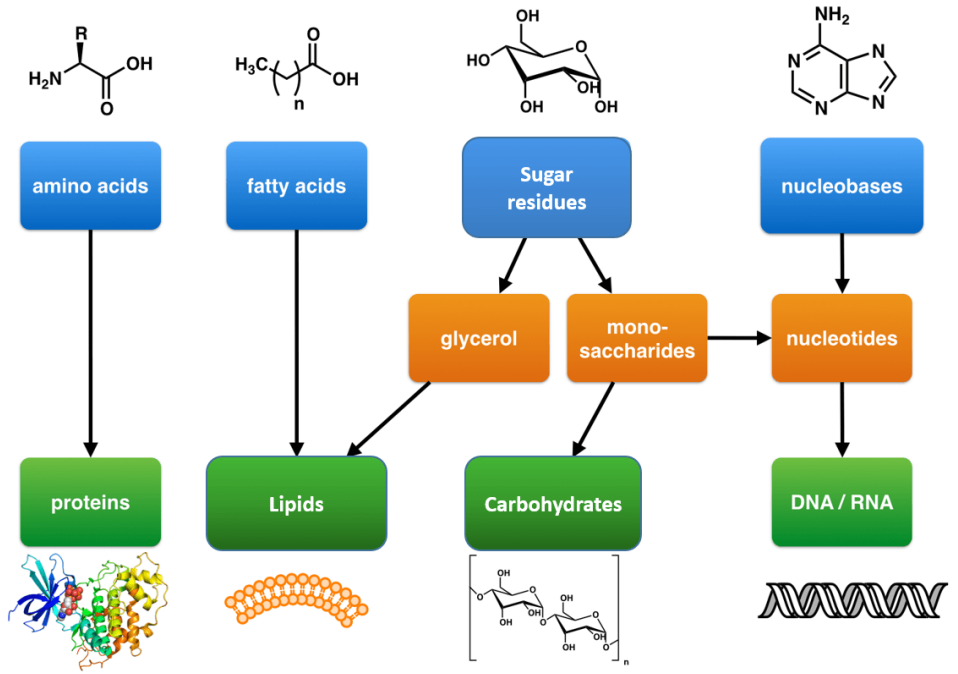
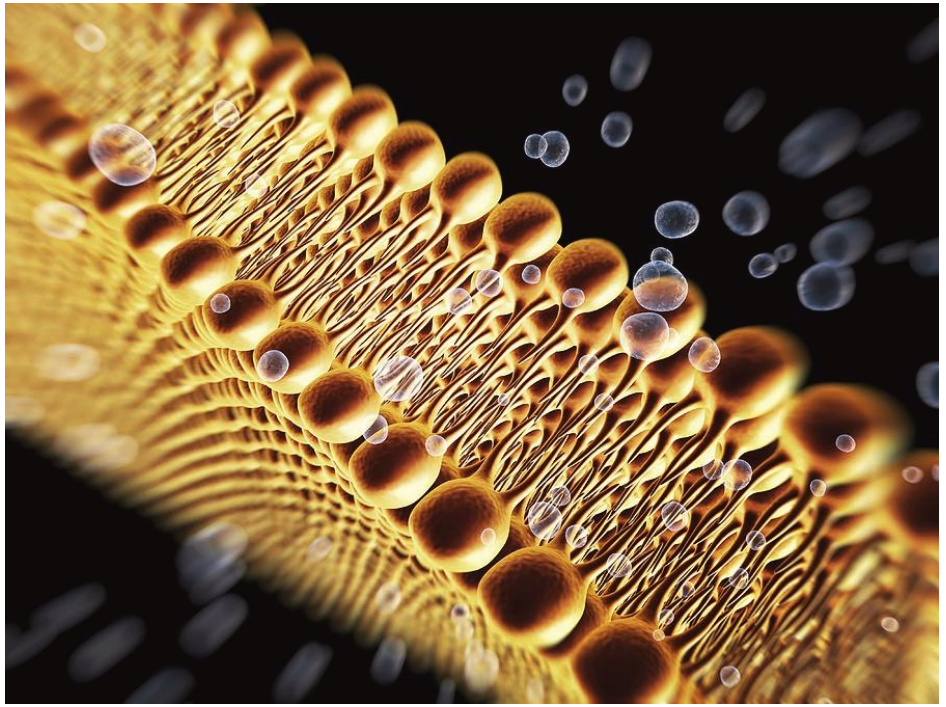
Lesson 2
Recognizing Macromolecules



Recognizing macromolecules

- Macro = big → Macromolecules = BIG molecules
- 4 major classes of macromolecules in cells:
  - Lipids



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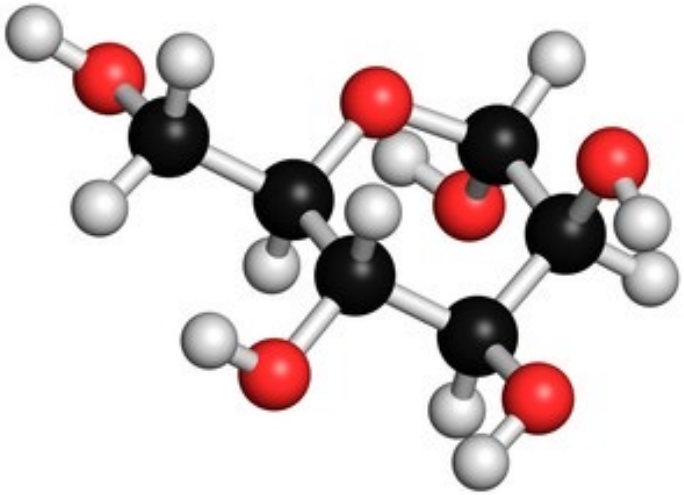

