General Biology 1
BIO1101
Syllabus & Textbook: http://goo.gl/rvgdrH

Letter Grade	Numerical Ranges
A	93-100
A-	90-92.9
B+	87-89.9
B	83-86.9
B-	80-82.9
C+	77-79.9
C	70-76.9
D	60-69.9
F	59.9 and below

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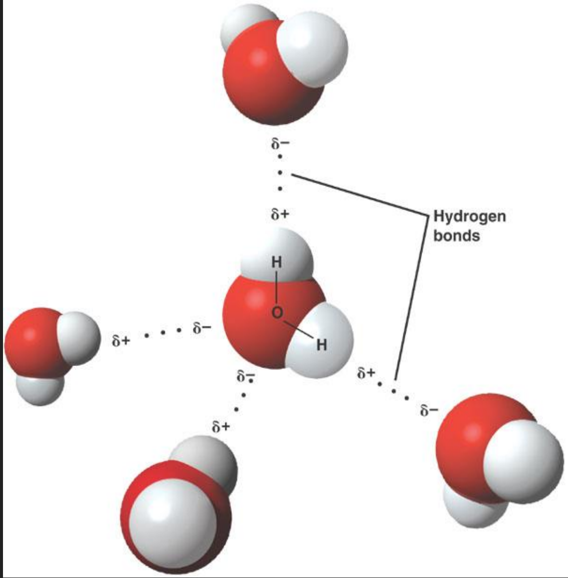
OER

Lecture: https://openlab.citytech.cuny.edu/bio-oer/page/2/
Lab: https://openlab.citytech.cuny.edu/bio-oer/

Grade Breakdown:

Exams (4): 20% Each
Quizzes: 20% Average

Recap: Lecture 5



1. **<u>Importance of Water: H_2O</u>** Abundance

The main reason the Earth is habitable

70-75% of earth's surface is under water!

70-95% of all cells are water!

The polarity of water allows hydrogen bonding

2. **<u>Water in Temperature Moderation</u>**

Water absorbs heat from warmer air and releases stored heat to cooler air

Water can absorb or release a large amount of heat with only a slight change in its own temperature **<u>(Thermal Inertia)</u>**

As a liquid evaporates, its remaining surface cools, called **<u>evaporative cooling</u>**

Ice Floats on water: Protects water underneath

3. **<u>Water is a solvent (Aqueous Solution)</u>**
   1) <u>Solute, Solvent, Solution</u>
4. **<u>Acid/Base Chemistry – pH scale</u>**
   1. <u>Buffers (Blood)</u>

5. If the pH of my favorite drink (for example: tomato juice) is 3.5; what is the concentration of H+ and OH- in that drink?

Carbon

Outline

- Importance of Carbon
- Organic vs Inorganic chemistry
- The formation of bonds with carbon
- The hydrocarbons
- Isomers
- Functional groups

Carbon: the backbone of biological molecules

- Although cells are 70–95% water, the rest consists mostly of carbon-based compounds
- Carbon is unparalleled in its ability to form large, complex, and diverse molecules
- Proteins, DNA, carbohydrates, and other molecules that distinguish living matter are all composed of carbon compounds
- **Organic Chemistry** is the study of Carbon-based molecules

Inorganic vs Organic Chemistry

- Inorganic – Chemistry of elements other than carbon
- Organic – Carbon-based chemistry

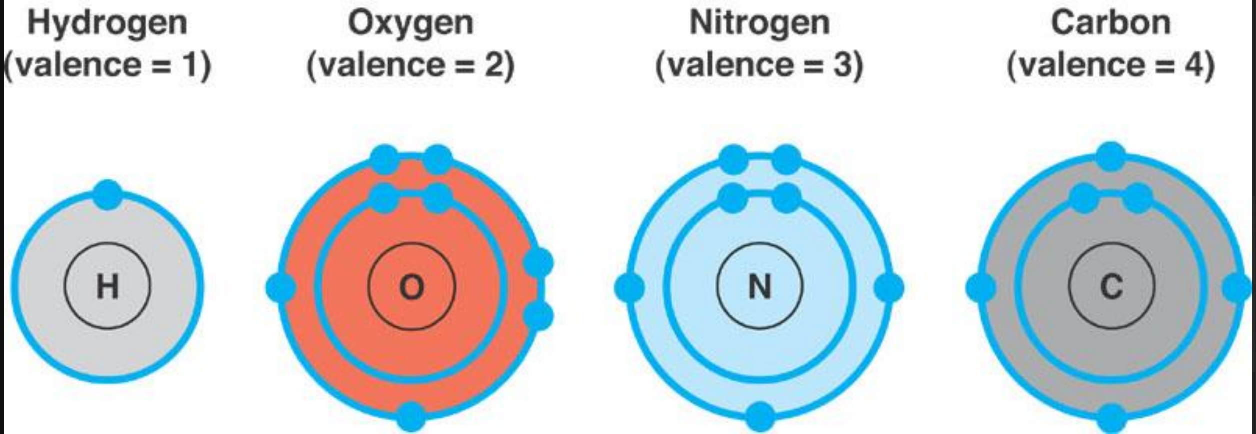
Inorganic	Organic
Usually with (+) & (-) ions	Always contain carbon and hydrogen
Usually ionic bonding	Always covalent bonding
Always with few atoms	Often quite large, with many atoms
Often associated with nonliving matter	Usually associated with living systems

Dihydrogen-monoxide, Organic or Inorganic?

