CONCEPT: FOUR CLASSES OF MACROMOLECULES

● **Polysaccharides** are sugars (carbohydrates) that are responsible for cellular energy storage and support

□ **Monosaccharides** are the building blocks that make up _____ polysaccharides

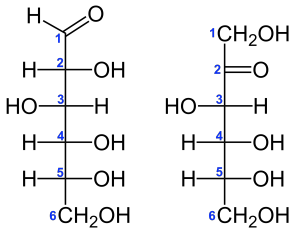
- Covalent **glycosidic bonds** between a carbon and hydroxyl (OH) attach two monosaccharides together

- Can form into linear or ring structures – $(CH_2O)_n$

□ **Aldose** and **Ketose** are the two _____ of polysaccharides

- The class is determined based on the position of the carbonyl group (C=O)

EXAMPLE: Ketose (C=O in middle) vs. Aldose structure (C=O on end)



□ **Starch, Cellulose,** and **Glycogen** are the three main storage and structural polysaccharides in cells

- In plant cells, energy is stored as *starch* and structural support is provided by *cellulose*

- In animal cells, *glycogen* stores surplus chemical energy

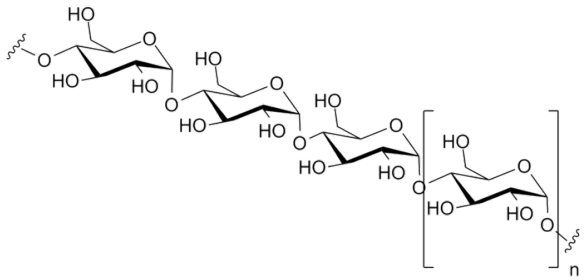
□ Sugars are named by the _____ of subunits they contain

- Mono- = 1 subunit; Di- = 2 subunits; Oligo- = up to 10 subunits, Poly- = 11+ subunits

- Common sugars include: Glucose (mono); Sucrose (Di); Lactose (Di); Amylose (Poly)

□ **Glycolipids** are sugars attached to lipids; **Glycoproteins** are sugars attached to proteins

EXAMPLE: Amylose is a linear polysaccharide made up of α(1→4) bonds



● **Nucleic acids** are the subunits of DNA and RNA which are responsible for storing and transmitting genetic information

□ Each nucleotide contains a **base**, a five carbon sugar (deoxyribose or ribose), and a phosphate group

- There are two classes of bases: **Purines** with a pair of fused rings and **Pyrimidines** with a single ring

- **Adenine (A)** and **Guanine (G)** = purines; **Cytosine (C), Thymine (T),** and **Uracil (U)** = pyrimidines

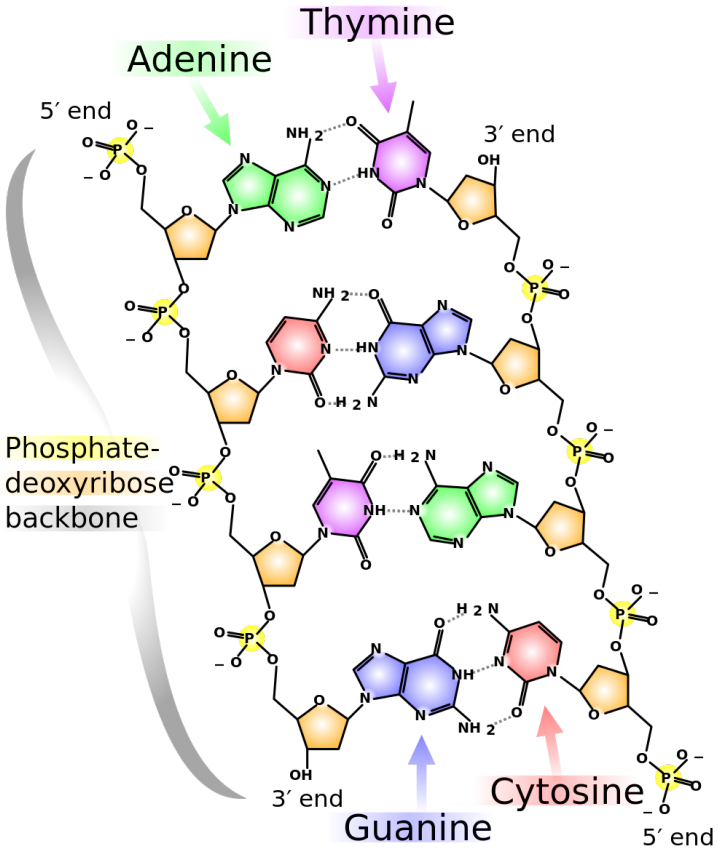
□ **Phosphodiester bonds** are responsible for _____ nucleic acids together

- Linear sequence of nucleic acids is important because it encodes genetic information

□ **Nucleotides** can also store energy

- Adenosine tri-phosphate (**ATP)** is a nucleotide that supplies energy for numerous cellular reactions

