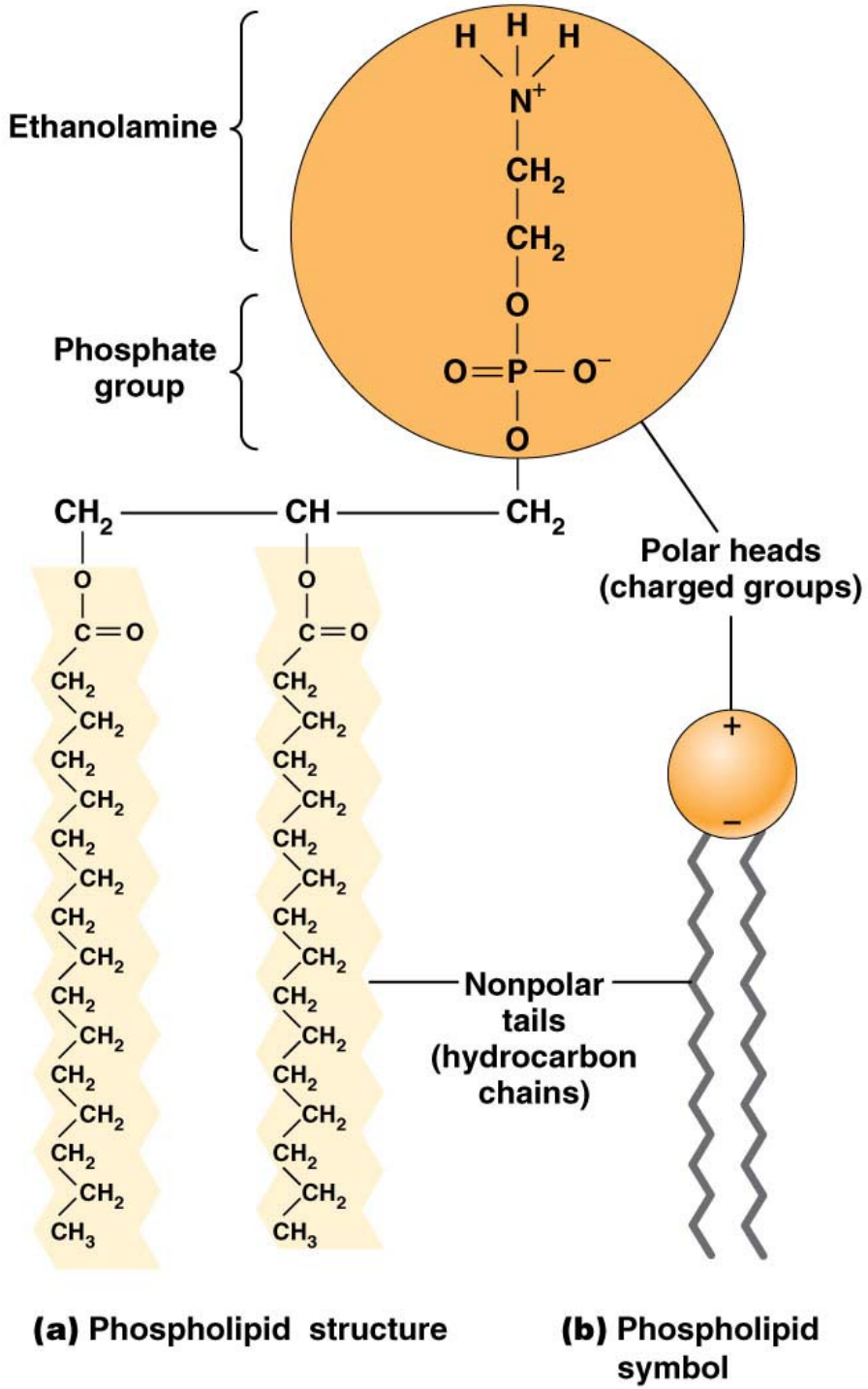
(b) Hydrogen bonding between water molecules

