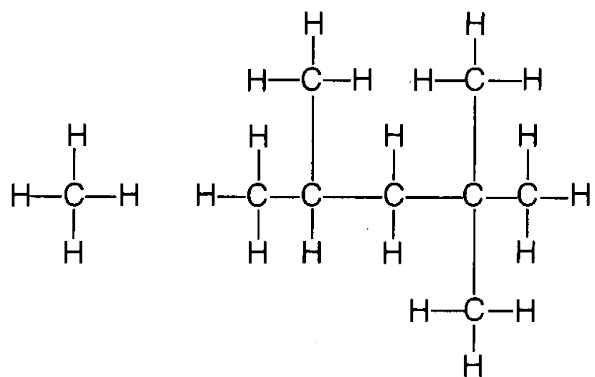
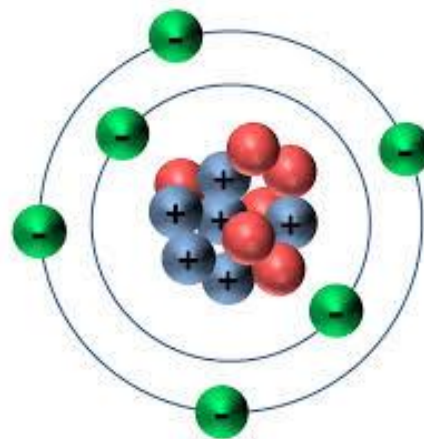


6.4 The Building Blocks of Life

Objectives: 1. Describe the role of carbon in living organisms. 2. Summarize the four major families of biological macromolecules. 3. Compare the functions of each group of biological macromolecules.

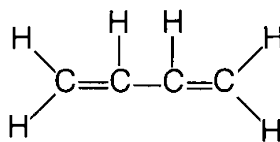
Organic Chemistry

- ▶ All living things on earth are Carbon based
 - ▶ Has 4 valence electrons;
 - ▶ Forms _____ bonds
 - ▶ Can bond in a variety of ways
 - ▶ Rings, chains, branched molecules
 - ▶ Single, double or triple bonds



Methane

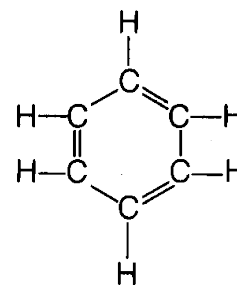
Iso-Octane



Butadiene



Acetylene



Benzene

Biological Molecules

- ▶ 4 classes
 - ▶ Carbohydrates
 - ▶ Proteins
 - ▶ Nucleic acids
 - ▶ Lipids
- ▶ All four of them are **macromolecules** (molecules made from combining smaller units together); but only the first three are **polymers**.
 - ▶ Smaller unit are called “monomers”, larger molecule of them bonded together is called a “polymer”
 - ▶ Lipids are not polymers, but they are macromolecules

many small
molecules
(of the same type)



monomers
(basic unit)

one large
molecule



polymer

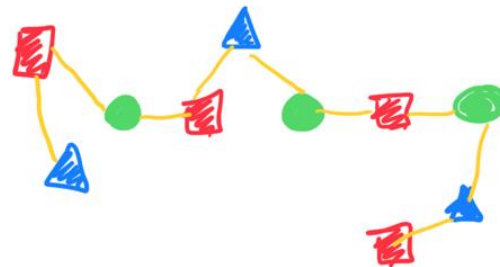
(also a macromolecule
since it is made up of
smaller units)

many small
molecules
(different types)



basic units

one large
molecule



macromolecule

Carbohydrates

- ▶ Made of C, H, and O, always in a ratio of 1C:2H:1O
- ▶ Includes monosaccharides, disaccharides and polysaccharides
 - ▶ Monomer (building block) is a monosaccharide...a single sugar unit
 - ▶ Able to bond together at specific locations on the molecule (-OH, hydroxyl groups)

- ▶ Monosaccharides

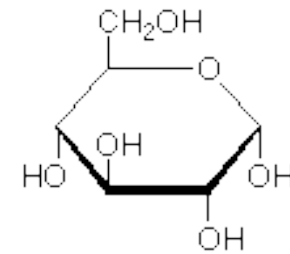
- ▶ Sugars like glucose

- ▶ Disaccharides

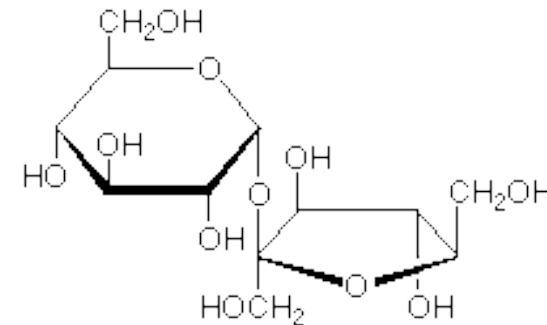
- ▶ Sugars like sucrose

- ▶ Polysaccharides

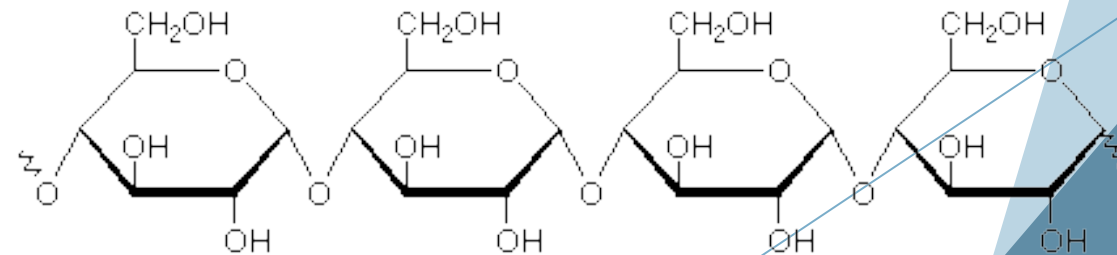
- ▶ Molecules like starch, cellulose, glycogen



monosaccharide (glucose)



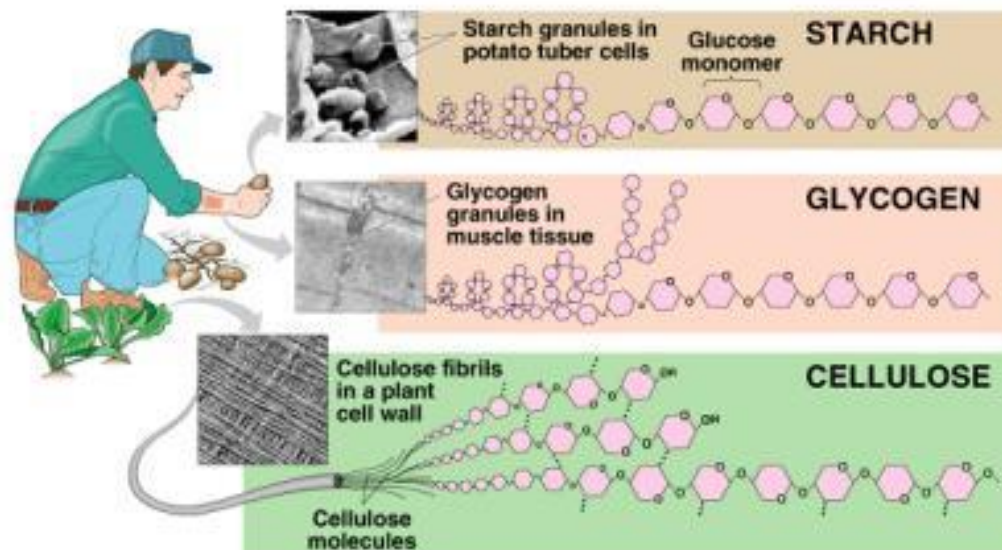
disaccharide (sucrose)



polysaccharide (amylose starch)

What do Carbohydrates do in Living Things?