The formation of bonds with Carbon

Valence = bond formation

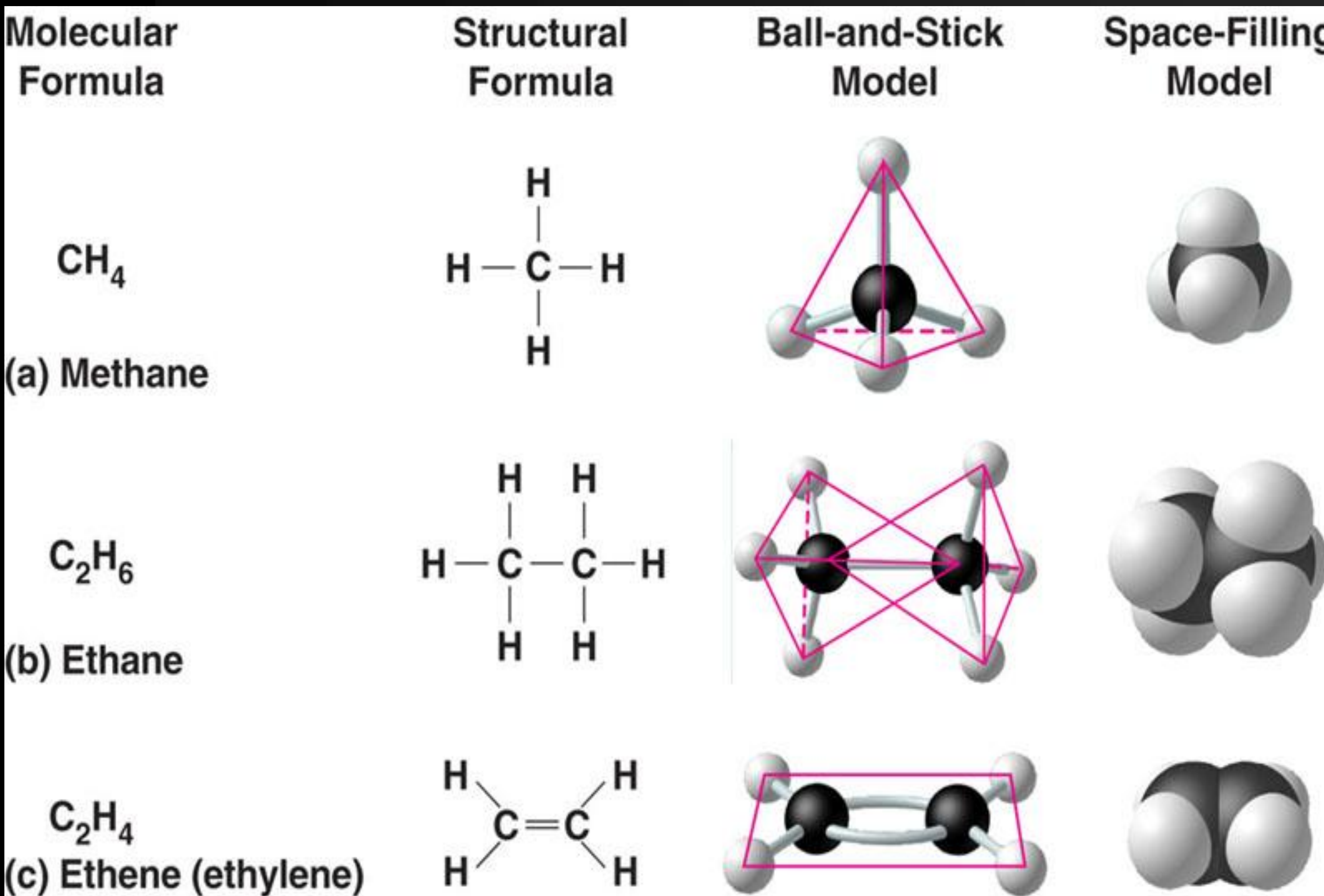
- Remember:
  - Electron configuration is the key to an atom's characteristics
  - atoms like to fill their outer shell
  - Valence = number of e^- required to fill outer shell
  - Valence number = number of bonds that the atom will form

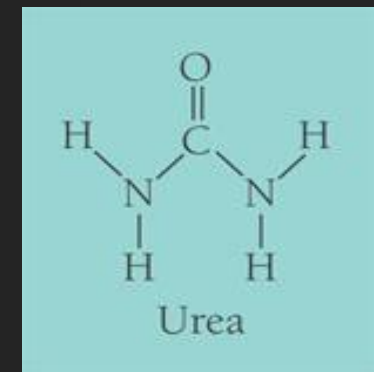


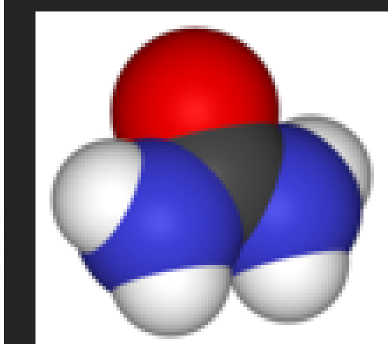
The formation of bonds with Carbon

- Carbon generally makes FOUR covalent bonds (valence = 4) to fill its outer shell
- This **tetravalence** makes large, complex molecules possible
- In molecules with multiple carbons, each carbon bonded to four other atoms has a tetrahedral shape
- However, when two carbon atoms are joined by a double bond, the molecule has a flat shape

Some common Carbon Molecules







Remember:
No free rotation around a double bond!!!!

The formation of bonds with Carbon

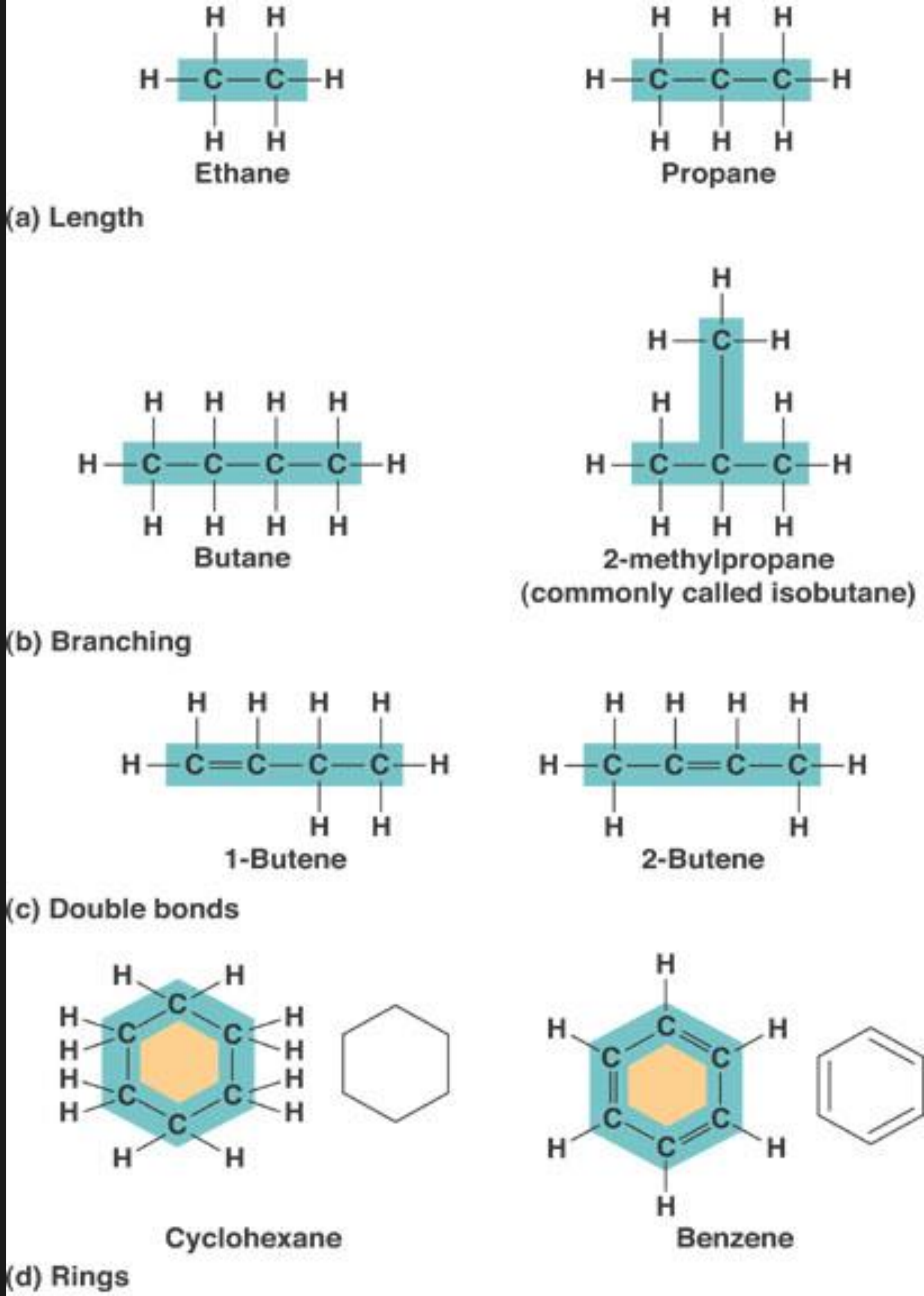
- The valences of carbon and its most frequent partners (hydrogen, oxygen, and nitrogen) are the “building code” that governs the architecture of living molecules (NOCH or CHON)