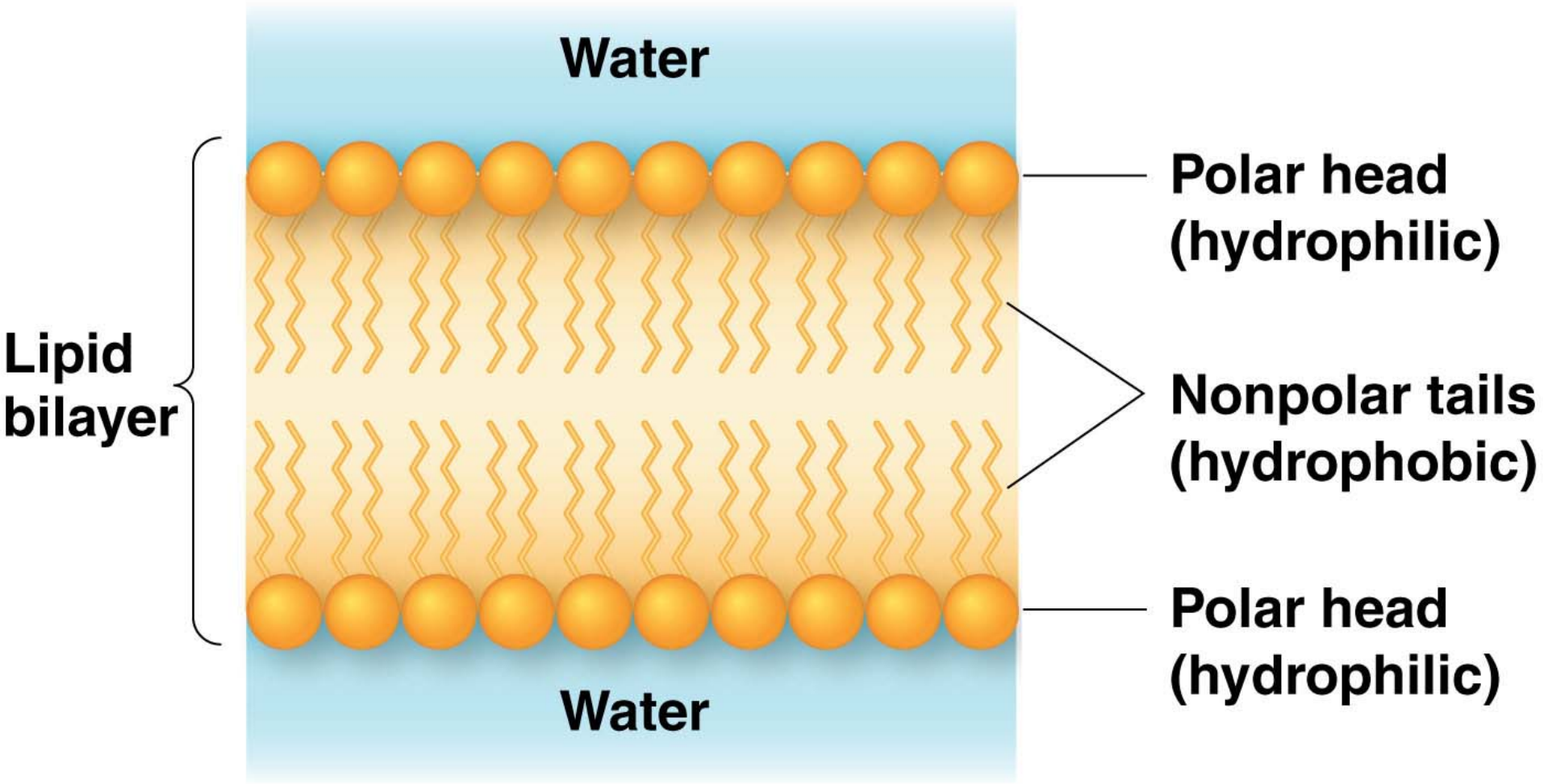


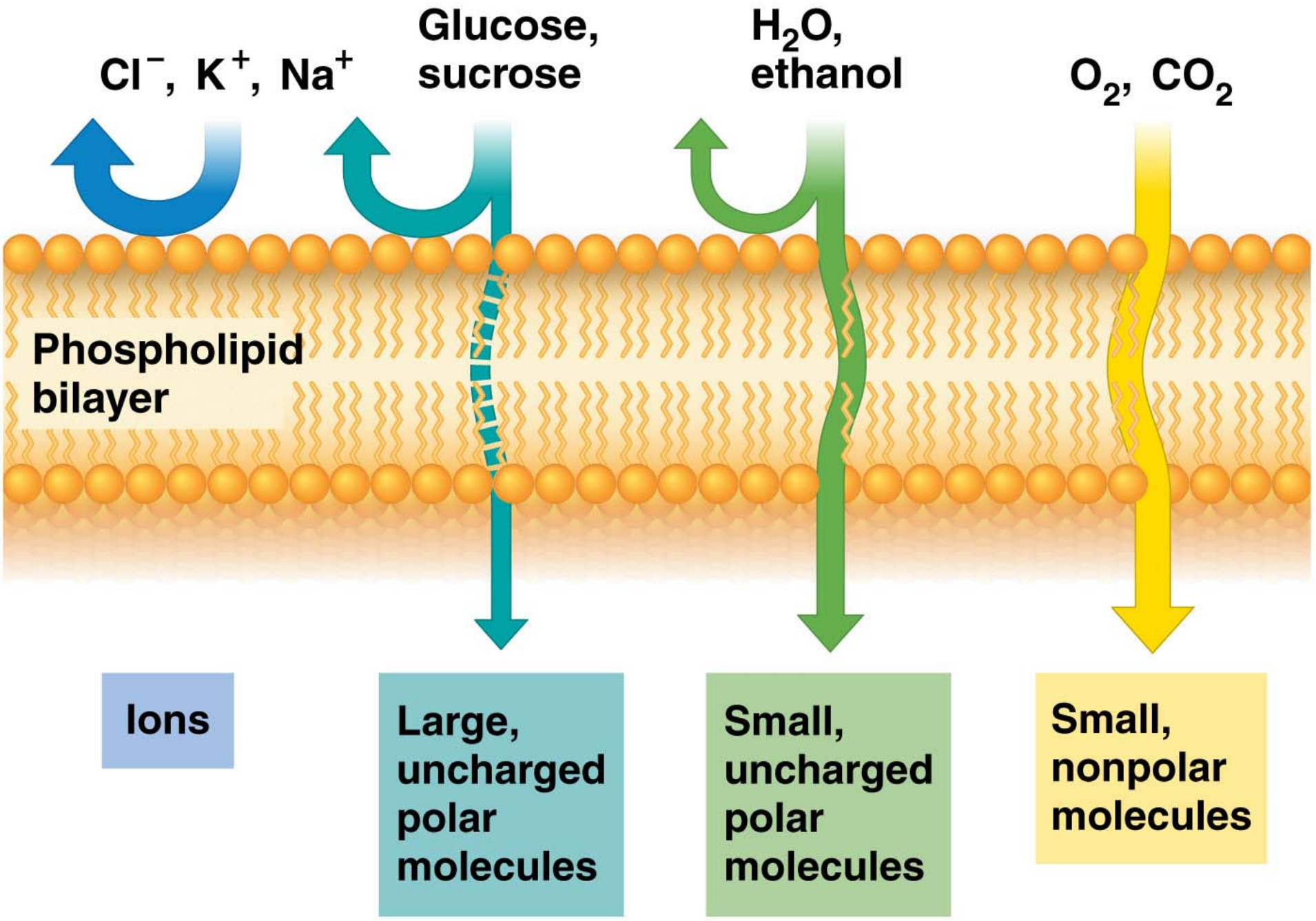