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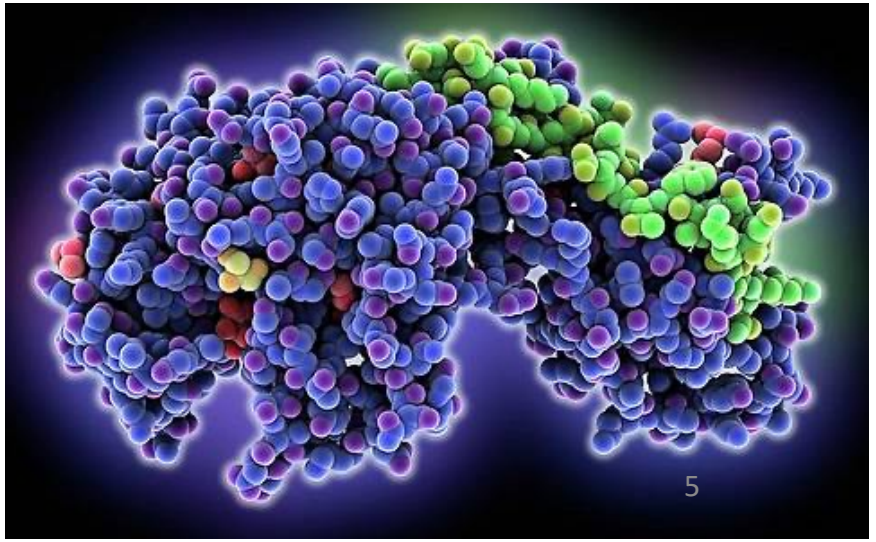

Recognizing macromolecules

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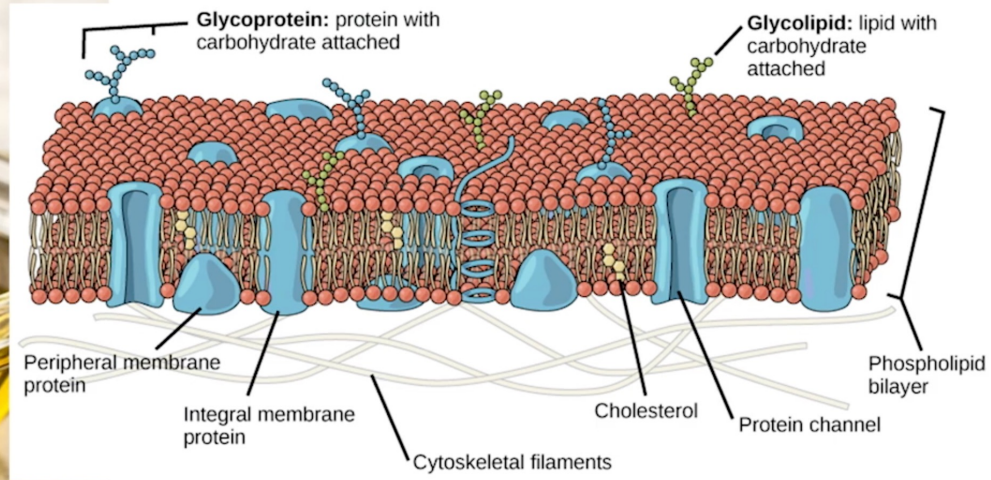
- 4 major classes of macromolecules in cells:
    - Lipids
    - Carbohydrates
    - Nucleic acids
    - Proteins
- They are often polymers –> (monomer = M, polymer = M_n)

Lipids

- Membranes, signals, energy storage, protection
- Non-polar (hydrophobic) (**key attribute**)
- Or amphipathic (partly polar)
- Long chain or small



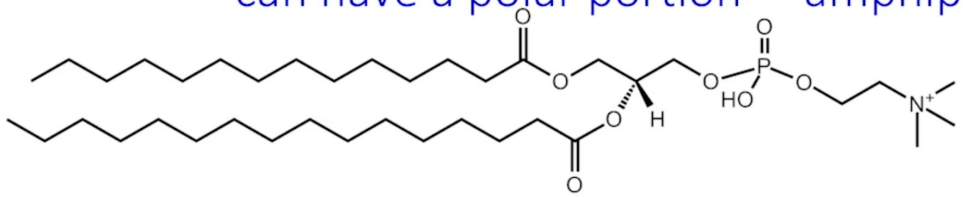
cell membranes

lipid functions

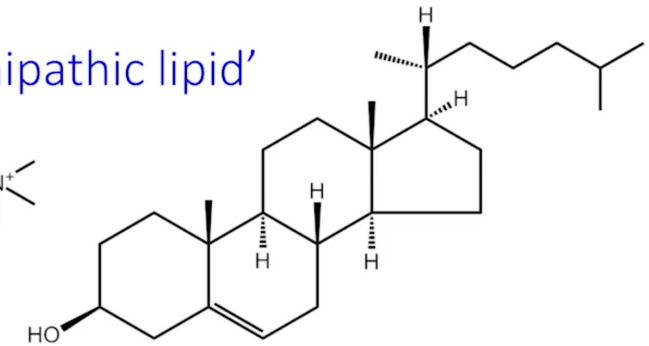
signaling

Lipids

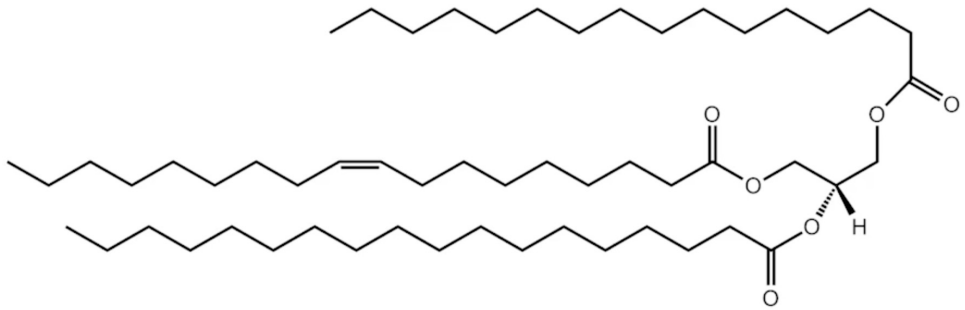
Lipids non-polar (hydrophobic)
can have a polar portion = 'amphipathic lipid'