- Carbon chains form the skeletons of most organic molecules

- Carbon chains vary in length and shape

Hydrocarbons

- Skeletons of C-H are called “hydrocarbons”
- Carbon Skeleton can vary in:
  – Length
  – Branching
  – Double bonds
  – Rings

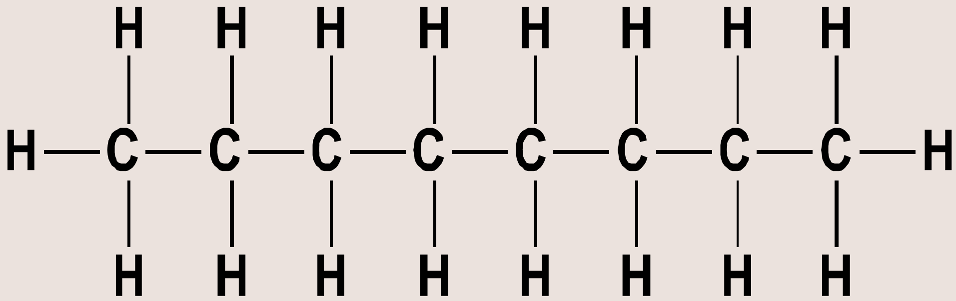


Hydrocarbons

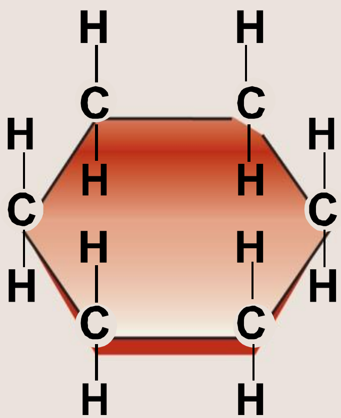
- Hydrocarbons are organic molecules consisting of only carbon and hydrogen
- Many organic molecules, such as fats, have hydrocarbon components
- Hydrocarbons can undergo reactions that release a large amount of energy
- Long-chain hydrocarbons are used as energy storage (fats/oils)

- Because of all the non-polar bonds, these molecules are hydrophobic (water-insoluble), form droplets in aqueous solutions.

