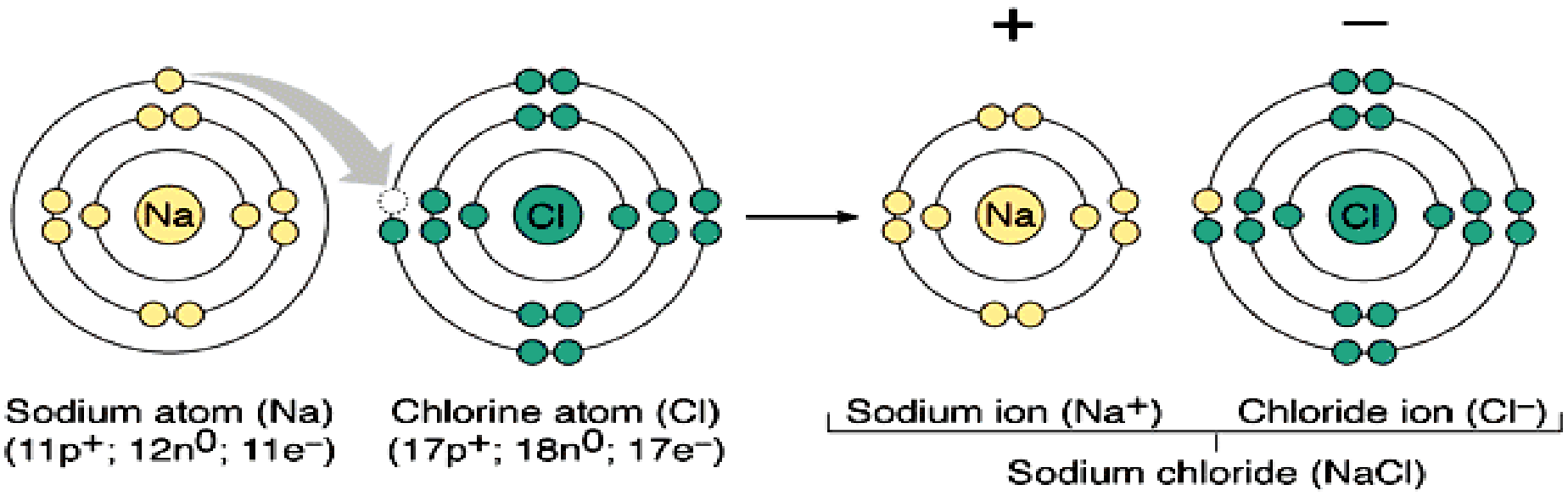
Ionic Bonds

- Example: table salt (sodium chloride)
  - Sodium atom has one electron in its outer valence shell it can lose 1 electron for greater stability
  - Chlorine has 7 electrons in its outer shell – it needs 1 more for greater stability
  - Sodium transfers one electron to chlorine
    - Cl^- becomes an anion and Na^+ becomes an cation
  - Ions are created and they attract each other forming an ionic bond



Organic Compounds – General Properties

- **ALWAYS** contain C, H, and generally O
- Sulphur, Nitrogen, Phosphorus and a few other elements may be present.
- Carbon atoms can form chains with other carbons. Organic molecules may be quite large
- Organic molecules make good structural components
- Could be simple molecules (monomers) or
- Could be polymers are combinations of monomers
- Four classes of biologically important polymers:
  - Carbohydrates
  - Lipids
  - Proteins
  - Nucleic Acids

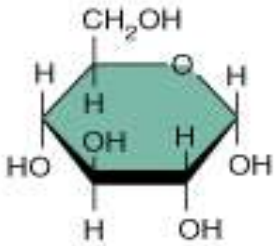
Carbohydrates

- Sugars, starch, glycogen, cellulose, chitin
- Classified by size
- Chemical formula = $[CH_2O]_N$ (multiples of CH_2O)
  - e.g., $C_6H_{12}O_6$ = glucose
- Carbohydrates have many functions
  - Structural components of molecules (e.g., DNA, RNA), cells and tissues
    - cellulose is the most abundant organic substance on earth
    - we cannot digest it, but it is an important part of our diet
  - Broken down for chemical energy production; often ATP formation
  - Chemical energy is stored as glycogen for future use