(a) Hydration of sodium ion

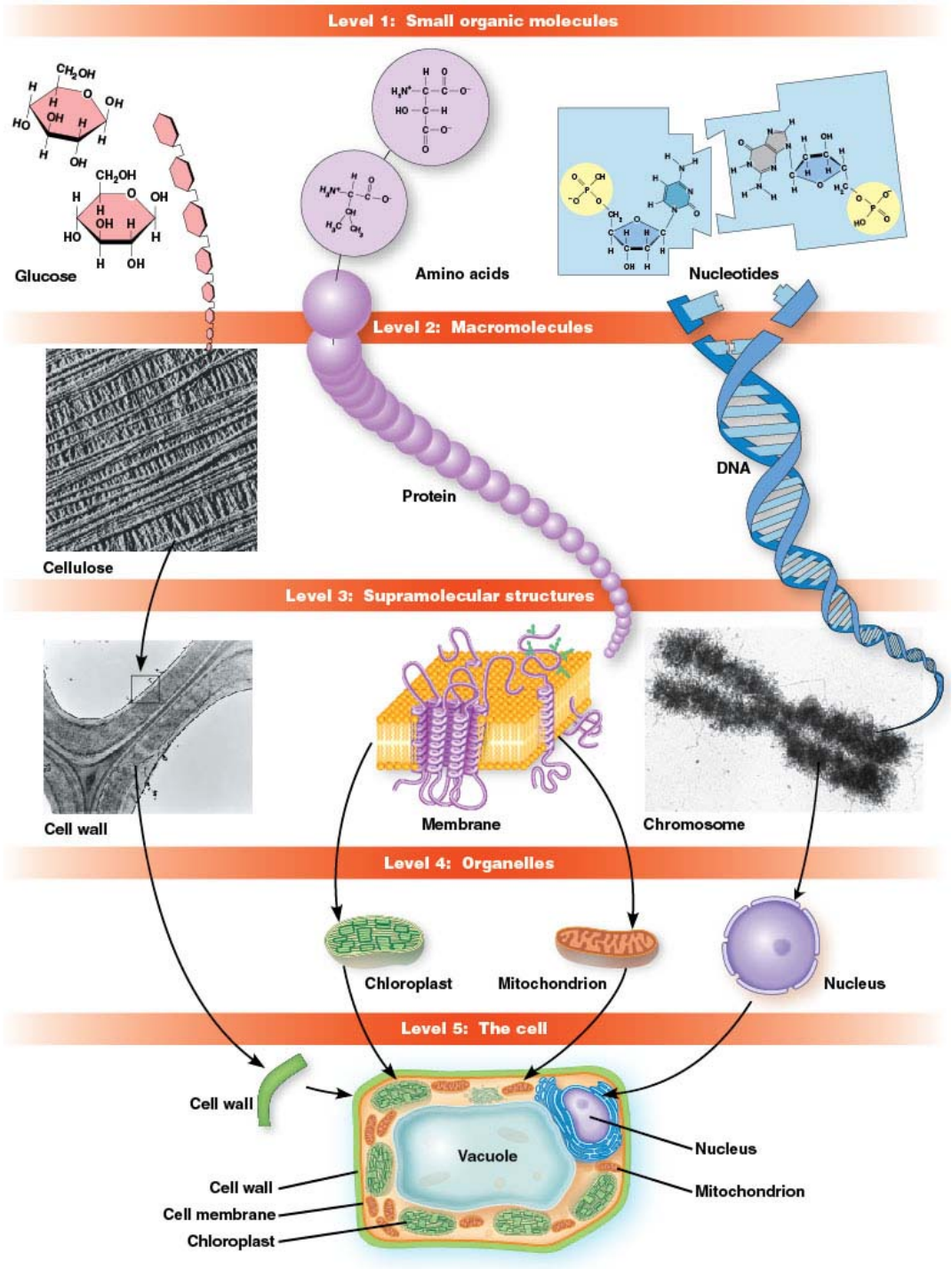