Octane & Cyclohexane

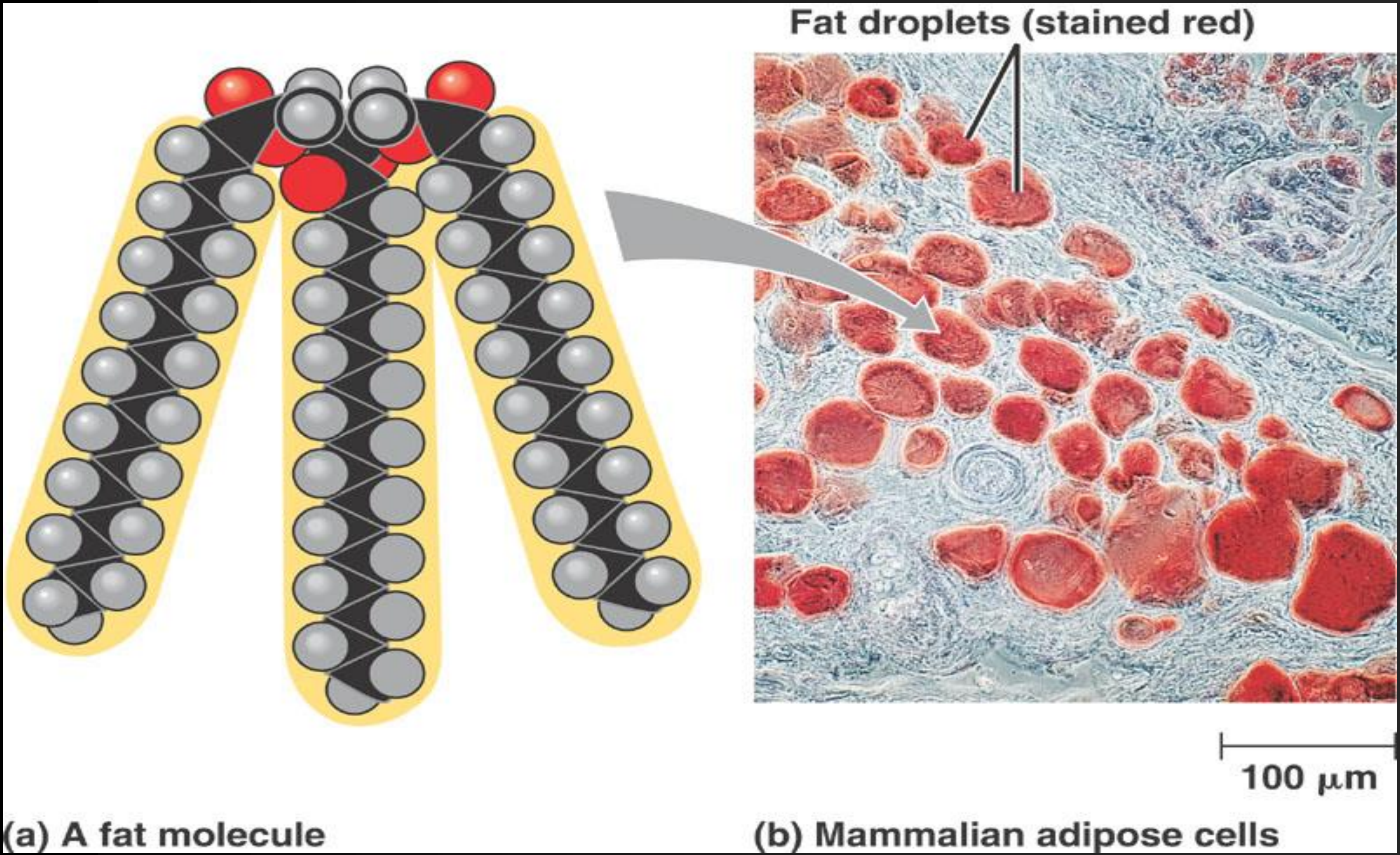


octane



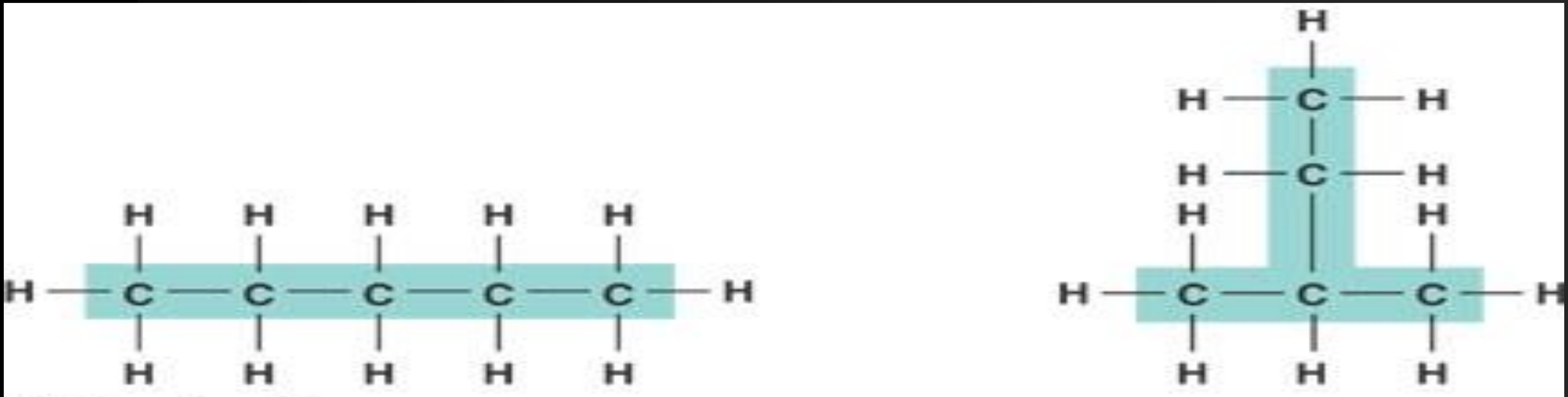
cyclohexane

Long-chain hydrocarbons



Chemical Structure and Shape
ISOMERS

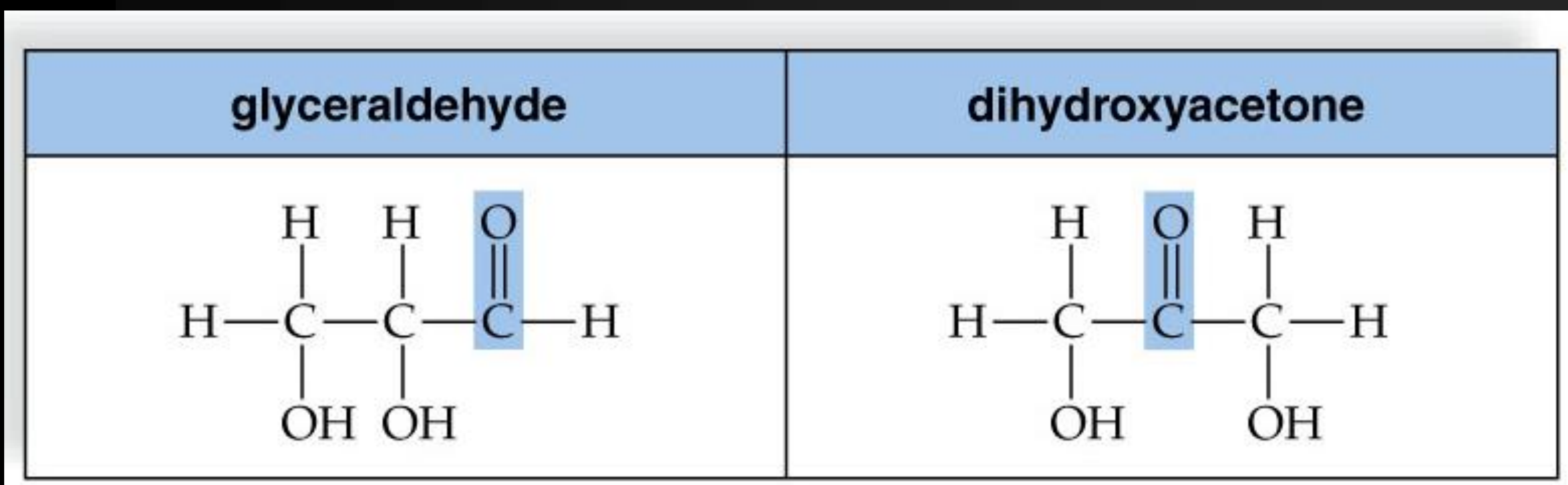
... = molecules with the same chemical FORMULA, but different STRUCTURE and PROPERTIES



(a) Structural isomers

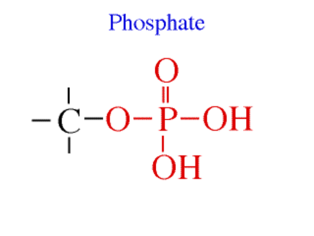
Chemical Structure and Shape
ISOMERS

... = molecules with the same chemical FORMULA, but different STRUCTURE and PROPERTIES