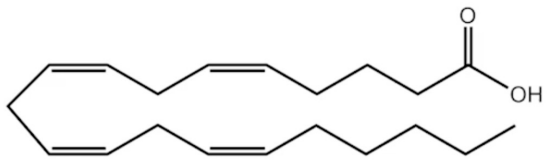
1-myristoyl-2-palmitoyl-*sn*-glycerophosphocholine
(Glycerophospholipids)



Cholesterol (Sterol lipids)

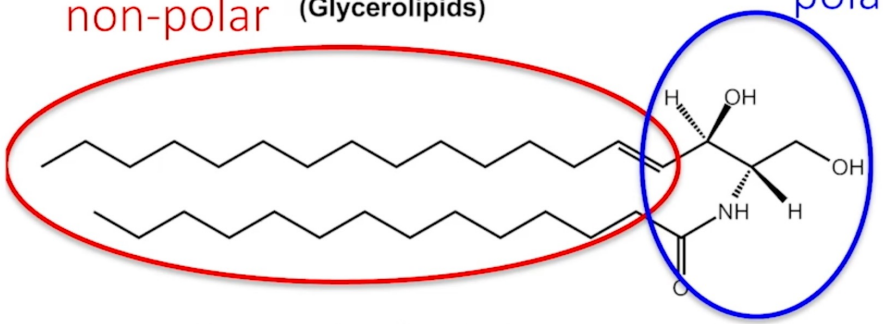


1-oleoyl-2-stearoyl-3-palmitoyl-*sn*-glycerol
(Glycerolipids)

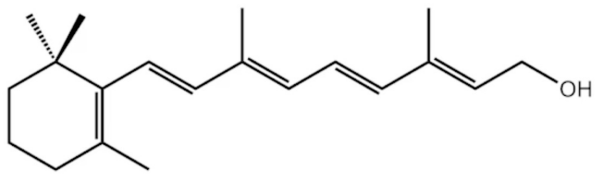


Arachidonic acid (Fatty acyls)

non-polar polar



N-myristoyl-sphing-4-enine
(Sphingolipids)

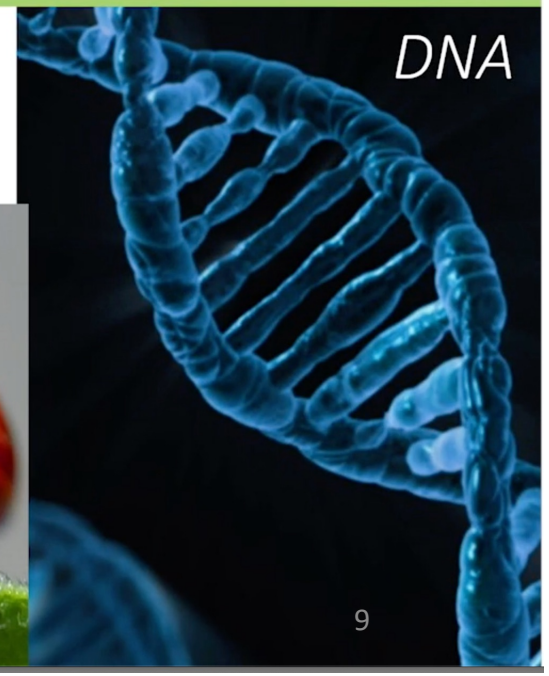


Retinol (Prenol lipids)

Carbohydrates

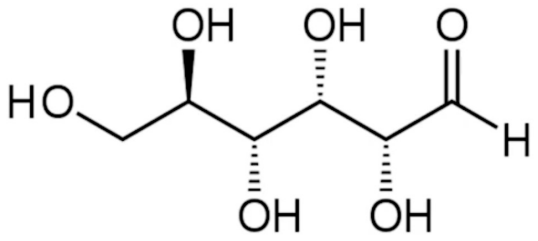
- Energy, information, structure
- Basic chemical formula CH_2O ($C_6H_{12}O_6$)
- Monomer M = monosaccharides (sugars)
- Polymers = polysaccharides (glycogen, starch, cellulose…)
- Ms joined by glycosidic bonds C-O-C