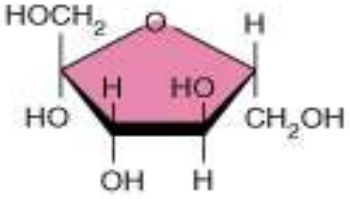
Monosaccharides

- Monomers = simple sugars = monosaccharides

- Single chain or ring structures
  - glucose – the preferred source of energy in the body
  - fructose
  - galactose
  - deoxyribose
  - ribose

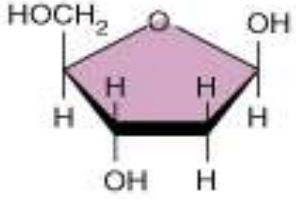


Glucose

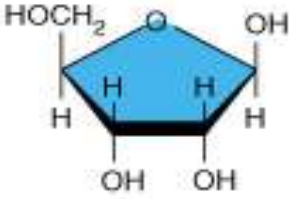


Fructose

Galactose



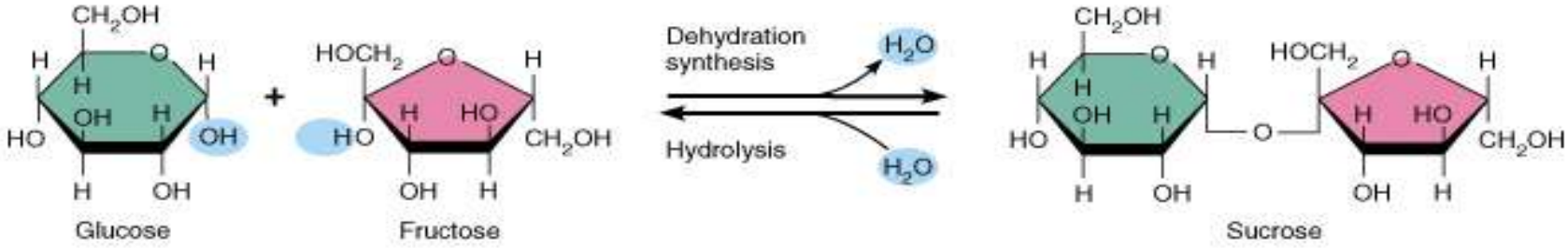
Deoxyribose

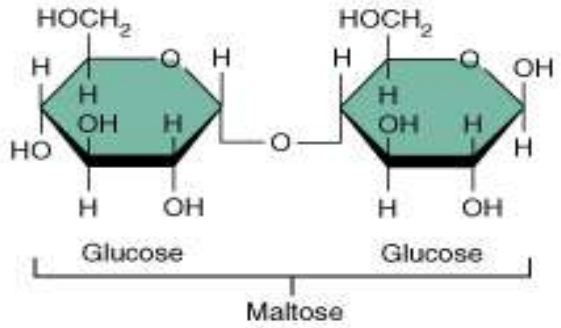


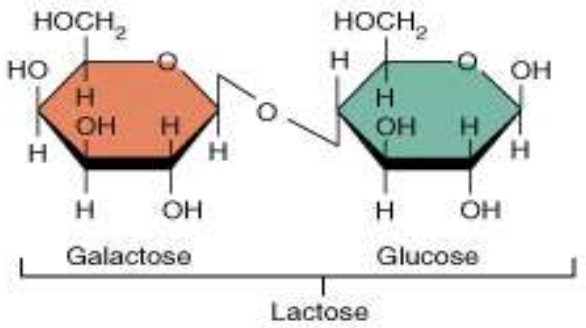
Ribose

Disaccharides

- 2 monosaccharides joined together
  - dehydration synthesis – a water molecule is removed during bond formation
  - hydrolysis - add a water molecule to liberate the monosaccharides
  - examples: sucrose, maltose, lactose