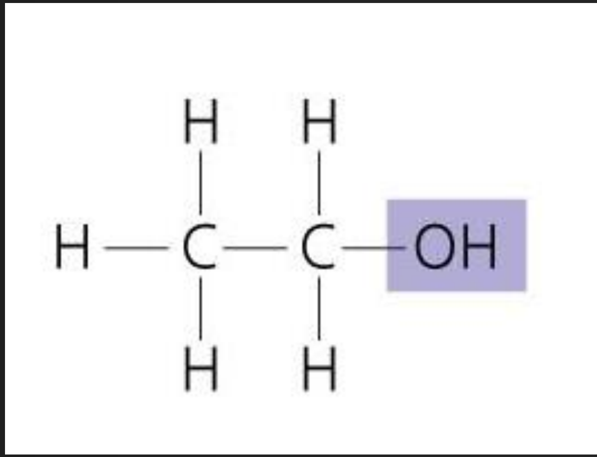


Functional Groups

- Specific combinations of bonded atoms
- Attached as a group to other molecules
  - Always react in the same manner, regardless of where attached
  - Determine activity and polarity of large organic molecules
  - Many functional groups, but only a few are of major biological importance
- The six most important in Biology:
  - Hydroxyl… (OH) don't confuse with hydroxide (OH^-)
  - Carbonyl (CO) → - C = O
  - Carboxyl (CO_2H) or (COOH) → O = C – O – H
  - Amino (NH_2) → H – N - H
  - Sulfhydryl (SH) → S - H
  - Phosphate (PO_4)

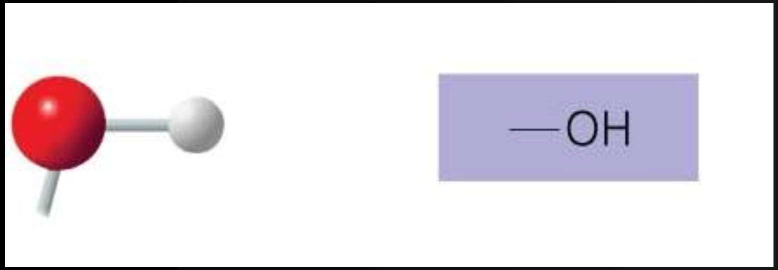


HYDROXYL (OH)



Ethanol, the alcohol present in alcoholic beverages

STRUCTURE



(may be written HO—)

NAME OF COMPOUNDS

Alcohols

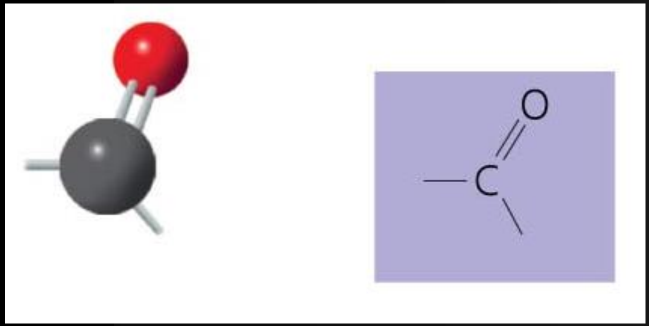
(their specific names usually end in *-ol*)

FUNCTIONAL PROPERTIES

- Polar as a result of the electroneg. oxygen atom drawing e- toward itself
- Attracts water molecules, helping dissolve organic compounds such as sugars

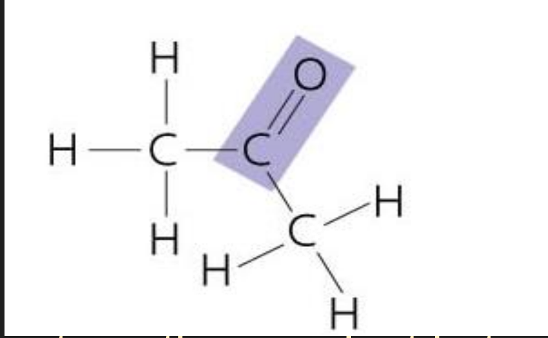
CARBONYL (CO)

STRUCTURE

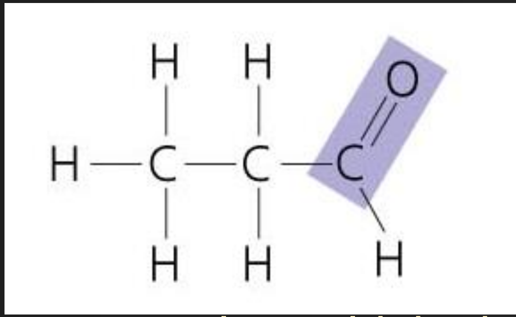


NAME OF COMPOUNDS

- Ketones if the carbonyl group is within a carbon skeleton
- Aldehydes if the carbonyl group is at the end of the C skeleton



Acetone the simplest ketone

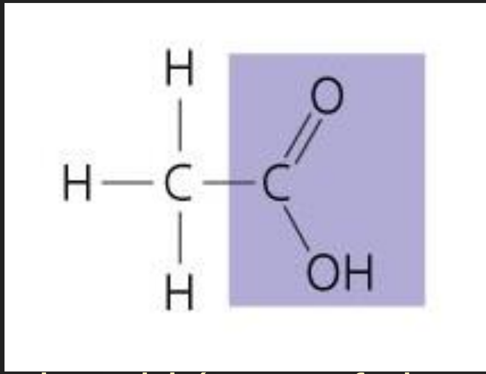


Propanol, an aldehyde

FUNCTIONAL PROPERTIES

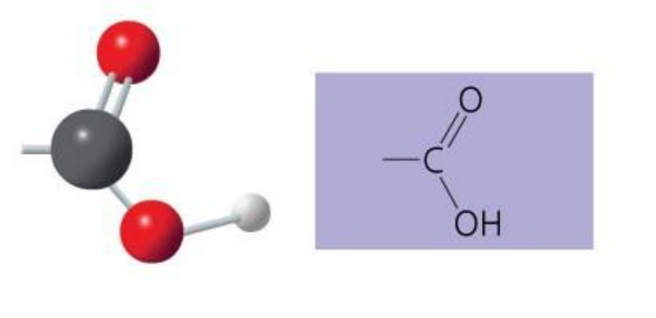
A ketone and an aldehyde may be structural isomers with <u>different properties</u>, as is the case for acetone and propanol.