carbohydrate functions

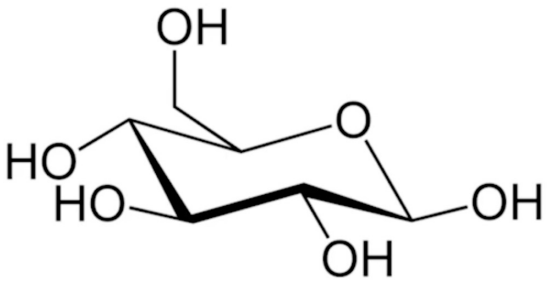


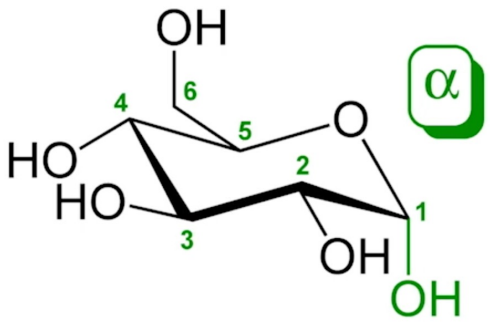
Carbohydrates

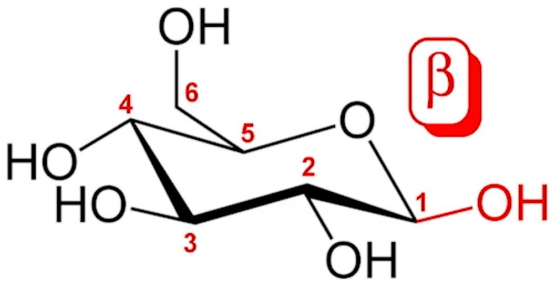
Glucose isomers

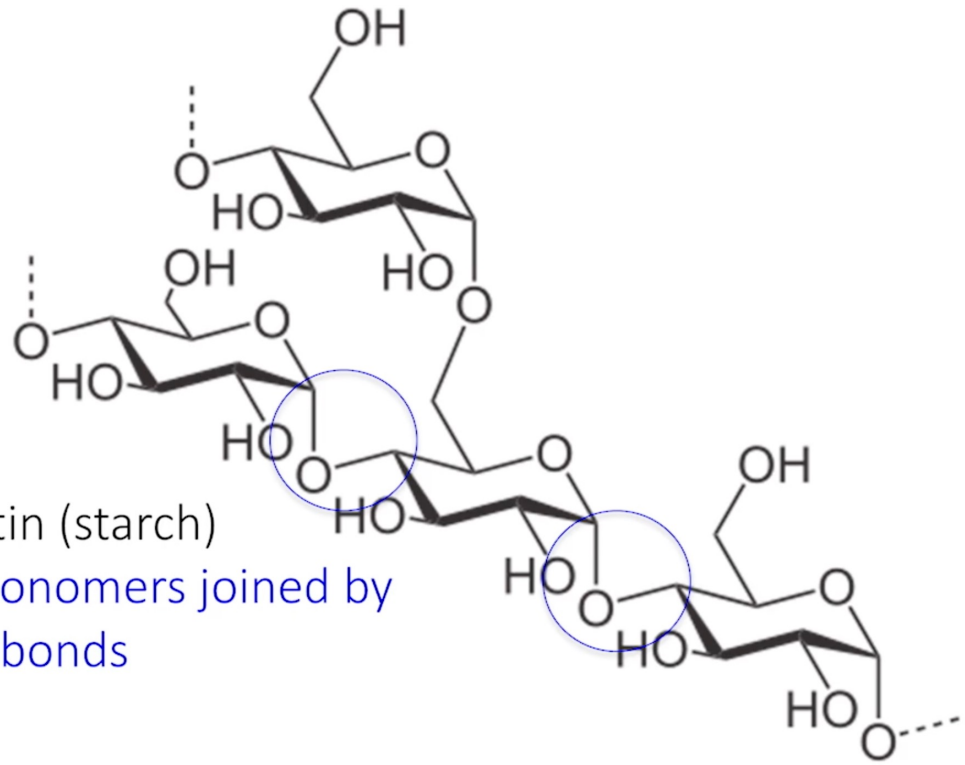


open chain









amylopectin (starch)
glucose monomers joined by
glycosidic bonds
C-O-C

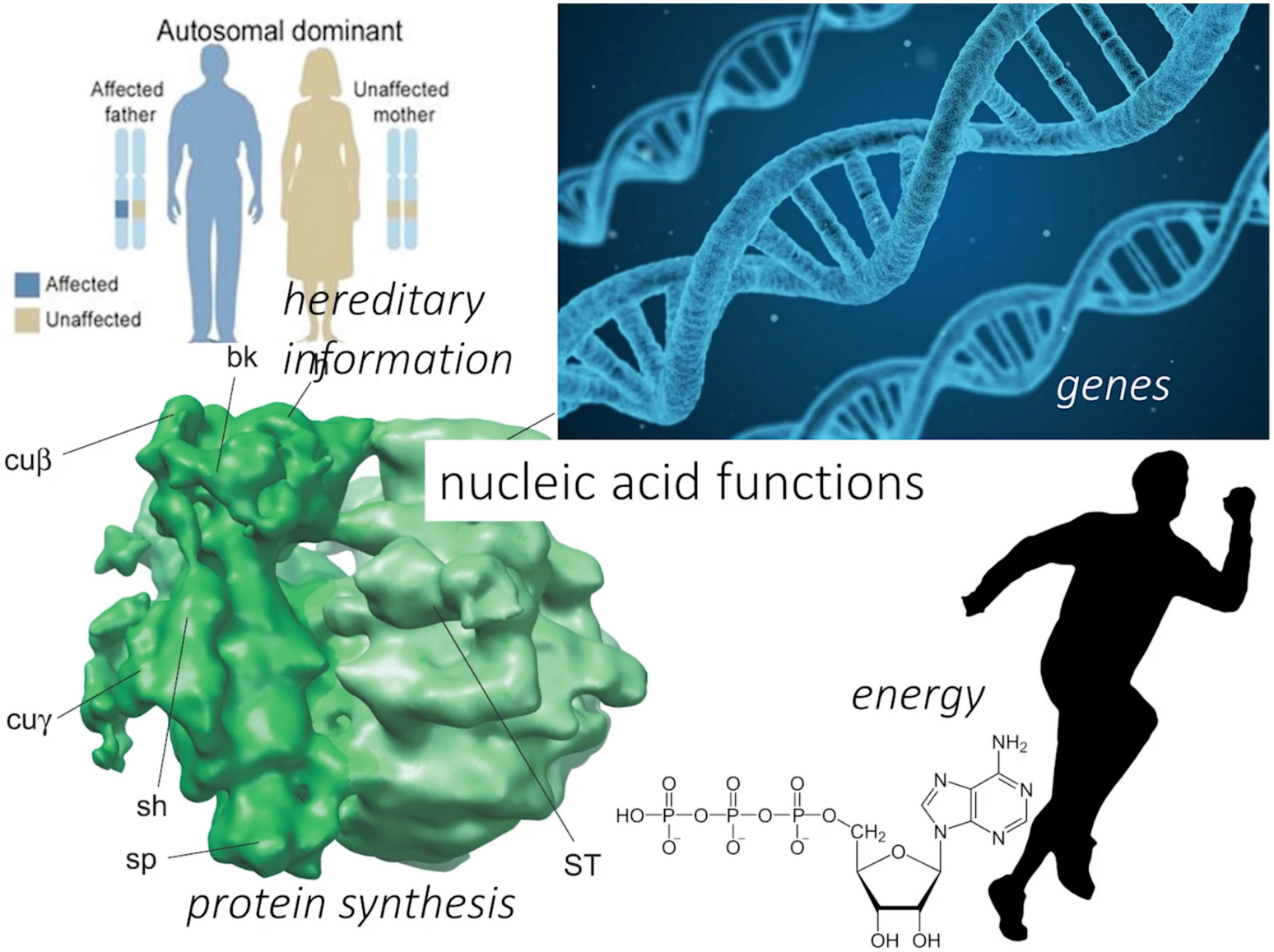
In starch → α-1,4 in cellulose → β-1,4 WHAT CAN WE DIGEST AND WHY?