- ▶ major immediate energy source (glucose)
- ▶ Polysaccharides have a couple of different functions
 - ▶ Store energy (glycogen - found in liver/muscle cells)
 - ▶ Store energy (starch - found in plants)
 - ▶ Structural support (cellulose - found in plants)
 - ▶ These molecules vary in their shape and organization of the individual monosaccharides that make them up



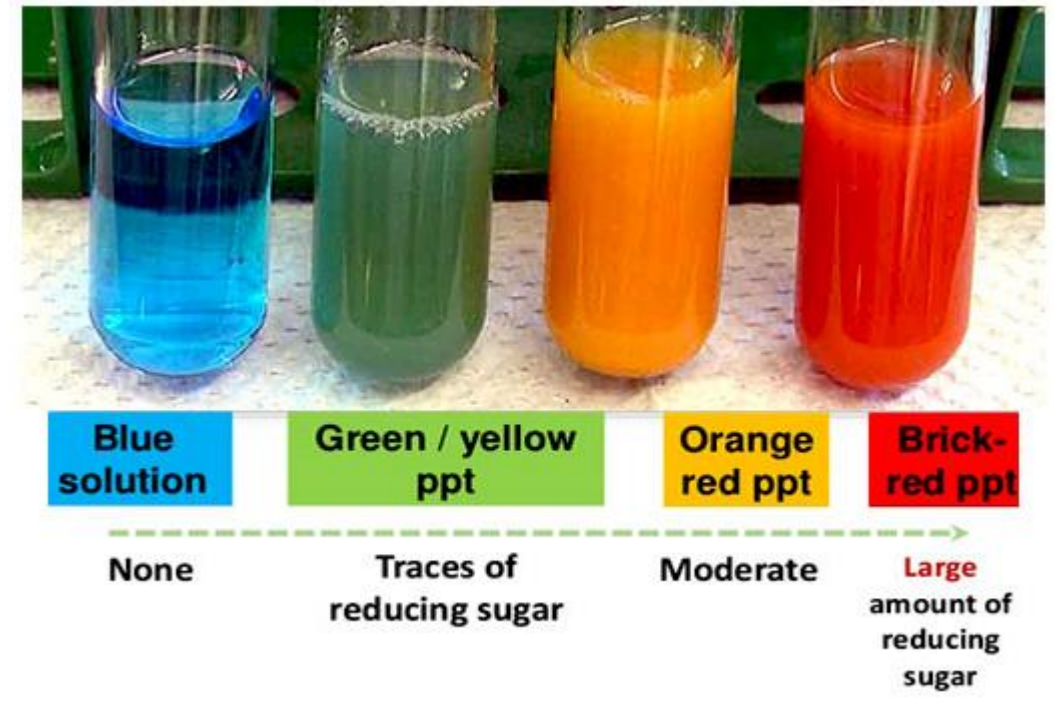
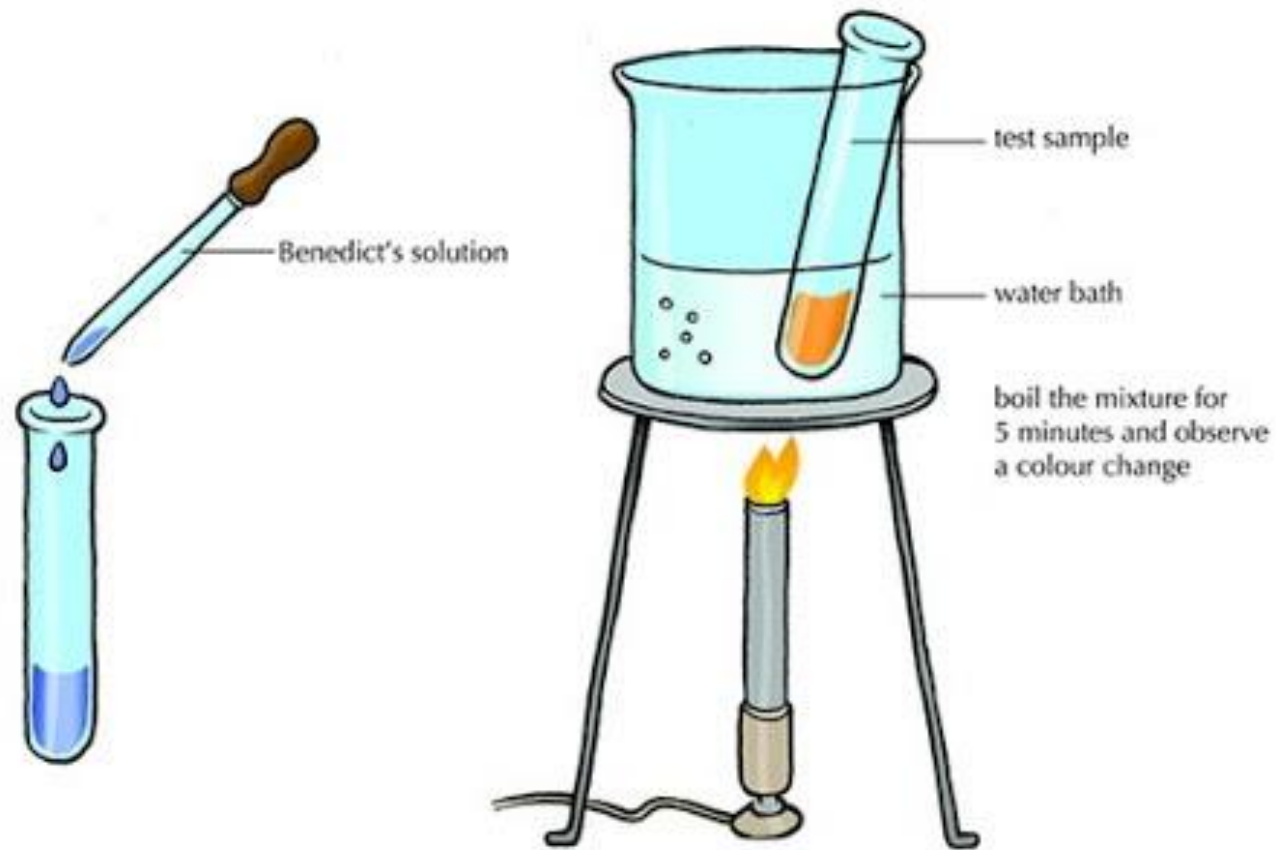
How can we test to see if an object has Carbohydrates?