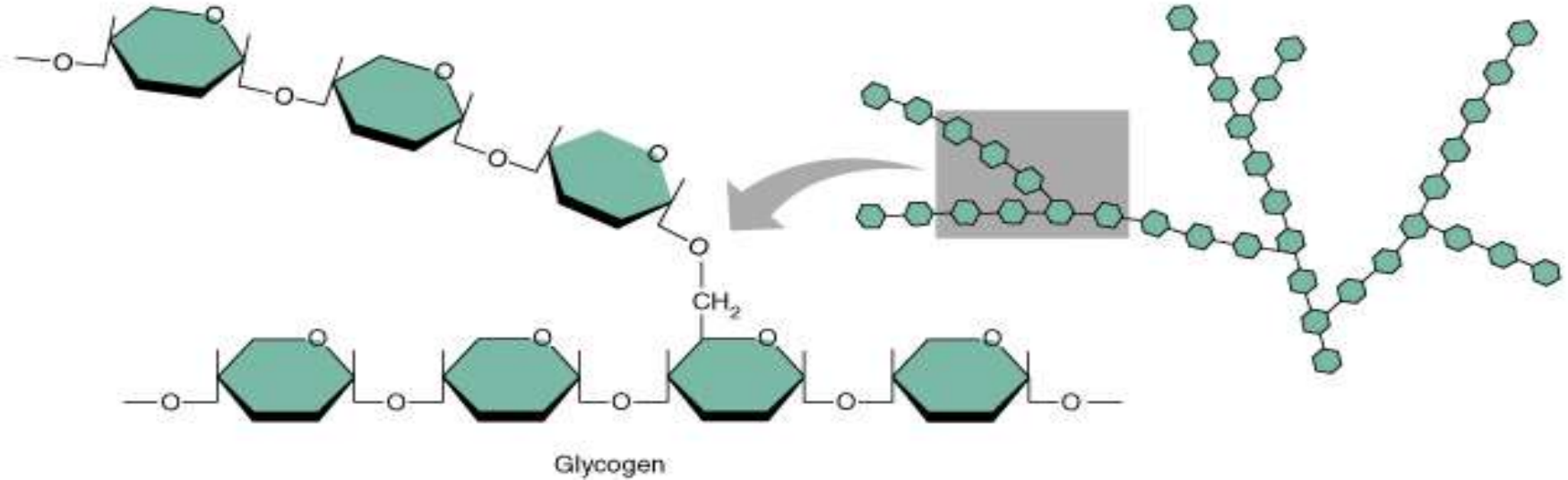






Polysaccharides

- Large, relatively insoluble carbohydrate polymers
- 10's or 100's of monosaccharides bonded together
  - glycogen - storage of glucose for energy in humans
    - in liver cells and muscle cells
  - starch – storage of glucose for energy in plants
  - cellulose – structural fiber in plants; "roughage" in our diet
  - chitin – structural fiber in some fungi, insects, crustaceans