Nucleic acids

- Hereditary information (genes), energy
- Monomer M = nucleotides
- Polymers = DNA or RNA
- The nucleotide structure is stereotypical:

Phosphate-sugar-base (P-S-B)

- Sugar = (5C) ribose (RNA) or deoxyribose (DNA)
- 5 bases:
  - Adenine (A), Guanine (G) = PURINES
  - Cytosine (C), Thymine (T), Uracil (U) = PYRIMIDINES
- A,G,C,**T** = DNA
- A,G,C,**U** = RNA

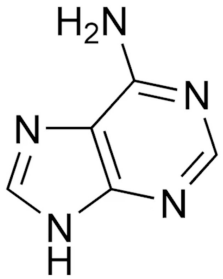


Nucleic acids

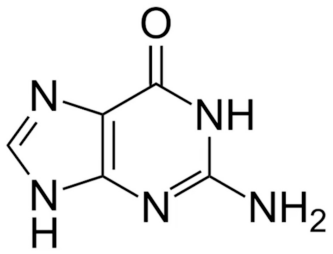
PURINES | PYRIMIDINES

BASES of nucleic acid

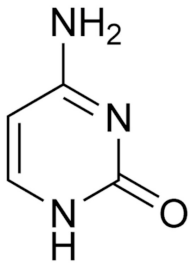
Adenine



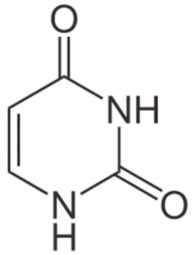
Guanine



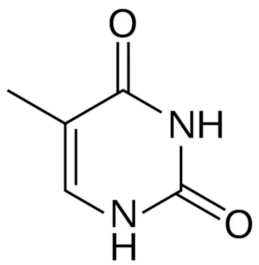
Cytosine



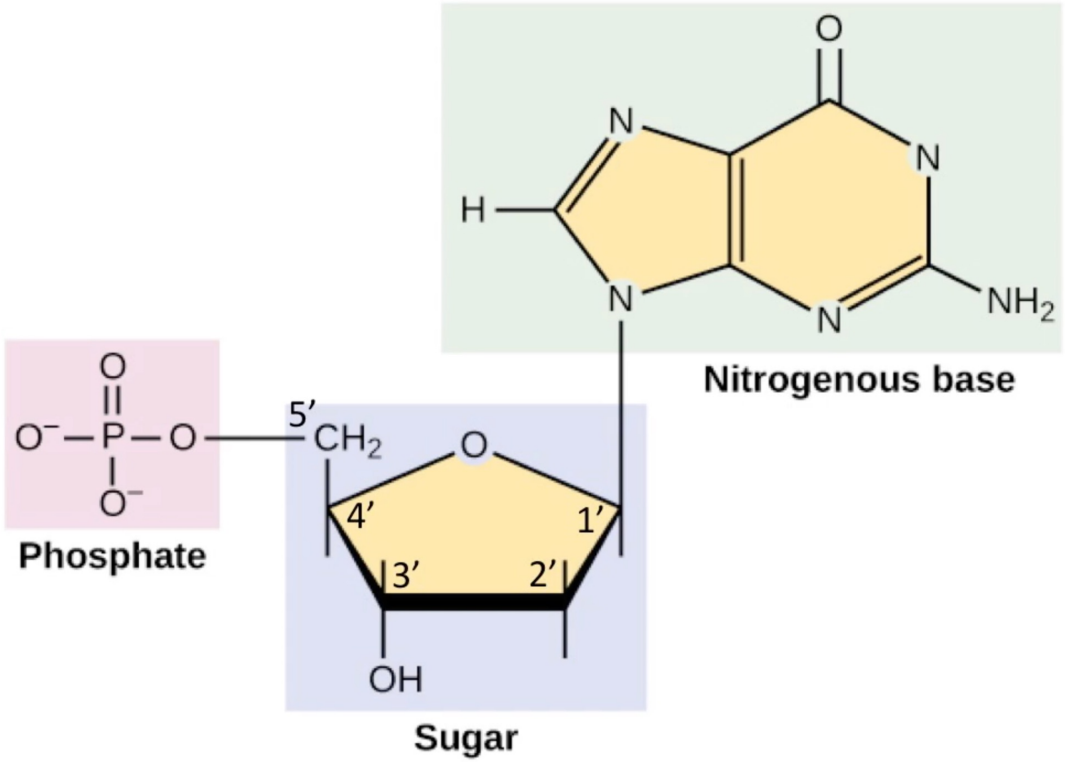
Uracil (RNA)