- ▶ Benedict's test for simple sugars



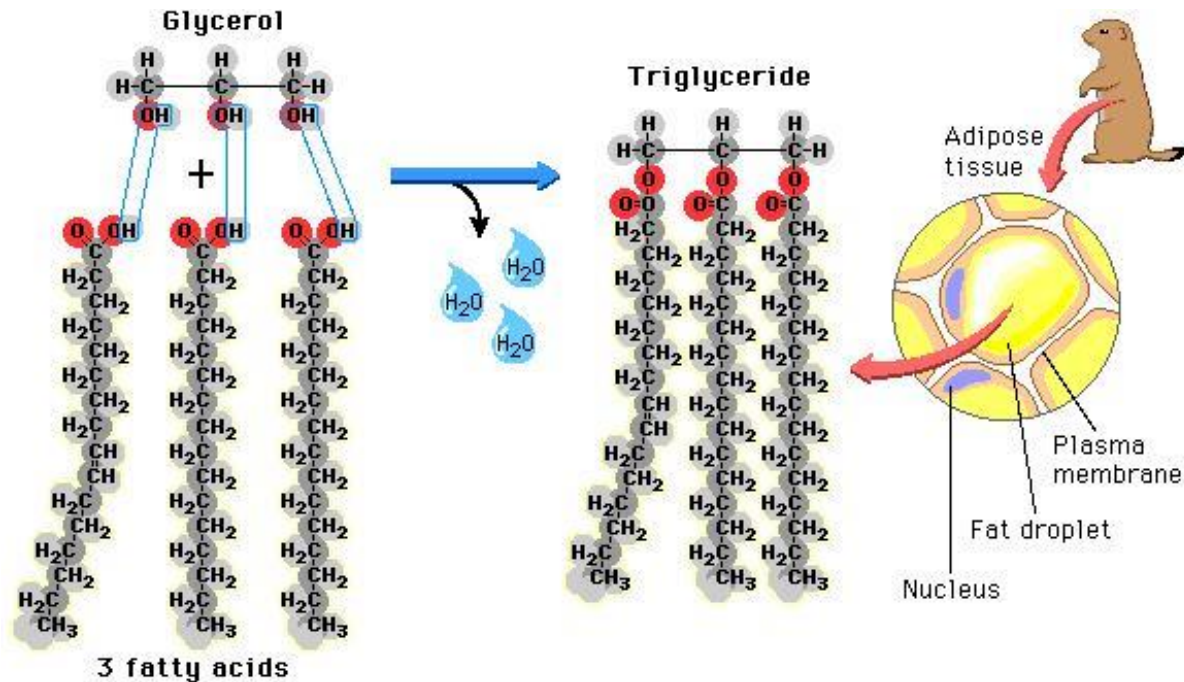
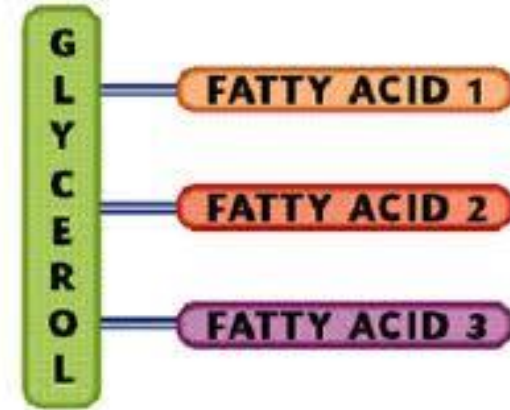
- ▶ Iodine test for starch/complex carbs





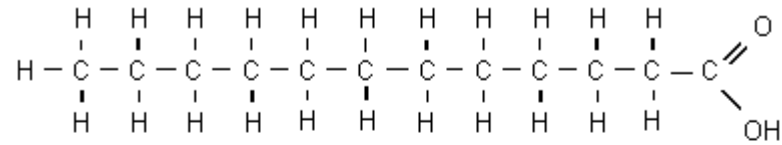
Lipids

- ▶ Made almost entirely of C and H
- ▶ Fats, oils, waxes
 - ▶ Main job is to store energy (long term use)
 - ▶ Also structural role in living cells
- ▶ Made primarily of fatty acids and glycerol

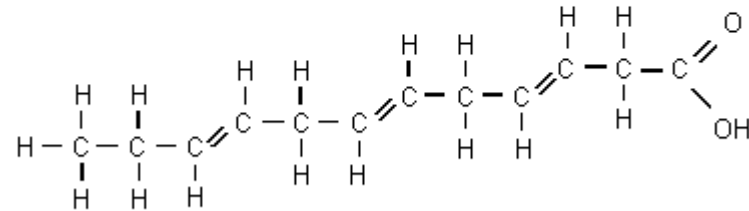


Lipids

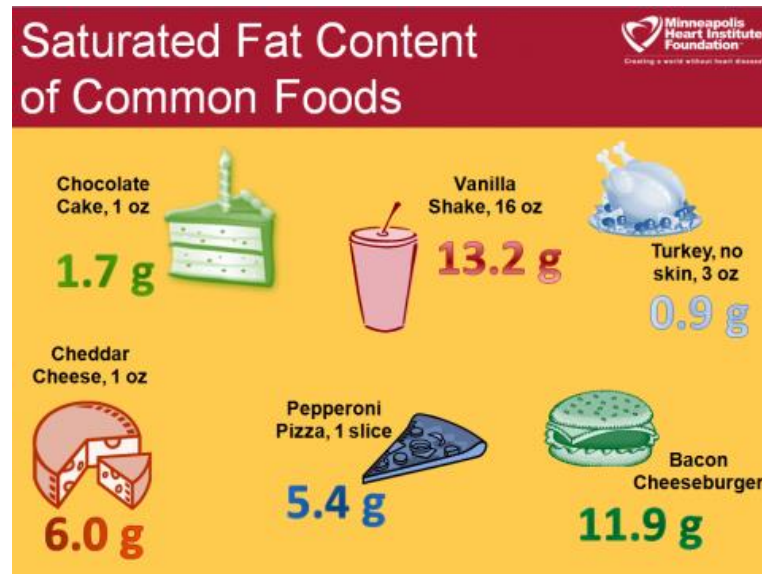
- ▶ May be fats
 - ▶ Saturated
 - ▶ All of the carbon's bonds are filled with H
 - ▶ Tend to exist in solid form
 - ▶ Unsaturated
 - ▶ Some of the carbon's have double bonds, leading to kinks in the shape of the fat
 - ▶ Exist in liquid form