CARBOXYL (CO_2H)



Acetic Acid (taste of vinegar)

STRUCTURE

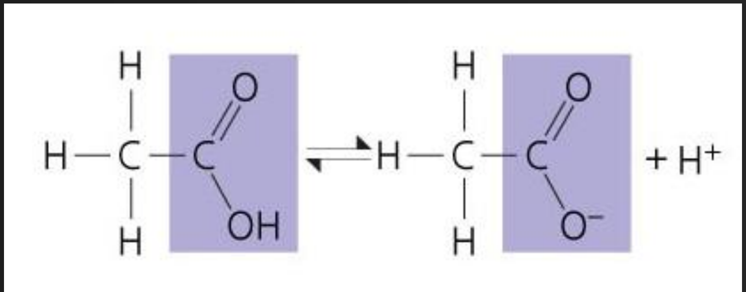


NAME OF COMPOUNDS

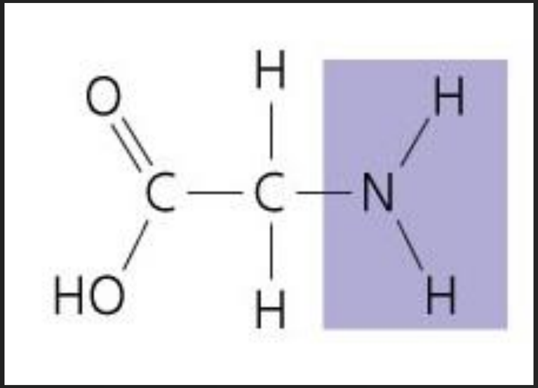
- Carboxylic acids or organic acids

FUNCTIONAL PROPERTIES

- Has acidic properties because it's a source of H ions
- Covalent bond between O and H is very polar

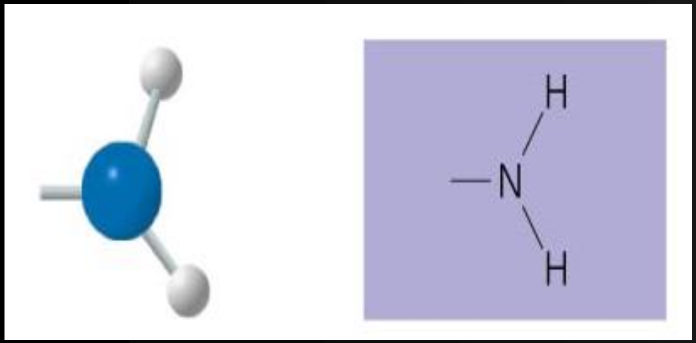


AMINO (NH_2)



Glycine
(also a carboxylic acid
so it's an amino acid)

STRUCTURE

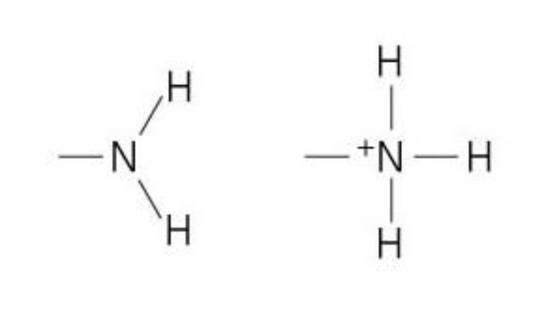


NAME OF COMPOUNDS

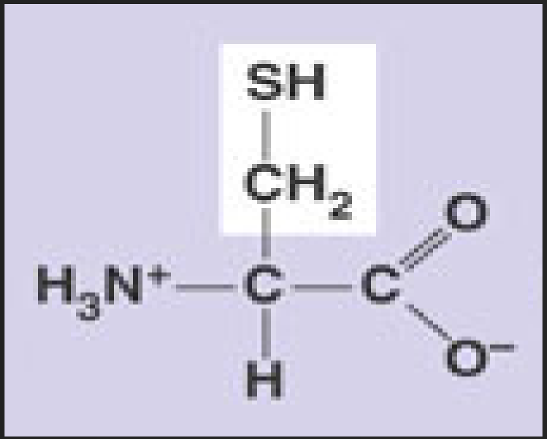
- Amine

FUNCTIONAL PROPERTIES

- Acts as a base (take up protons)
- Ionized at pH<10

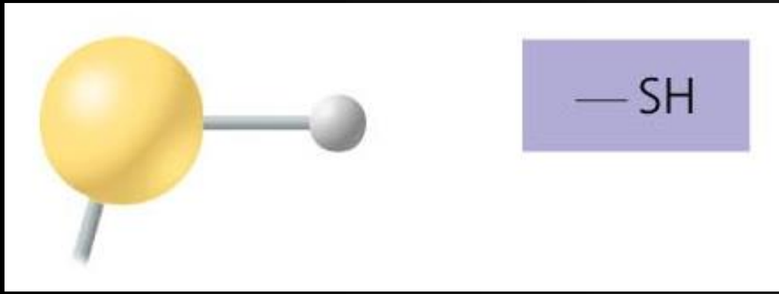


SULFHYDRYL (SH)