Thymine



Nucleotide

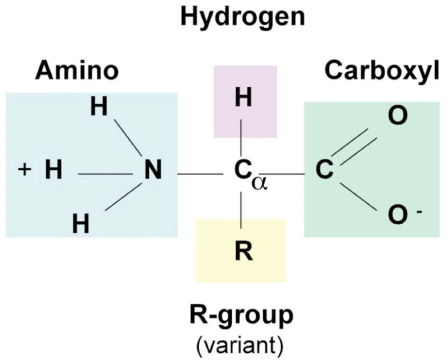


Note that the carbon atoms of the sugar are called C1', C2' etc
C1' is where the base attaches
C2' can have attached a H (as here, for DNA) or a OH group (for RNA)
C3'is very important and where the next nucleotide will join
C5' is where the phosphate group attaches

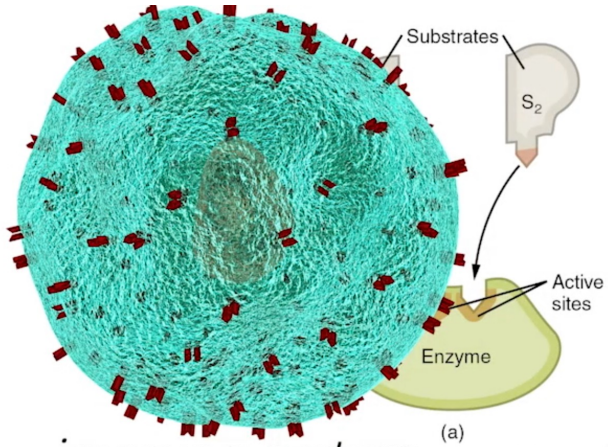
Proteins

- Everything except genes
- Monomer M = amino acids
- 20 natural common amino acids
- Polymer = protein
- Amino acid structure:

Alpha C + NH_2 + COOH + R (side group)

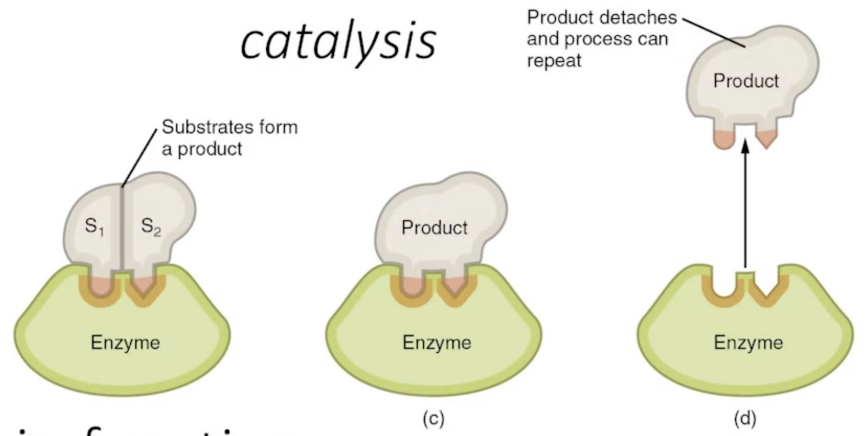


- R can be polar, non-polar, charged, uncharged
- Three or one letter code:
  - Valine = VAL
  - Valine = V