Saturated Fatty Acid



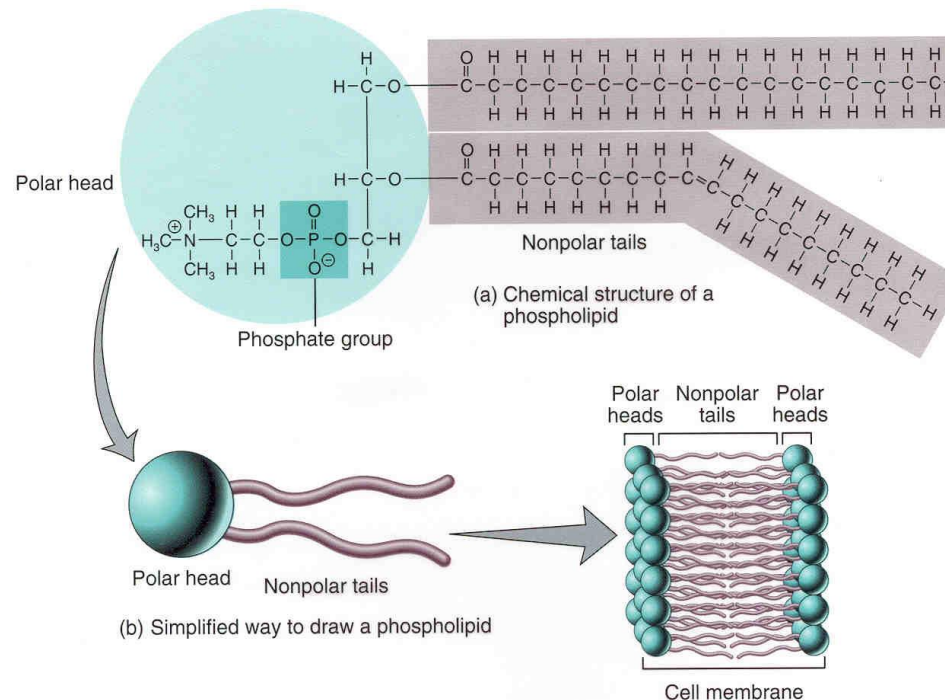
Unsaturated Fatty Acid



Lipids

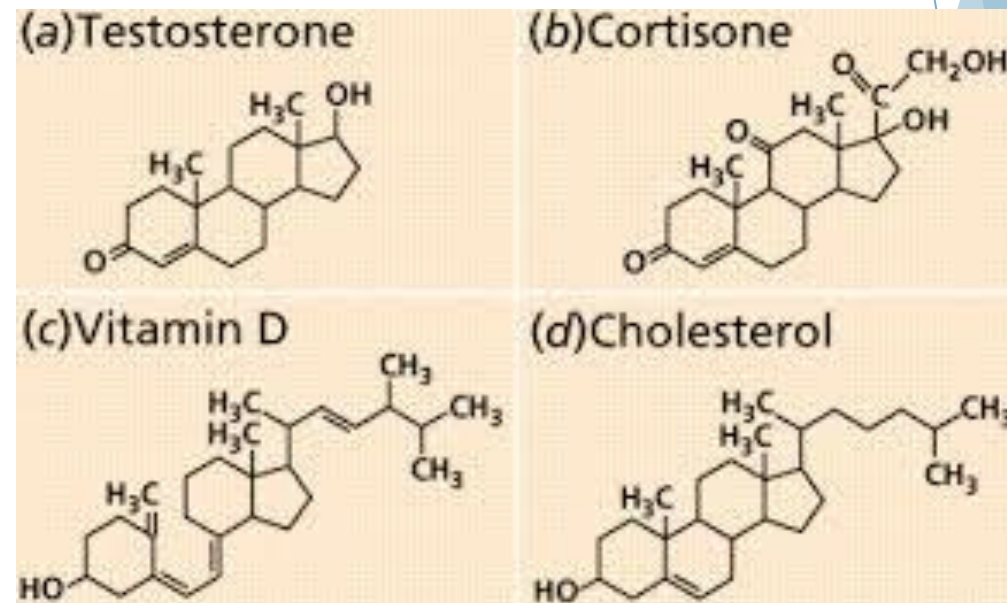
▶ Phospholipids

- ▶ Crucial to the structure of cell membranes
- ▶ Glycerol backbone, 2 fatty acid chains and a phosphate head
- ▶ Polar and non-polar ends



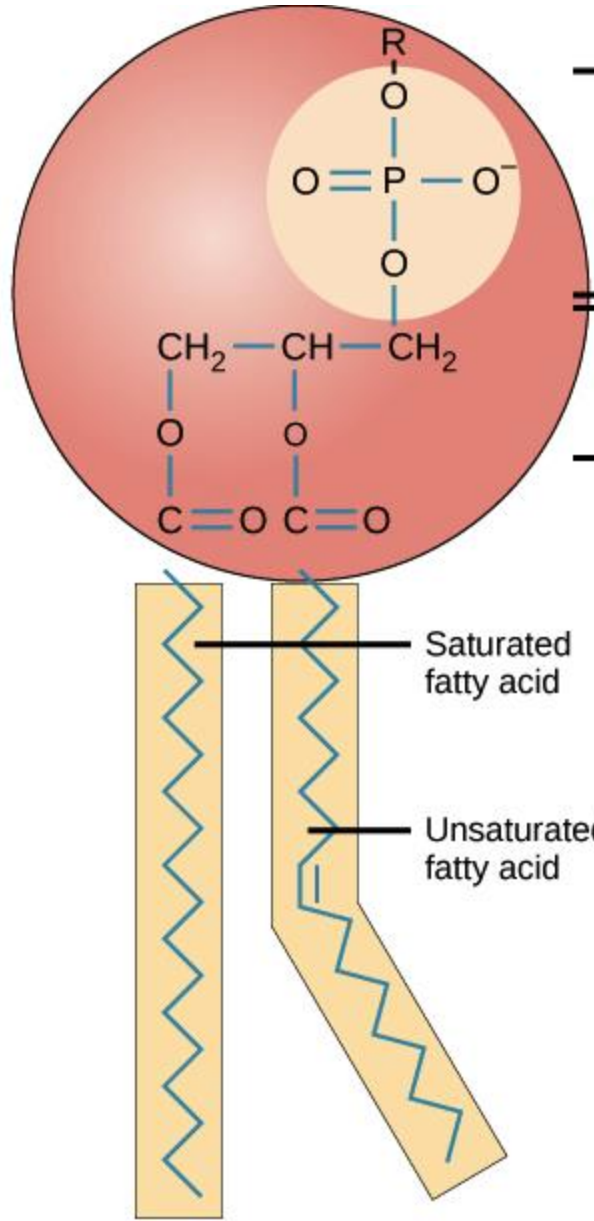
▶ Steroids

- ▶ Ring structures
- ▶ Cholesterol
- ▶ Hormones (estrogen/testosterone)
- ▶ vitamins