Cysteine

STRUCTURE



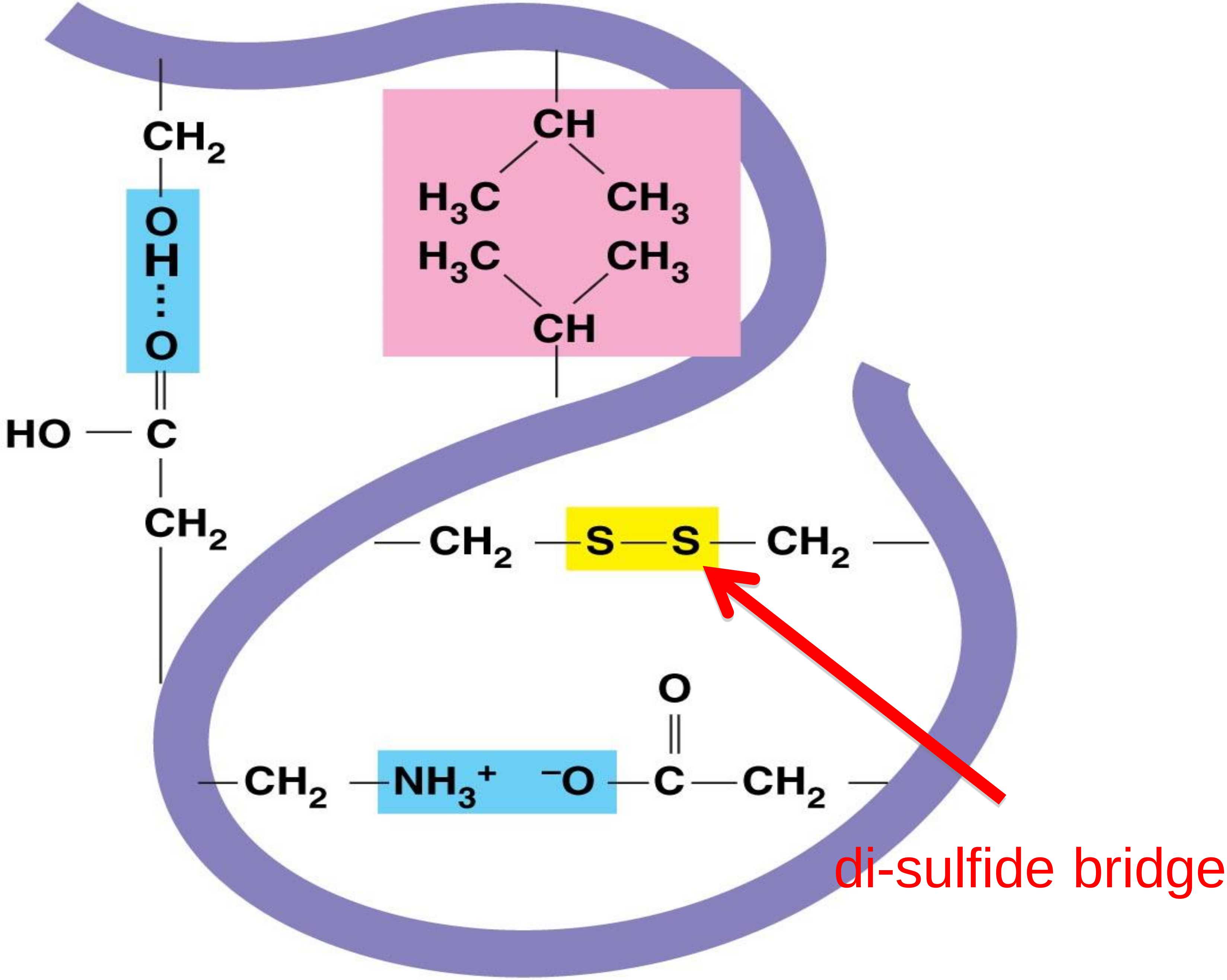
May be written HS-

NAME OF COMPOUNDS

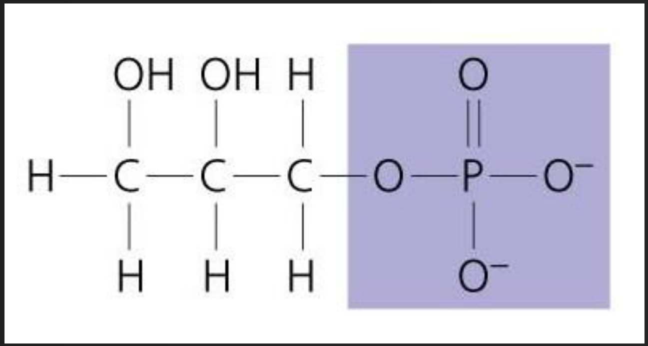
- Thiols

FUNCTIONAL PROPERTIES

- Two sulfhydryl groups can interact to help stabilize protein structure by formation of di-sulfide bridges

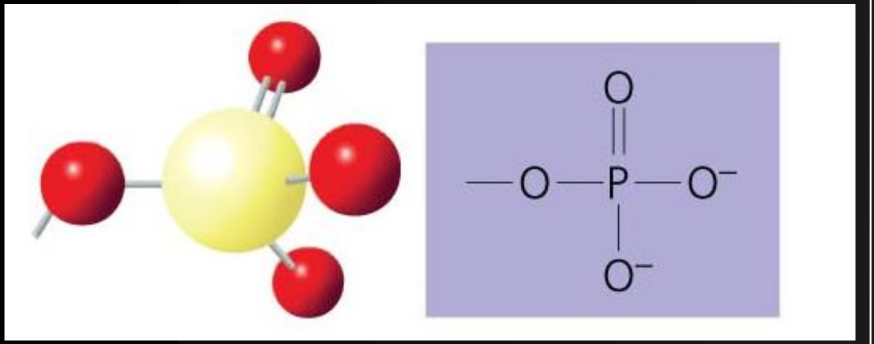

CH2
O
H
O
HO — C
CH2
CH
H3C
CH3
H3C
CH3
CH
— CH2 — S — S — CH2 —
O
— CH2 — NH3+ −O — C — CH2 —
di-sulfide bridge

PHOSPHATE (PO_4)



Glycerol phosphate

STRUCTURE



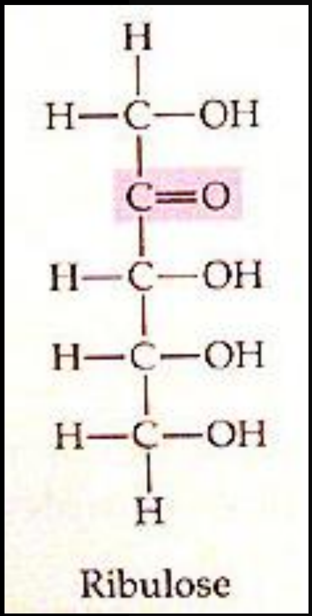
NAME OF COMPOUNDS

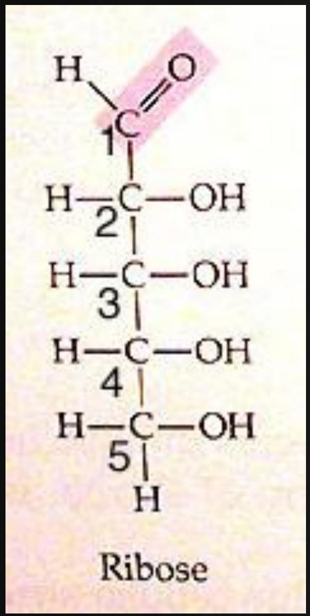
- Organic phosphates

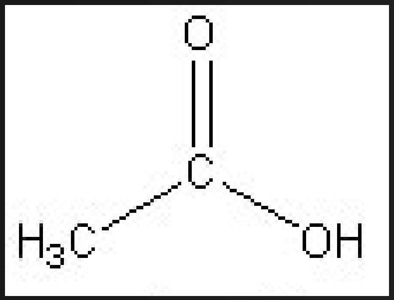
FUNCTIONAL PROPERTIES

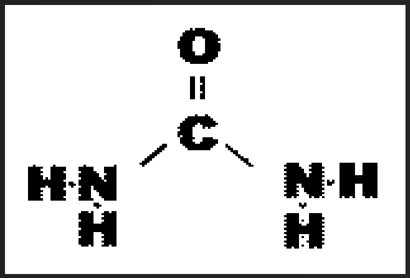
- Negatively charged: Anion
- Capable of high-energy bond formation

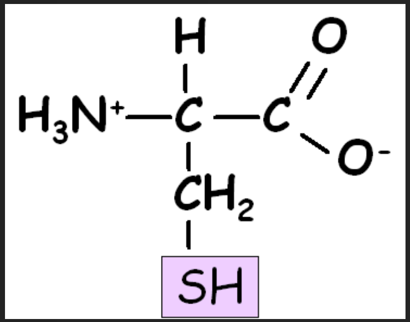
Identify the functional groups!