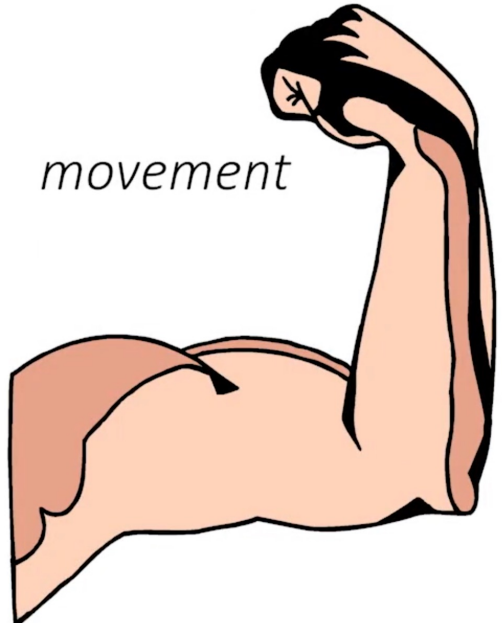
immune system

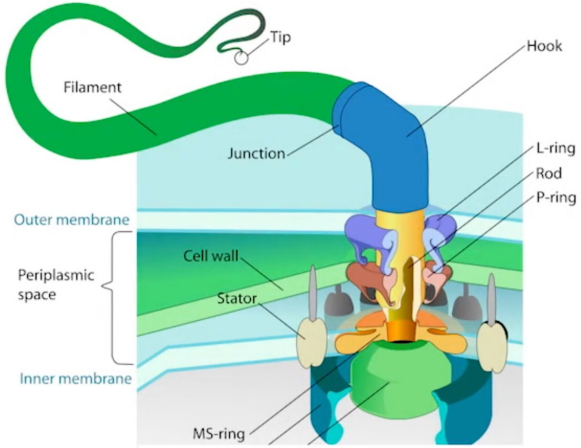
catalysis



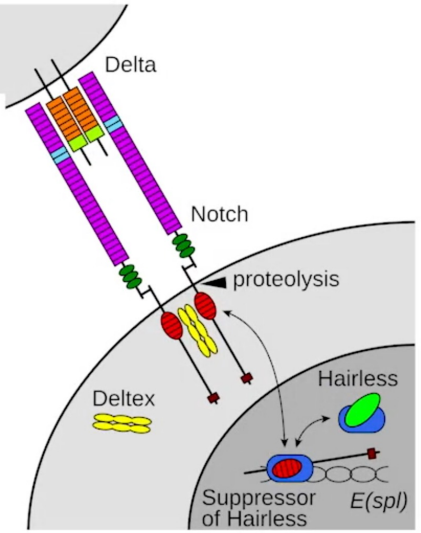
protein functions (almost everything)