Hydrophilic head

Hydrophobic tails

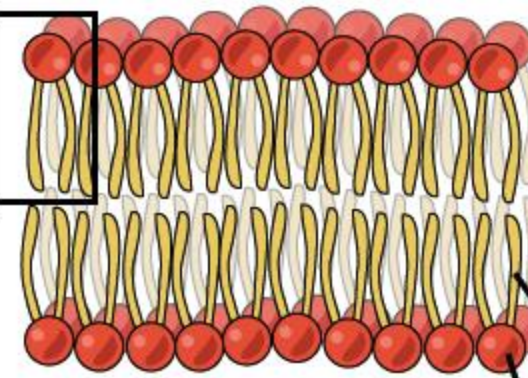


Phosphate

Glycerol

Saturated fatty acid

Unsaturated fatty acid



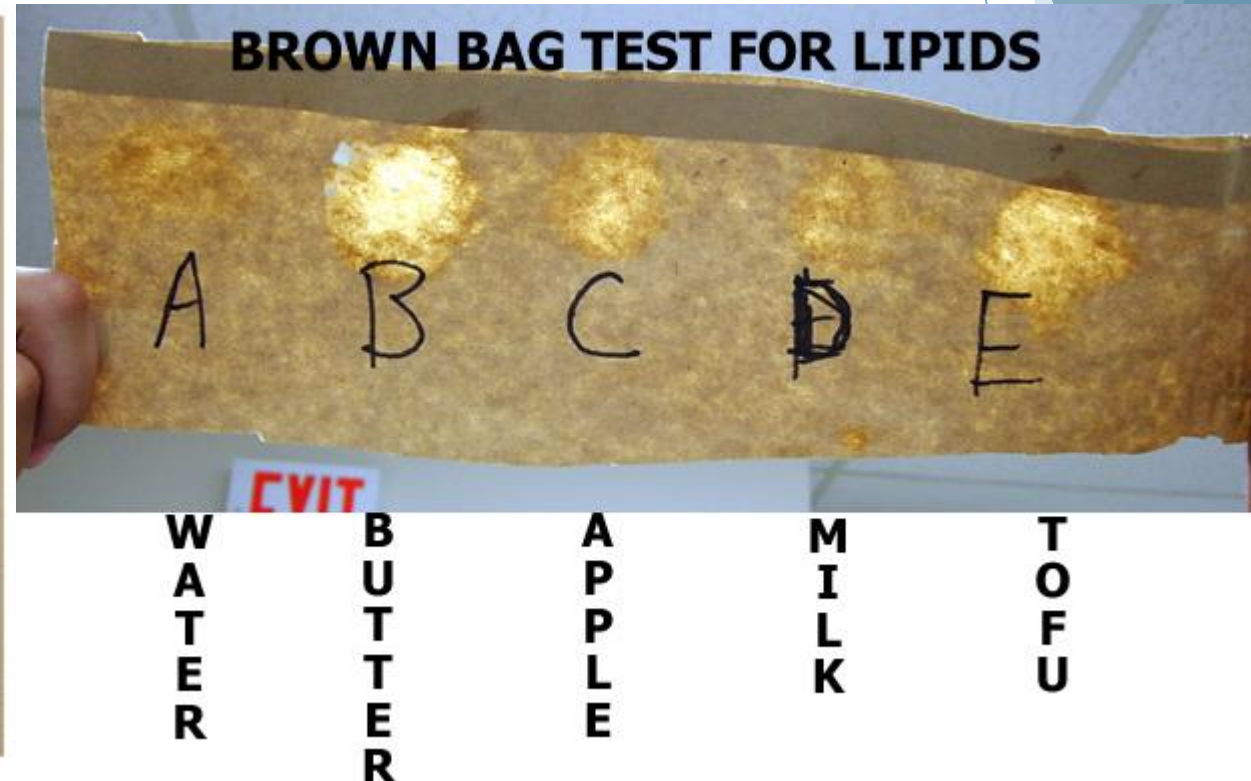
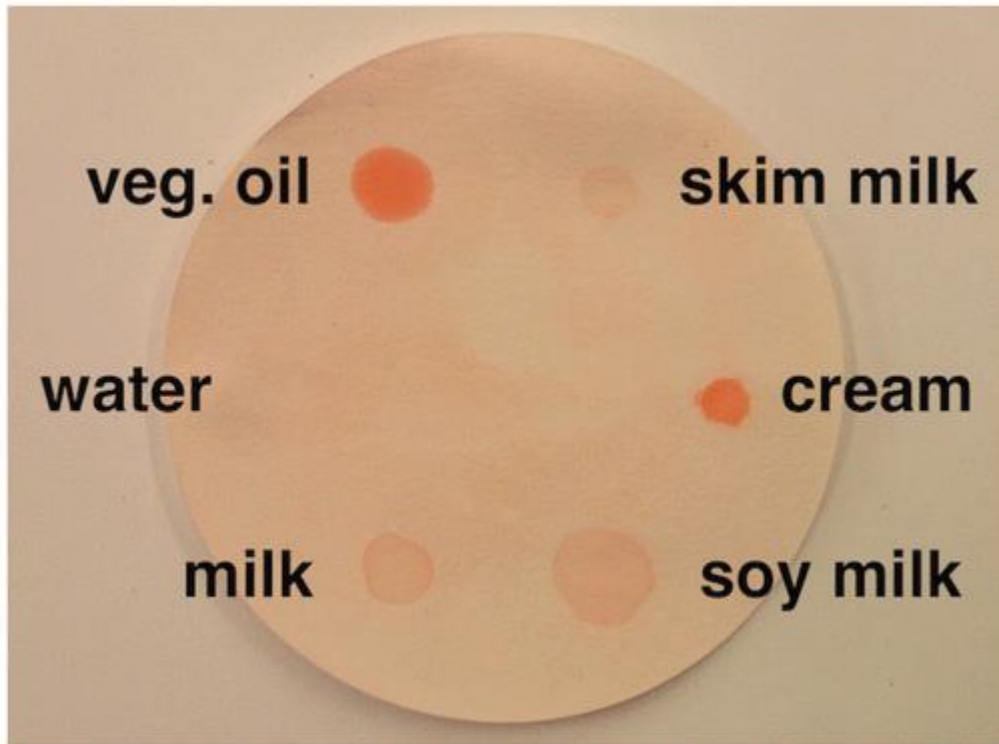
Phospholipid bilayer

Hydrophobic tail

Hydrophilic head group

How do we test for lipids?

- ▶ Sudan III or IV test





Apdalla official

emulsion test : is the method to determine the presence of lipids using the wet chemistry .

allowing lipids present to dissolve (lipids are soluble in Alcohols)

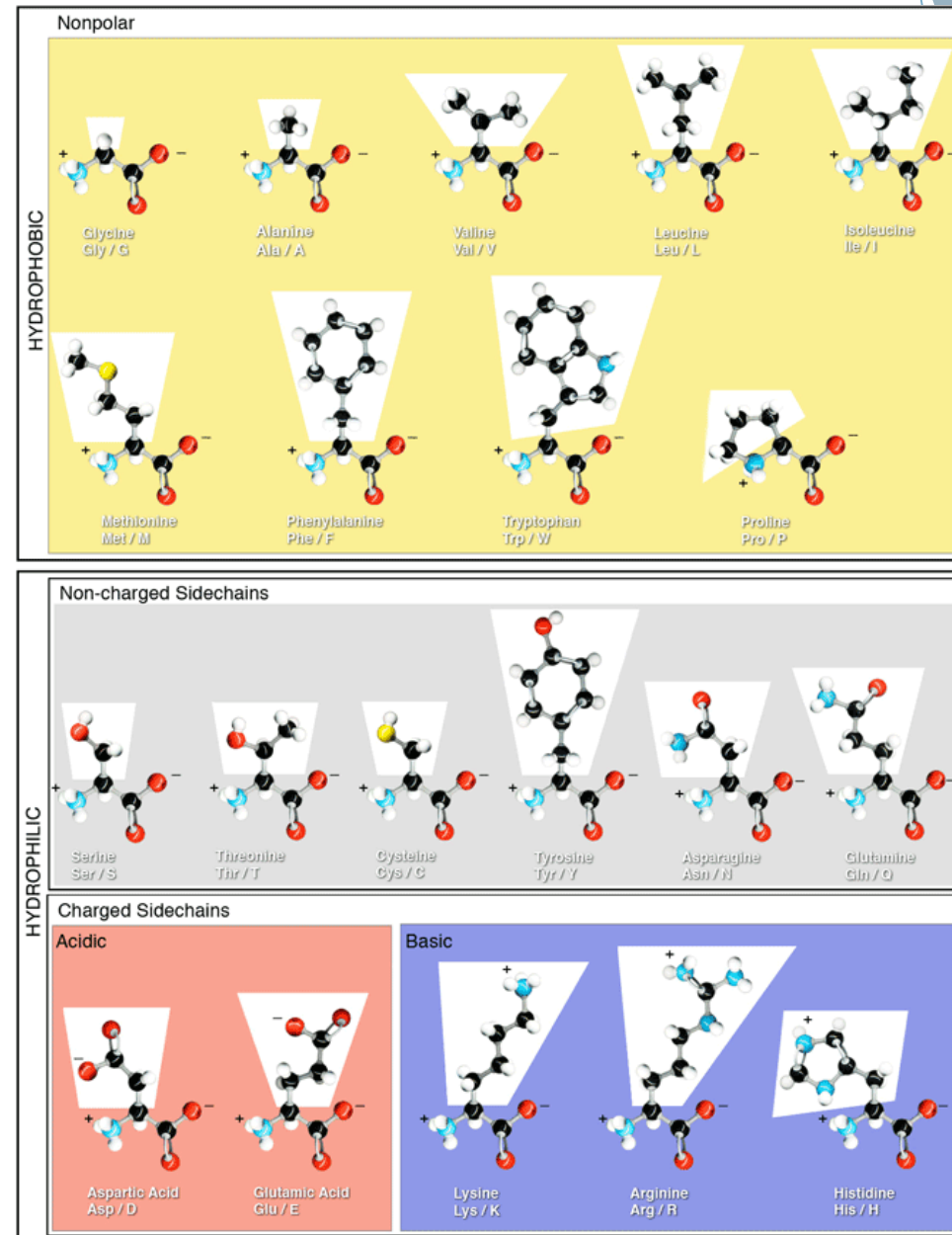
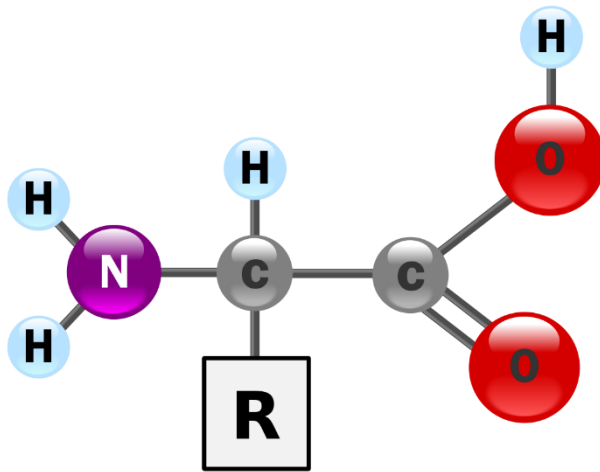