(b) Hydration of chloride ion









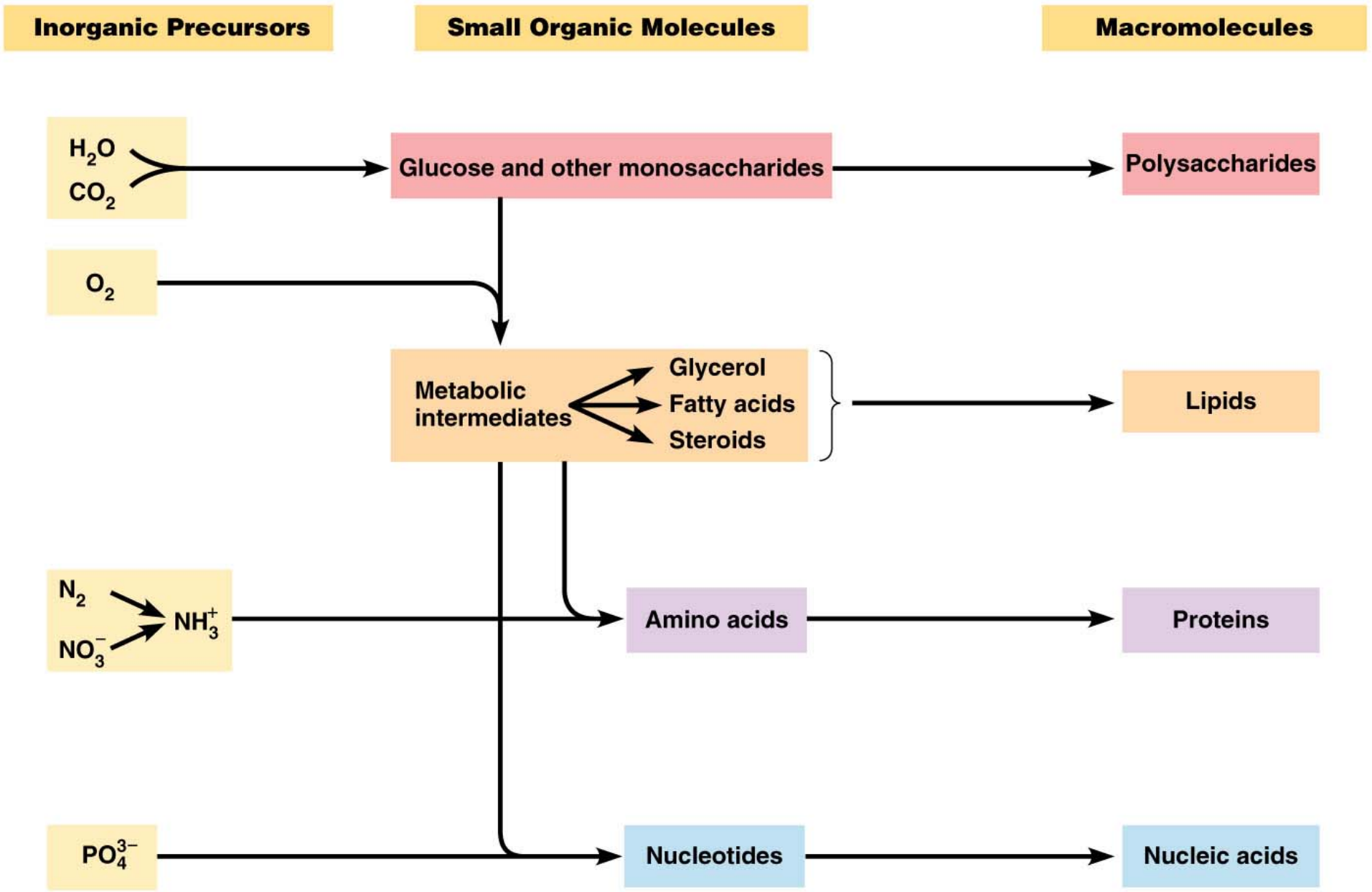
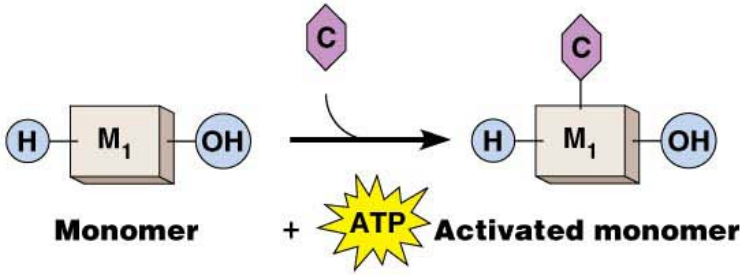