EXAMPLE: Complementary nucleotides bound in a DNA molecule



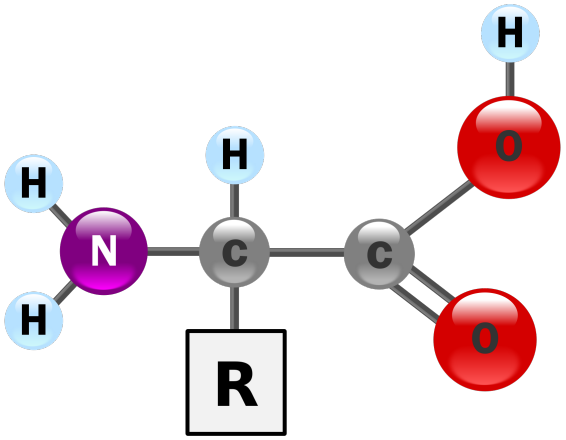
● **Proteins** are macromolecules responsible for carrying out cellular _____

□ **Amino acids** are subunit building blocks used to build **polypeptide chains** that form proteins

- Amino acids have an alpha carbon, a carboxyl group (COOH), an amino group (NH_3), and a "R" group

- Amino acids (called **residues**) are linked by **peptide bonds** between the carboxyl group and amino group

EXAMPLE: Amino acid structure



□ Proteins function is determined by _____ properties

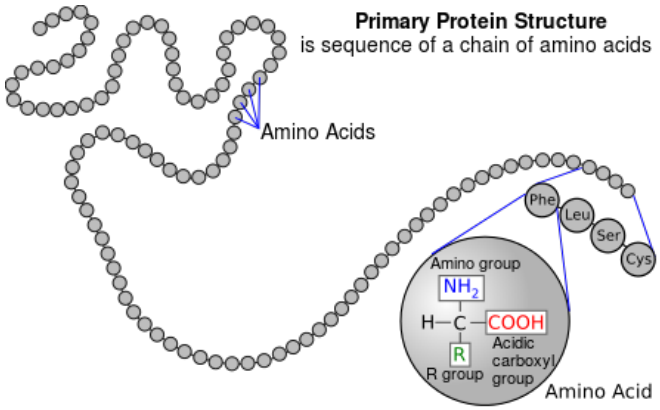
- The **20 amino acids** are arranged in a specific formation to provide the protein its function

- The properties of the **side chain** (R group) gives the protein unique structural and functional properties

  - Can be classified as polar, charged, nonpolar or "other"

  - Forms stabilizing *disulfide bridges* between sulfhydryl groups (SH) on the amino acid cysteine

EXAMPLE: Polypeptide chain made up of single amino acids – add extra image on structure of amino acid up!



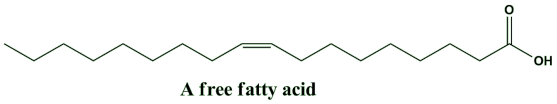
● **Lipids** are macromolecules responsible for the formation of cellular barriers; They are *nonpolar* = do not dissolve in H_2O

□ **Phospholipids** are one main class of lipids responsible for the formation of bilayer membranes

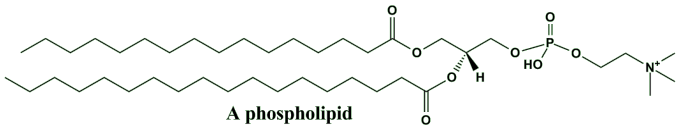
- Composed of two **fatty acids** (long unbranched hydrocarbon chains with carboxyl group) and polar group

- They are **amphipathic**, which means they contain both *hydrophilic* and *hydrophobic* parts

EXAMPLE: A free fatty acid compared to a phospholipid



A free fatty acid



A phospholipid

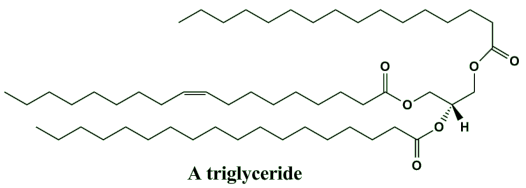
□ **Fats** are a second class of lipids responsible for energy _____

- **Triglycerides** are composed of three fatty acids, linked by an **ester bond** to a glycerol molecule

- Can be **saturated** if they do not contain double bonds, or **unsaturated** if they contain chemical bonds

- 1 gram of fat stores twice the energy of 1 gram of carbohydrate

EXAMPLE: Triglyceride structure



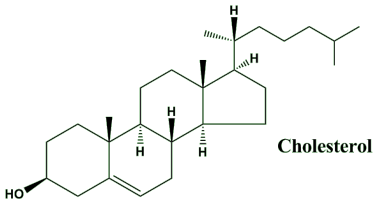
A triglyceride

□ **Steroids** are a class of lipids responsible for hormone signaling and membrane structure

- Composed of a ringed hydrocarbon skeleton

- **Cholesterol** is a common example found in cellular membranes that provided rigidity

EXAMPLE: Structure of cholesterol



Cholesterol

PRACTICE

1. Which of the following is false?
    - **a.** Polysaccharides are responsible for energy storage and cellular support
    - **b.** Nucleic acids are linked via Phosphodiester bonds
    - **c.** Amino acid sequence and structure provide proteins with unique physical attributes
    - d. Fatty acids are composed of branched hydrocarbon chains

2. Which of the following macromolecules does the cell use for structure and support?
    a. Polysaccharides
    b. Nucleic Acids
    c. Lipids
    d. Proteins

3. Animal cells store excess sugar in the form of what?
    a. Starch
    b. Cellulose
    c. Amylose
    d. Glycogen

4. True or False: Polysaccharides are the macromolecules that act as a source of energy storage.
    a. True
    b. False