Checkpoint

Compare and contrast the structure and function of carbohydrates and lipids.

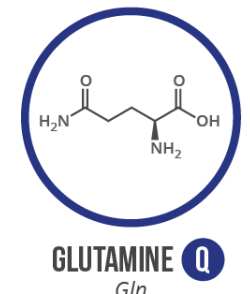
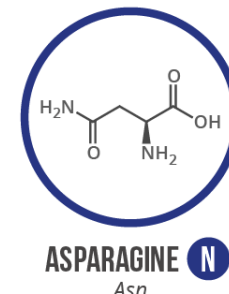
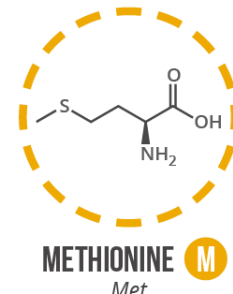
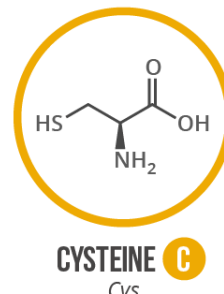
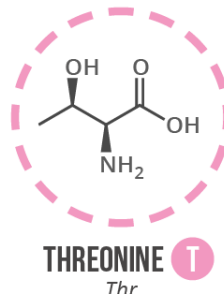
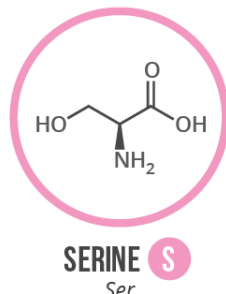
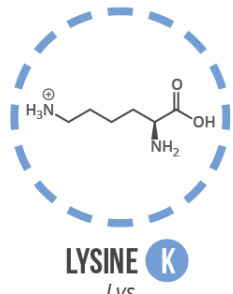
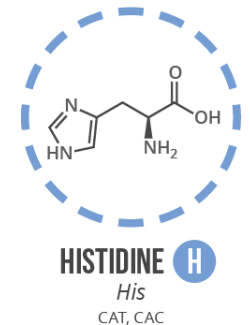
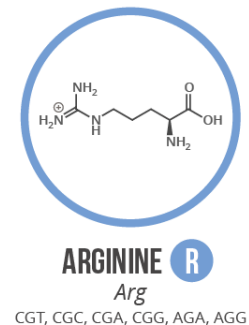
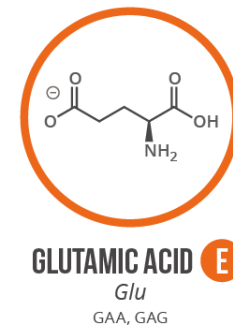
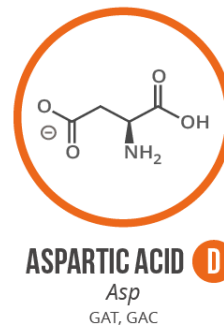
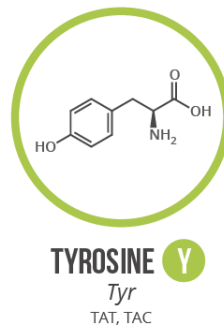
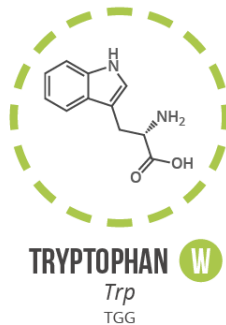
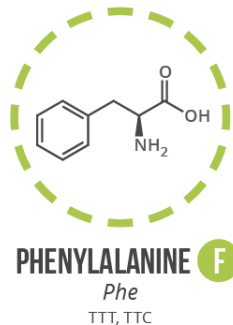
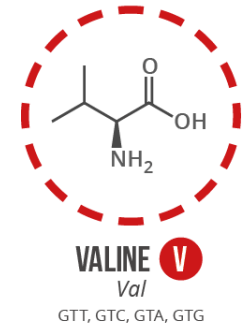
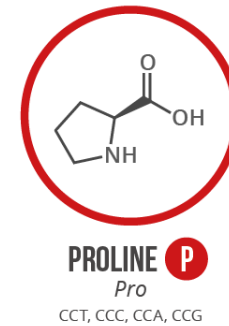
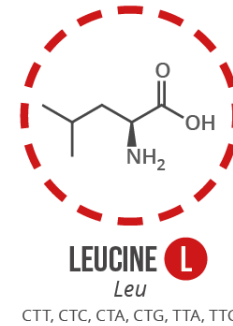
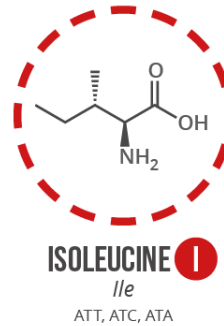
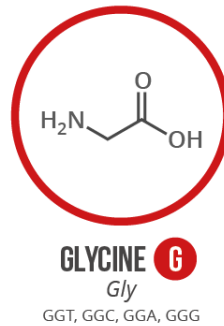
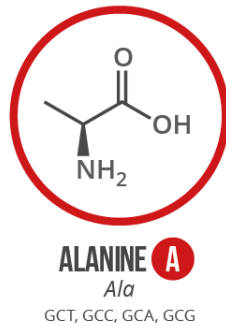
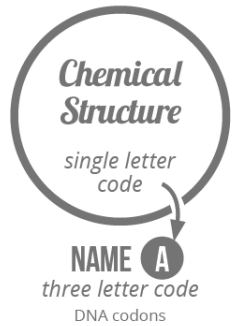
Proteins

- ▶ Essential molecules; involved in almost every function of your body
 - ▶ Make up 15% of our total body mass
- ▶ Made of smaller units called **amino acids**, which are joined together to make larger protein molecules
 - ▶ 20 different amino acids; only variation is in the R group



AMINO ACIDS ARE THE BUILDING BLOCKS OF PROTEINS IN LIVING ORGANISMS. THERE ARE OVER 500 AMINO ACIDS FOUND IN NATURE - HOWEVER, THE HUMAN GENETIC CODE ONLY DIRECTLY ENCODES 20. 'ESSENTIAL' AMINO ACIDS MUST BE OBTAINED FROM THE DIET, WHILST NON-ESSENTIAL AMINO ACIDS CAN BE SYNTHESISED IN THE BODY.