movement



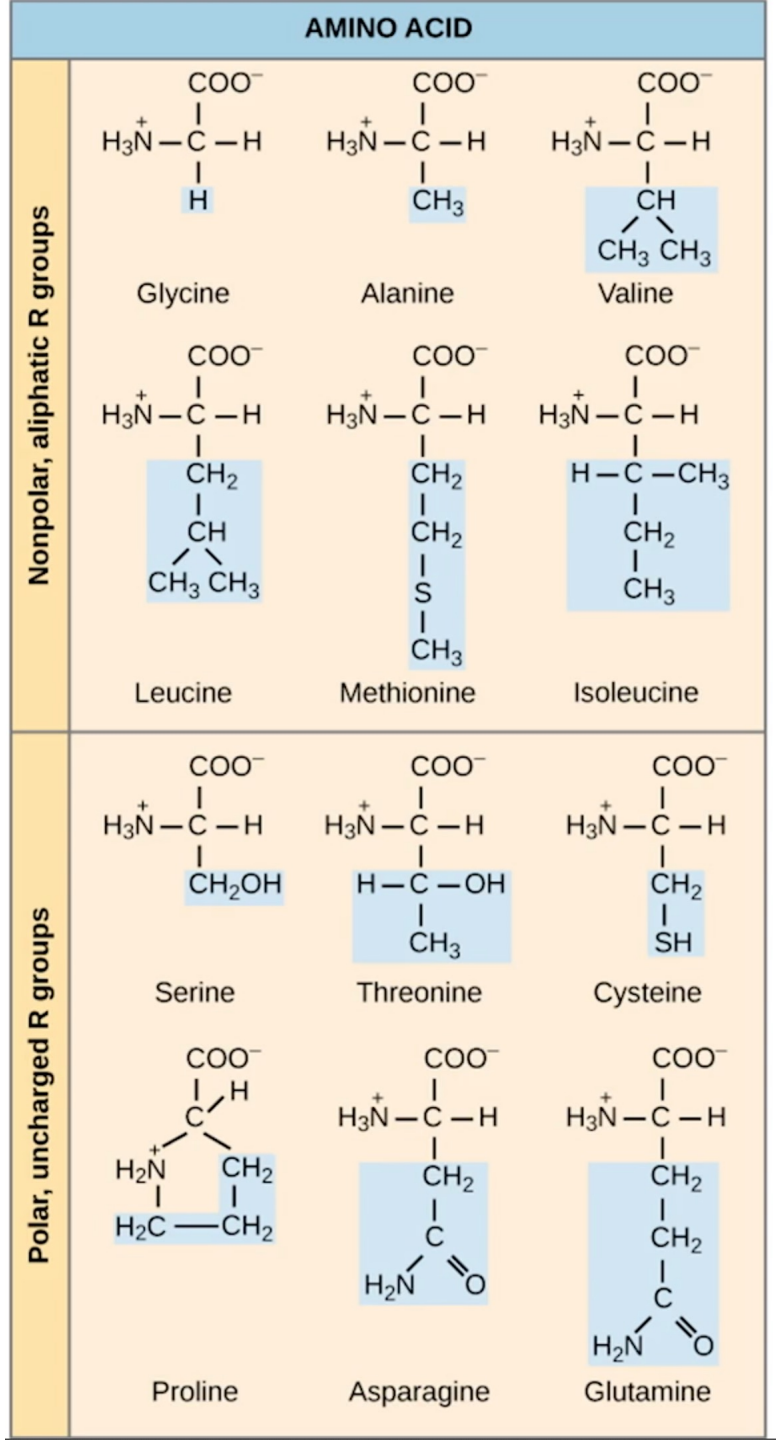


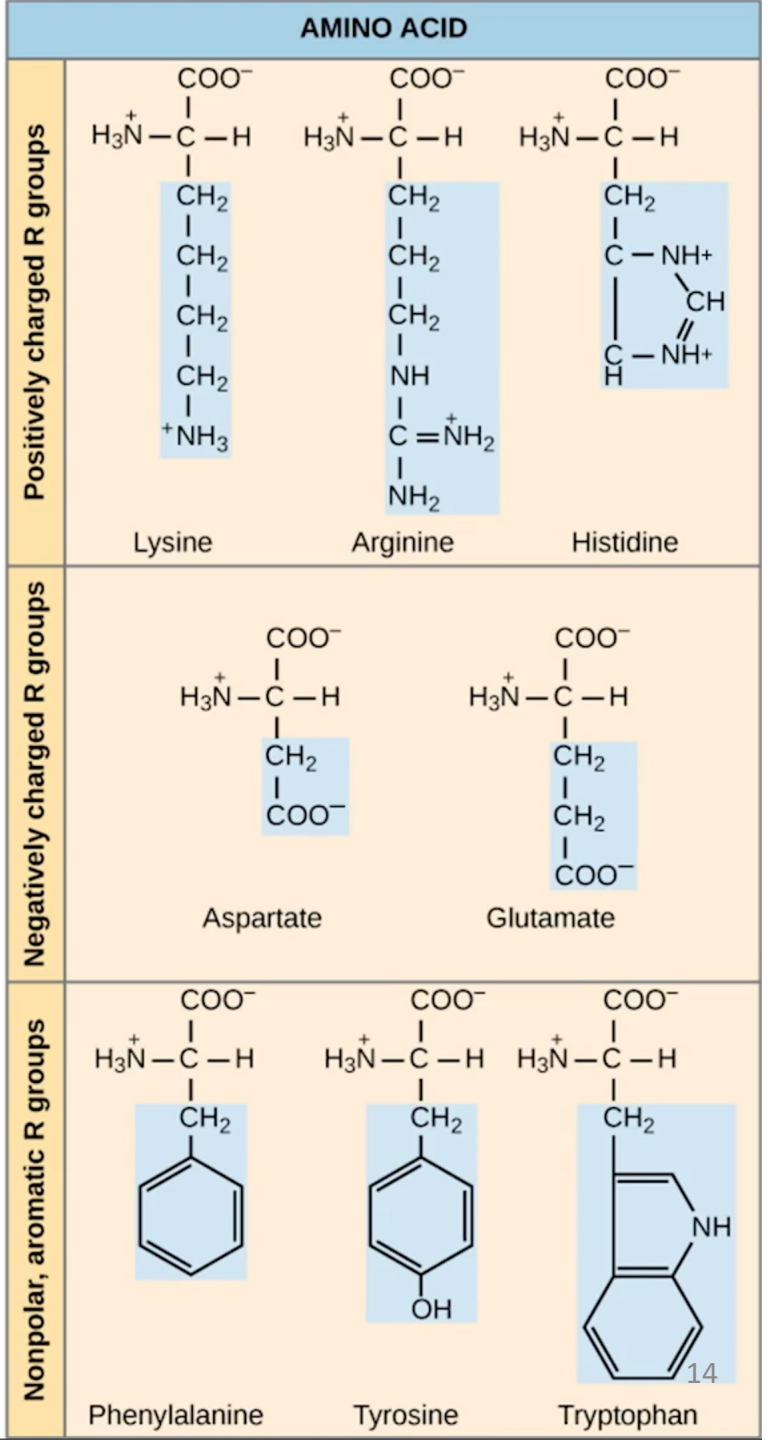
cellular motors



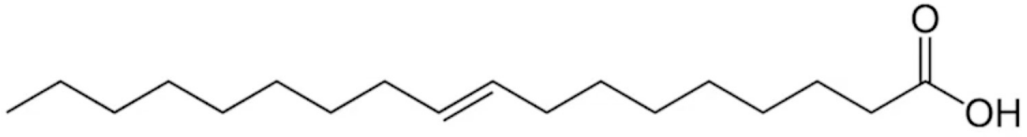
signaling

Proteins

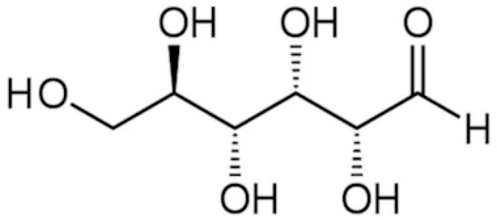

AMINO ACID
Nonpolar, aliphatic R groups
Glycine
Alanine
Valine
Leucine
Methionine
Isoleucine
Polar, uncharged R groups
Serine
Threonine
Cysteine
Proline
Asparagine
Glutamine


AMINO ACID
Positively charged R groups
Lysine
Arginine
Histidine
Negatively charged R groups
Aspartate
Glutamate
Nonpolar, aromatic R groups
Phenylalanine
Tyrosine
Tryptophan

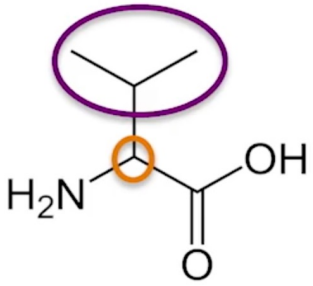
Recognizing macromolecules - review



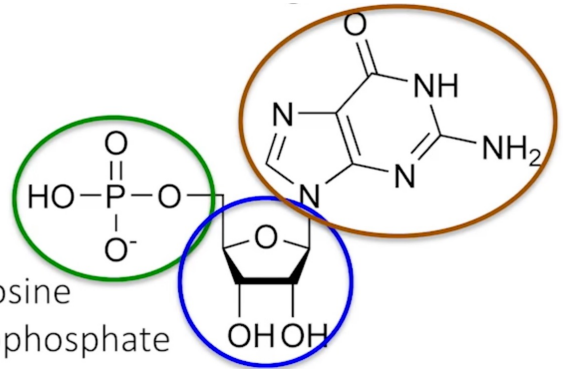
trans-oleic acid



glucose



valine



guanosine monophosphate

Lipids: **nonpolar**/hydrophobic

Carbohydrates: **CH_2O** formula/**polar**

Proteins: M = **amino acid** = **αC bonded to NH_2, COOH and R**, R = polar/nonpolar

Nucleic acids: M = **nucleotide** = **phosphate + sugar + base**, **polar**