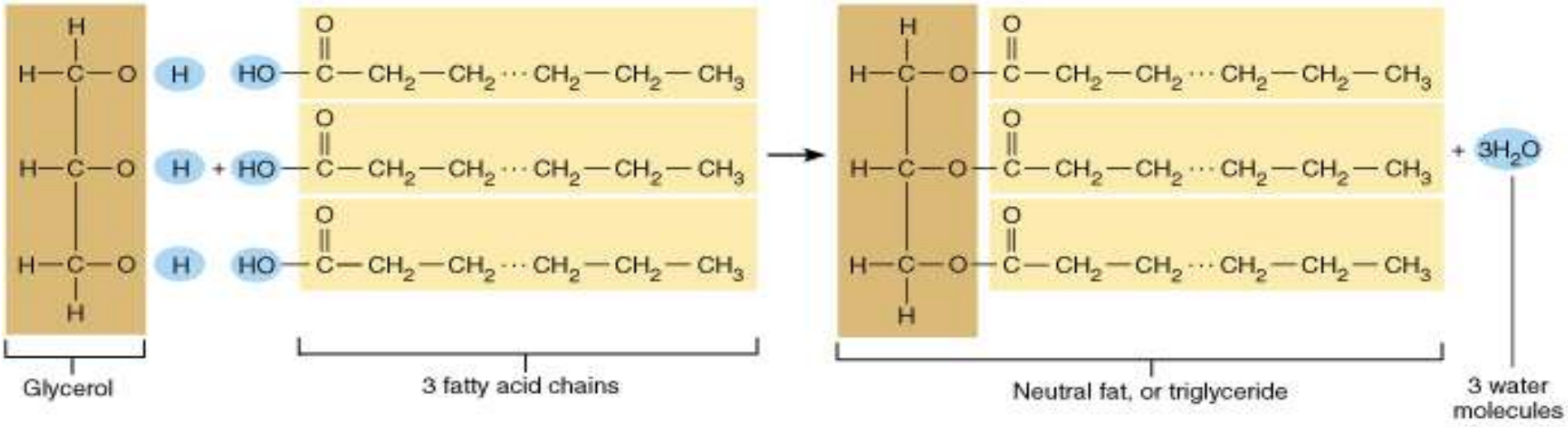
Glycogen

Lipids (Fats)

- Contain carbons, hydrogens, oxygens (fewer oxygens per carbon)
- Roughly 18-25% of body weight
- Insoluble in water = hydrophobic
- Dissolve in lipid solvents, e.g., alcohols, detergents
- Major energy storage compounds
- Structural components of cell membranes
- Some serve as molecular signal compounds
  - steroid hormones, prostaglandins, etc.

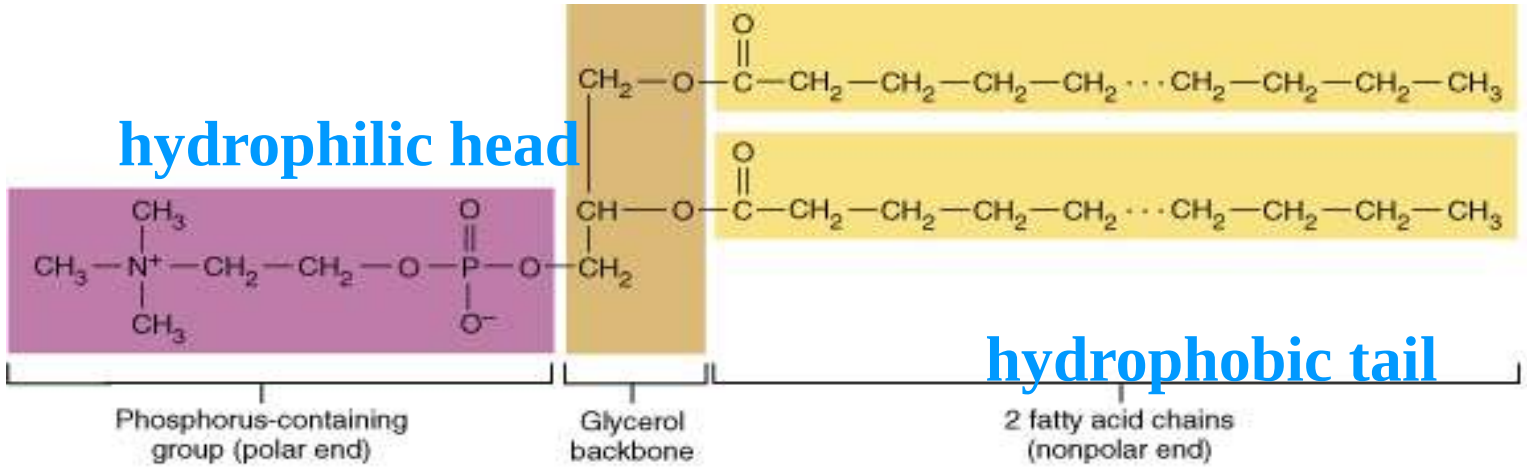
Triglycerides

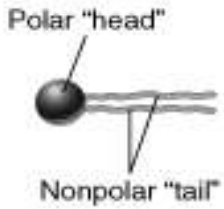
- Storage form of fats for energy
- Glycerol head and 3 fatty acid side-chains
- Saturated fatty acids vs. unsaturated fatty acids
  - double bonds in unsaturated fatty acids
  - the more unsaturated bonds, the more fluid at room temp.