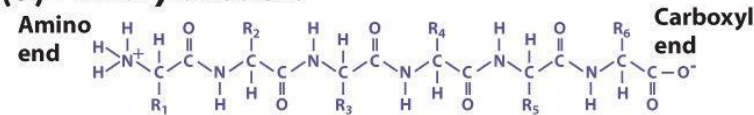
Chart Key: ● ALIPHATIC ● AROMATIC ● ACIDIC ● BASIC ● HYDROXYLIC ● SULFUR-CONTAINING ● AMIDIC ○ NON-ESSENTIAL ○ ESSENTIAL



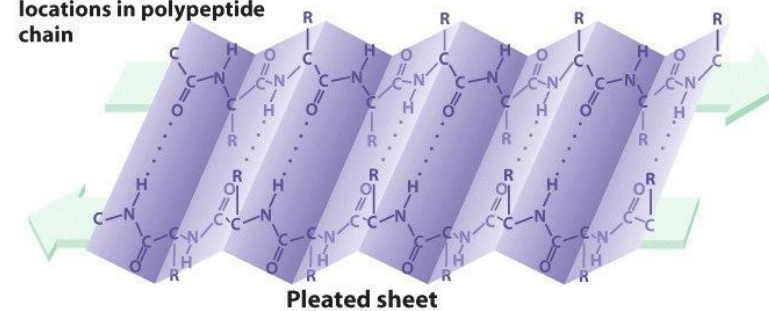
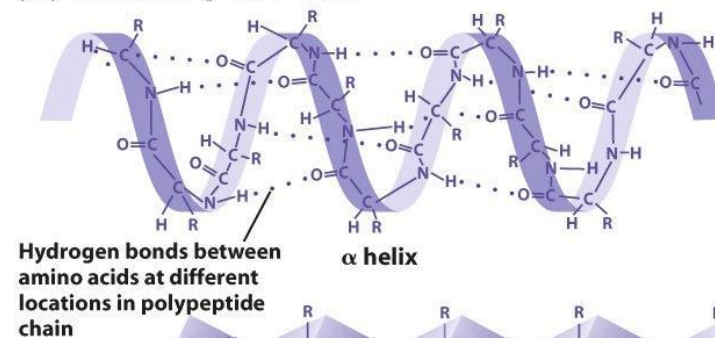
Levels of Protein Structure

- ▶ Primary
 - ▶ Sequence of amino acids
- ▶ Secondary
 - ▶ Alpha helices or beta pleated sheets
 - ▶ Due to hydrogen bonds
- ▶ Tertiary
 - ▶ Interactions of side chains leads to a folding of the molecule
- ▶ Quaternary
 - ▶ Sometimes multiple chains come together to create a larger protein