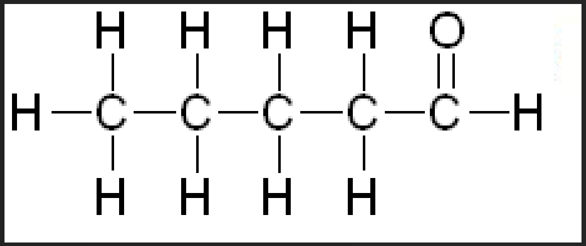


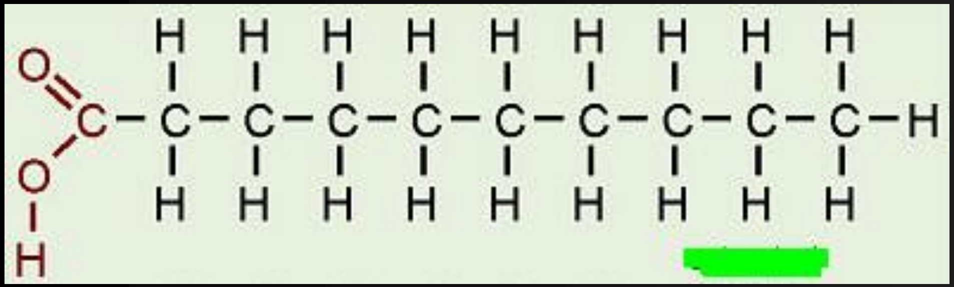


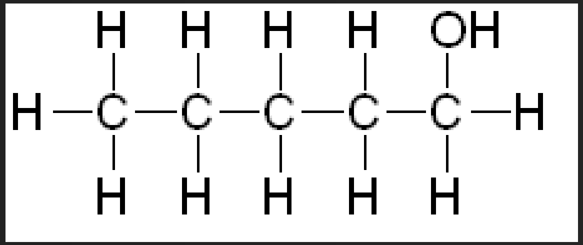




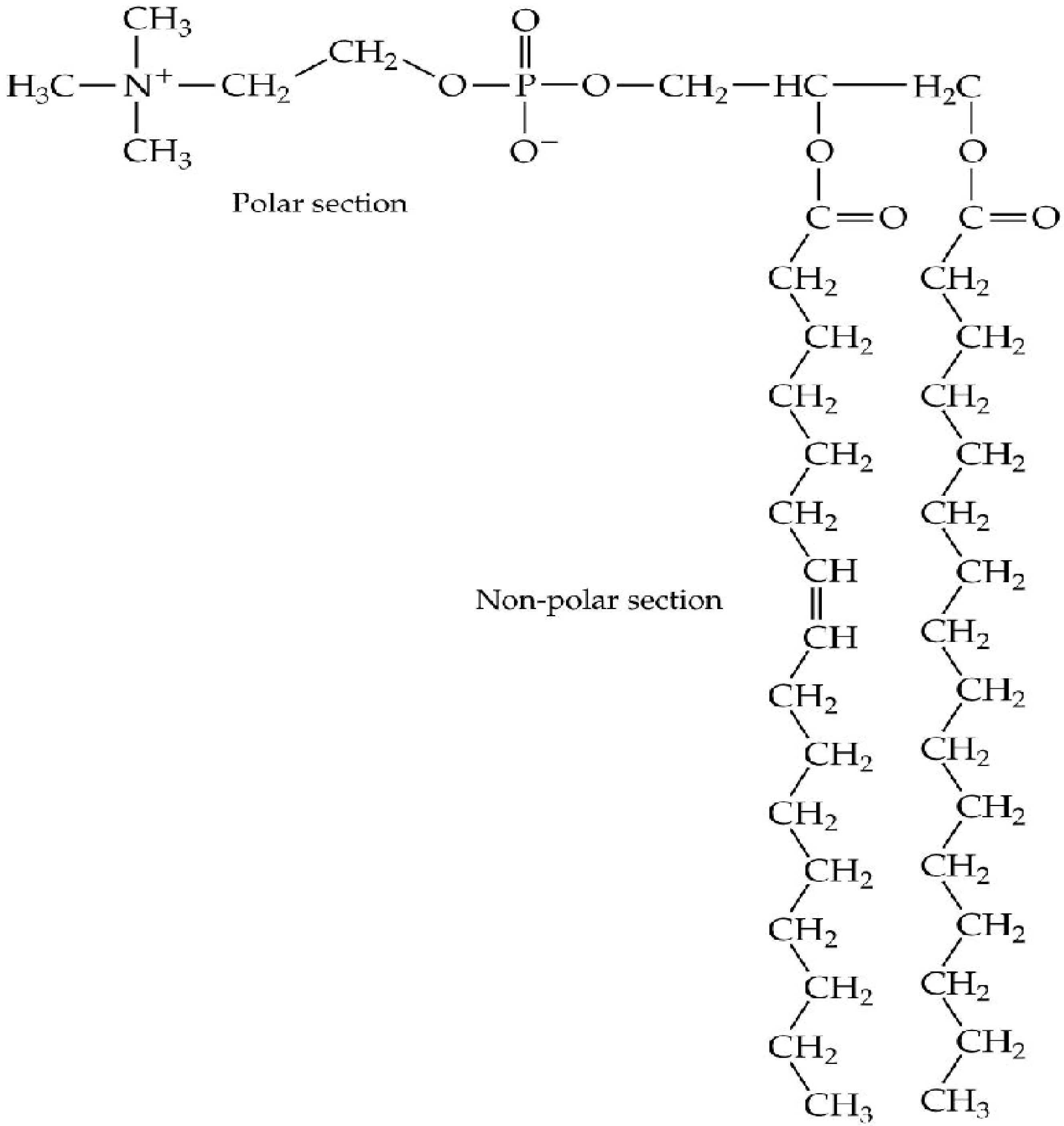








Identify the functional groups!



Identify the functional groups!