Phospholipids

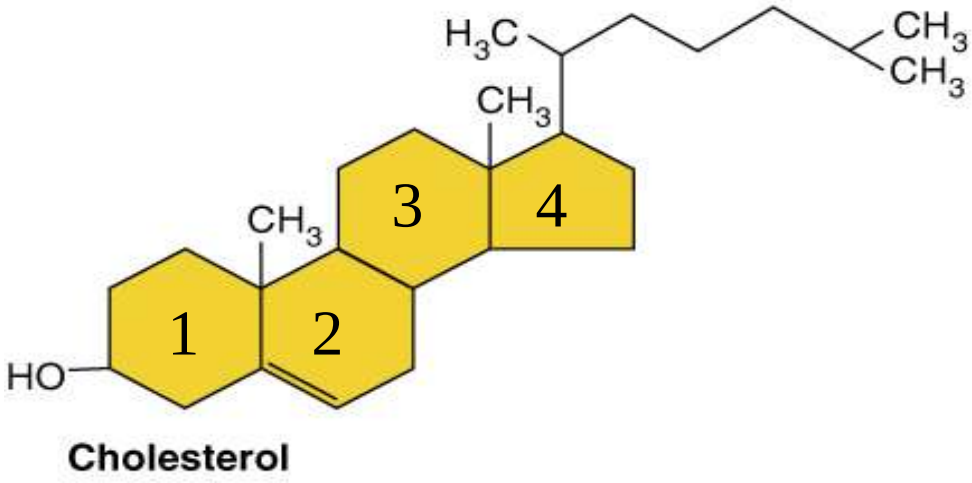
- Modified triglyceride
  - 2 fatty acids and a phosphate group attached to glycerol
- Phosphate group is a polar group
  - dipole
  - amphipathic - has polar and non-polar regions
  - can hydrogen bond with water due to phosphate's polarity
- Found in cell membranes





Other Lipid Compounds

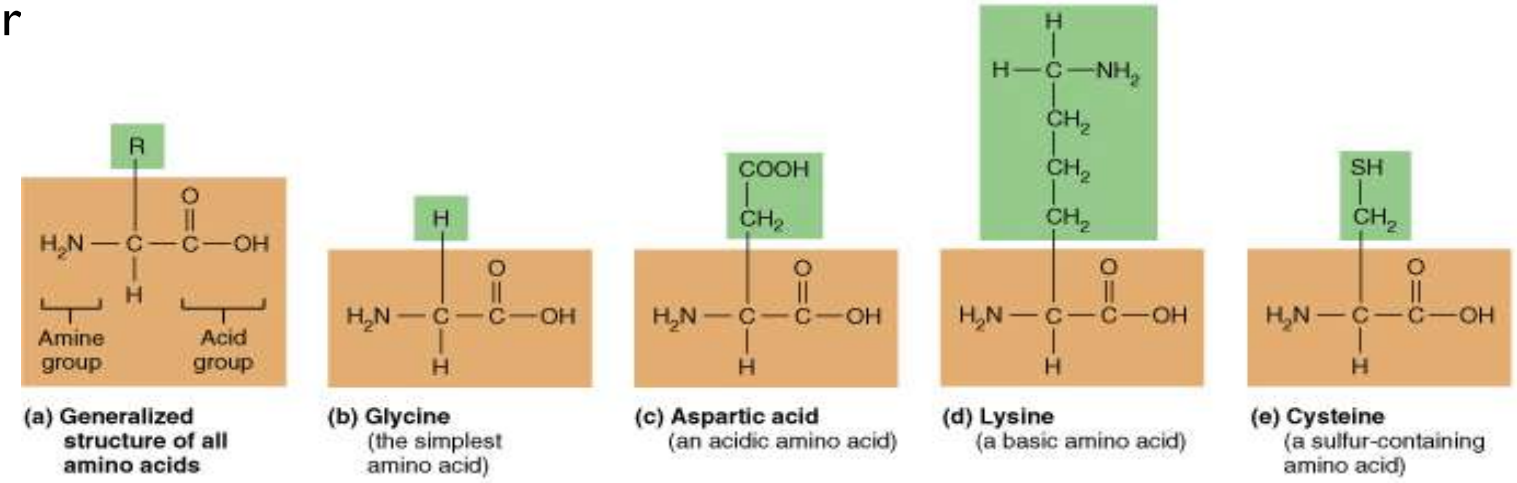
- Steroids
  - 4 rings of carbon atoms
  - Fat soluble/hydrophobic
  - Cholesterol is a membrane structural component
  - Cholesterol-derived steroid hormones