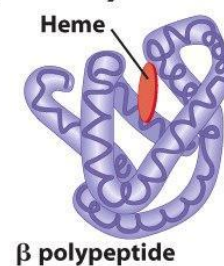
(a) Primary structure



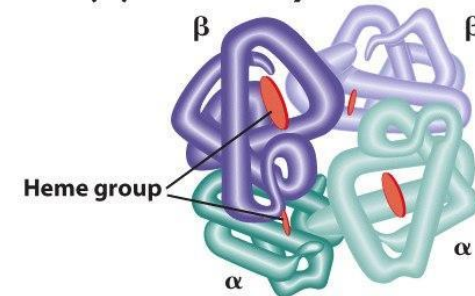
(b) Secondary structure



(c) Tertiary structure

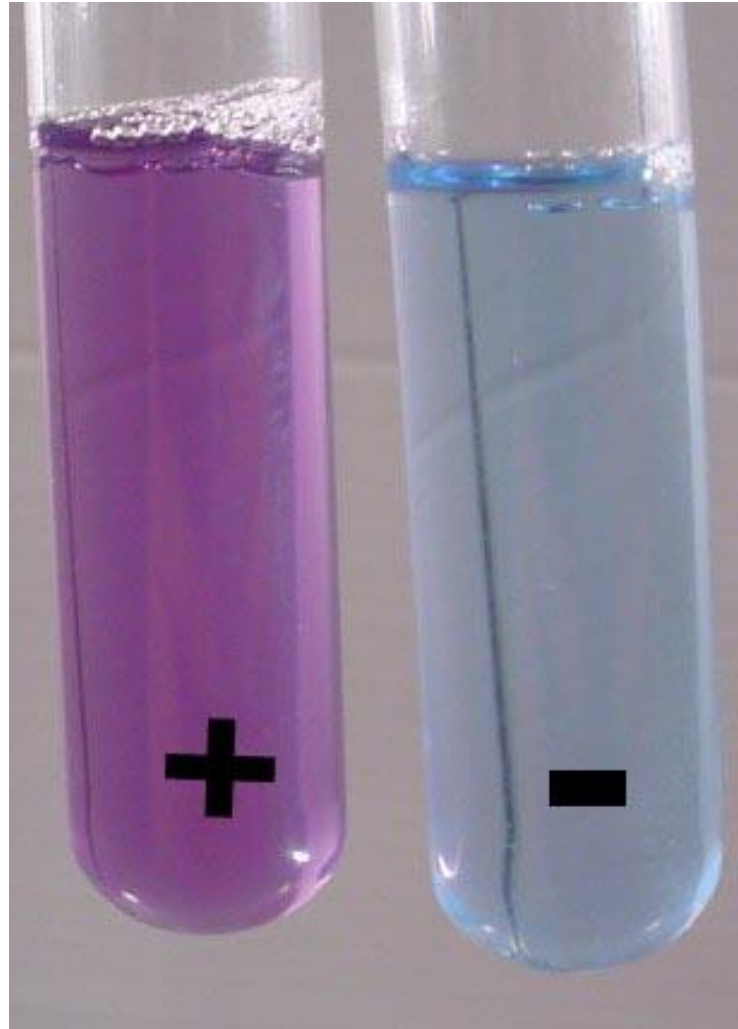


(d) Quaternary structure



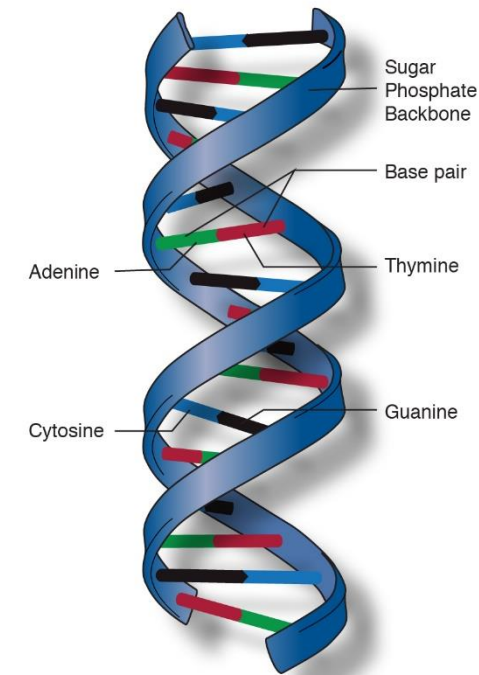
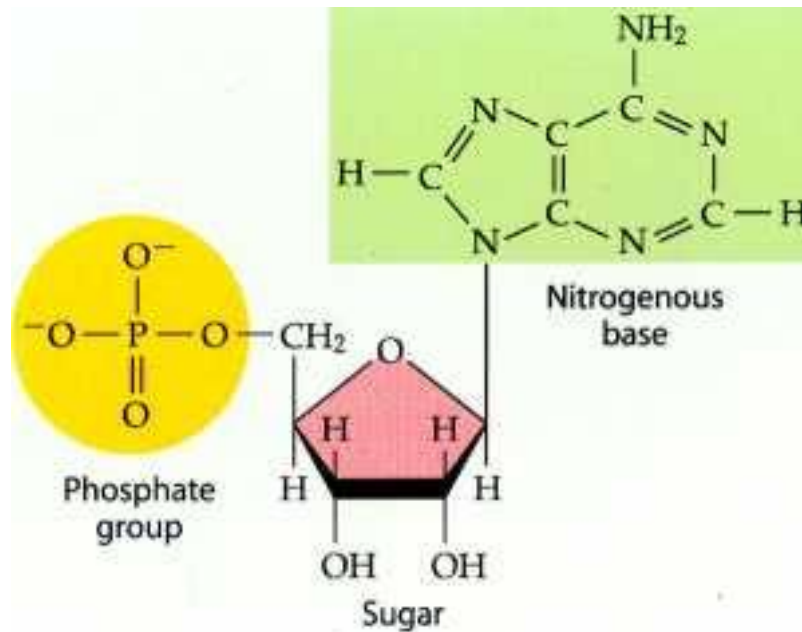
How do we test for proteins?

- ▶ Biuret test

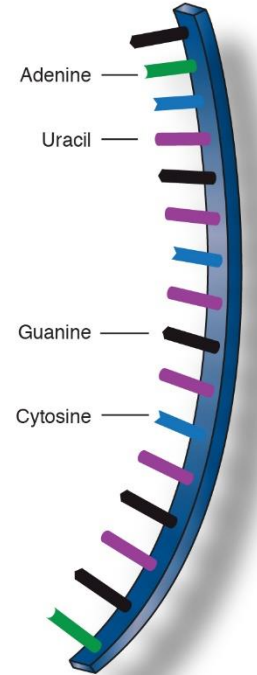


Nucleic Acids

- ▶ Primary job is to store and transmit genetic information
- ▶ DNA and RNA
- ▶ Made of smaller monomers called **nucleotides**
 - ▶ made of sugar, phosphate and nitrogen containing base



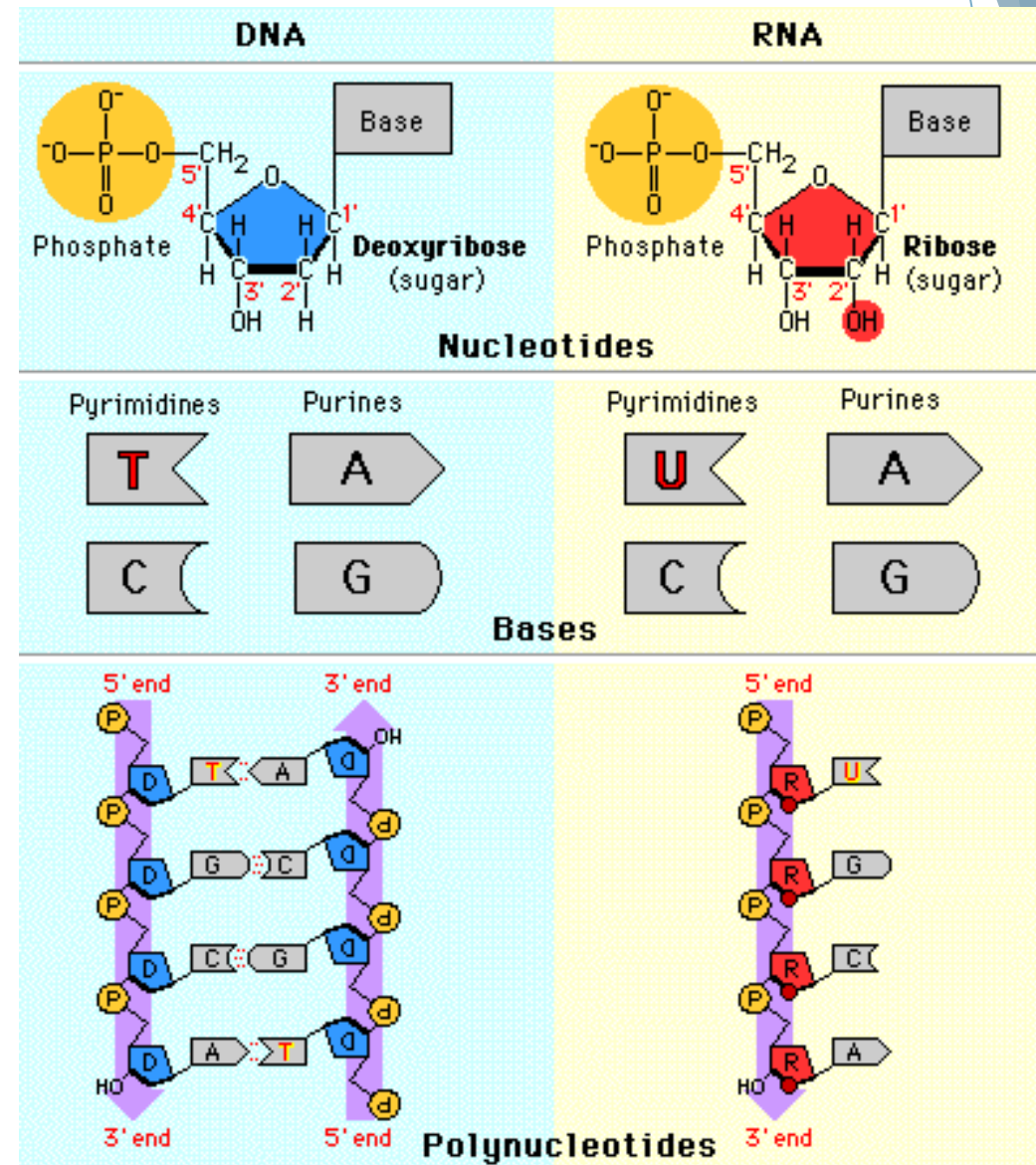
Deoxyribonucleic acid
(DNA)



Ribonucleic acid
(RNA)

Nucleic acids

- ▶ Join together in long chains
- ▶ DNA stores genetic information
- ▶ RNA transmits it, and enables that genetic information to be decoded
- ▶ We will be learning about these molecules in greater detail later in the course



FACT CHECK/PARTNER TALK

Review the structure and function of proteins and nucleic acids.

Review (Amoeba sisters)

Biological molecule	Basic Unit	Function	Example	Common elements at building block level	Extra note
Carbohydrate					
Lipid					
Protein					
Nucleic acid					