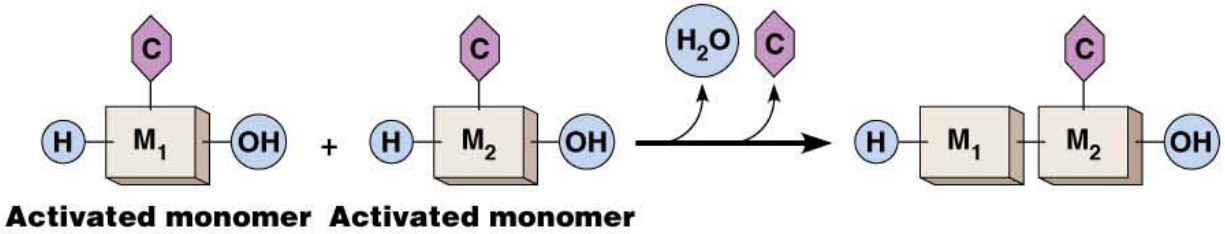
Table 2-1 Biologically Important Macromolecular Polymers*

	Proteins	Nucleic Acids	Polysaccharides**	
General function	Various (see below)	Informational	Storage	Structural
Examples	Enzymes, hormones, antibodies, carriers, ion channels	DNA, RNA	Starch, glycogen	Cellulose, chitin
Type of monomer	Amino acids	Nucleotides	Monosaccharides	Monosaccharides
Number of different monomers	20	4	One or a few	One or a few

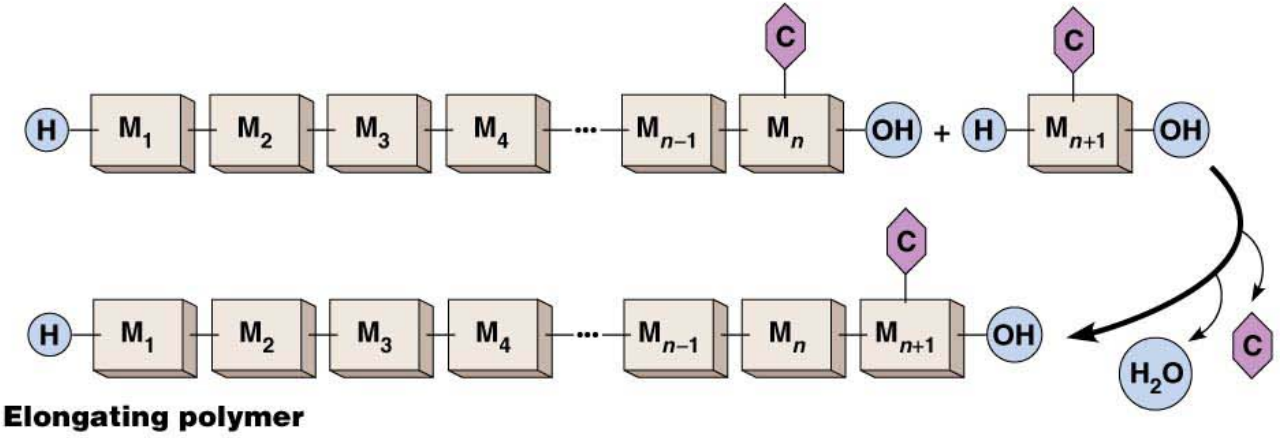
* Lipids are not included in this table because, although often considered as macromolecules, they are not long polymers.
** Also, addition of short oligosaccharide side chains to proteins and lipids is important in cell-cell interactions and signaling.



(a) Monomer activation. Monomers (M_1, M_2, etc.) with available H and OH groups are activated by coupling them to the appropriate carrier molecule (C shown in purple), using energy from ATP or a similar high-energy compound.



(b) Monomer condensation. The first step in polymer synthesis involves the condensation of two activated monomers, with the release of one of the carrier molecules.



(c) Polymerization. The *n*th step will add the next activated monomer (M_{n+1}) to a polymer that already has *n* monomeric units.

Denaturation. First, the folded polypeptide was exposed to denaturing conditions, resulting in a ribonuclease molecule with no fixed shape and no enzymatic activity.

Renaturation. Then, renaturing conditions allowed the denatured polypeptide to return spontaneously to its native conformation, regaining enzymatic activity.