Cholesterol

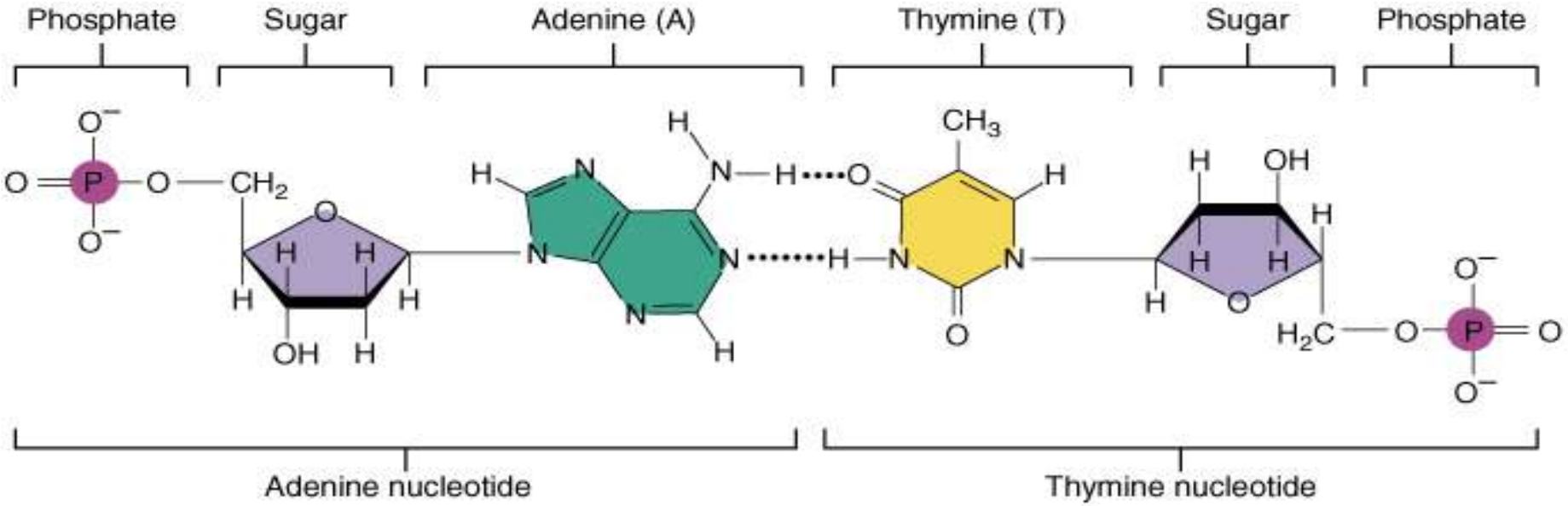
Proteins

- Contain carbon, hydrogen, oxygen, nitrogen, sulfur
- 12 - 18% of body mass
- A wide variety of structural and functional roles
- Amino acids (monomers) combine in a linear sequence to form a polypeptide (polymer)
  - Amino acids are the building blocks of proteins
    - 20 different AA's
    - amino group (NH_2), carboxyl group (CO_2H) side group (R)
    - amino, car



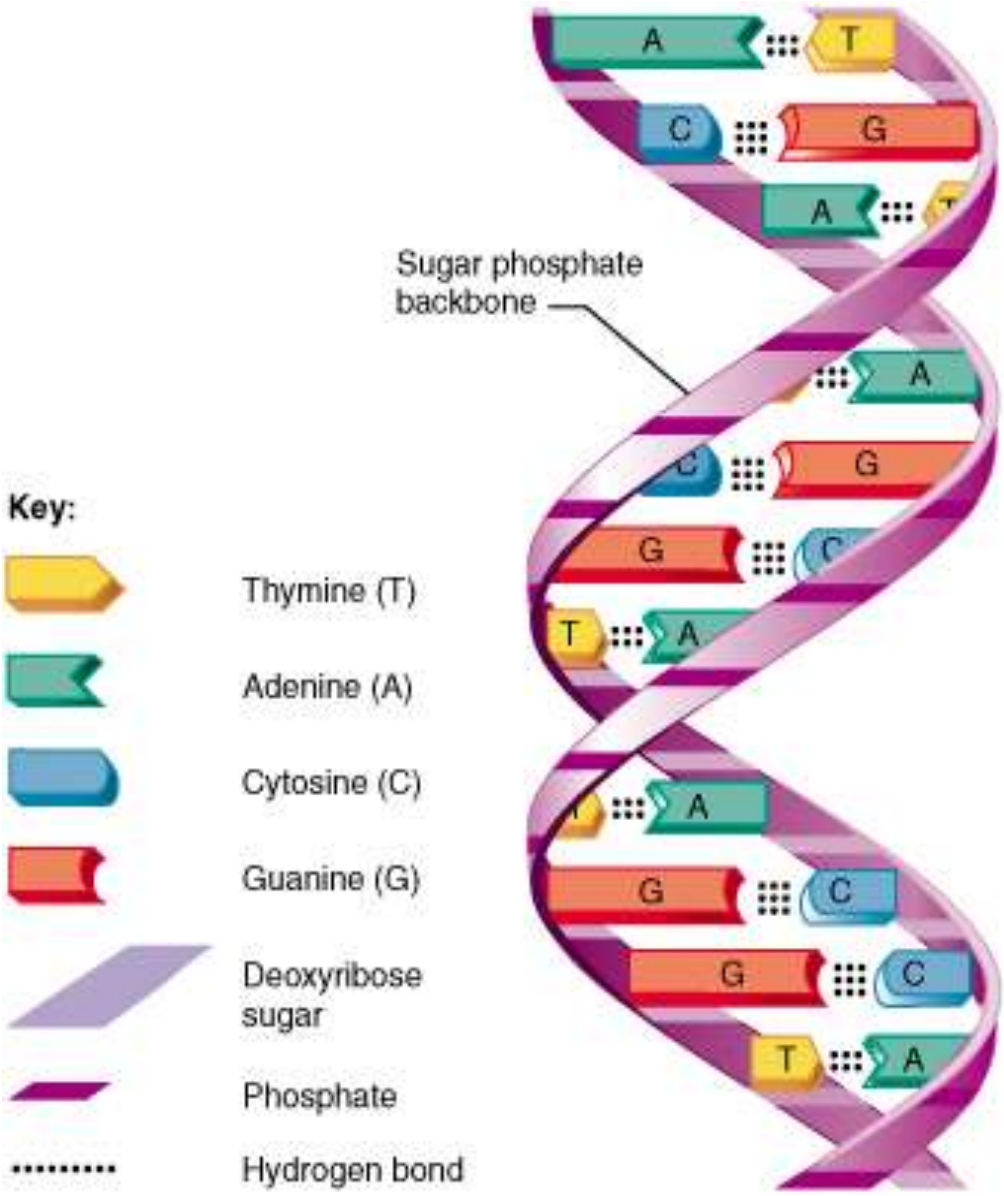
Nucleic Acids

- Deoxyribonucleic Acid (DNA)
- Ribonucleic acid (RNA)
- DNA, RNA made of nucleotides - 3 parts to nucleotide
  - nitrogenous bases: adenine, thymine (DNA only), cytosine, guanine, uracil (RNA only)
  - pentose sugar (5 carbon) deoxyribose or ribose
  - phosphate group



Nucleic acids

- DNA is the genetic material
  - made of 4 building blocks – nucleotides
    - adenine (A), guanine (G), cytosine (C), thymine (T)
    - A-T, C-G in the chain
    - double helix model
    - double stranded DNA
- RNA carries hereditary information from nucles to the cytoplasm
  - uracil (U) replaces T
  - single stranded RNA



Adenosine Triphosphate

- Three phosphate groups, attached to adenine and ribose sugar; a special nucleotide
- ATP ⇔ ADP + P_i
- Aerobic or anaerob
  metabolic productic
- Major cellular energ
  transfer compound