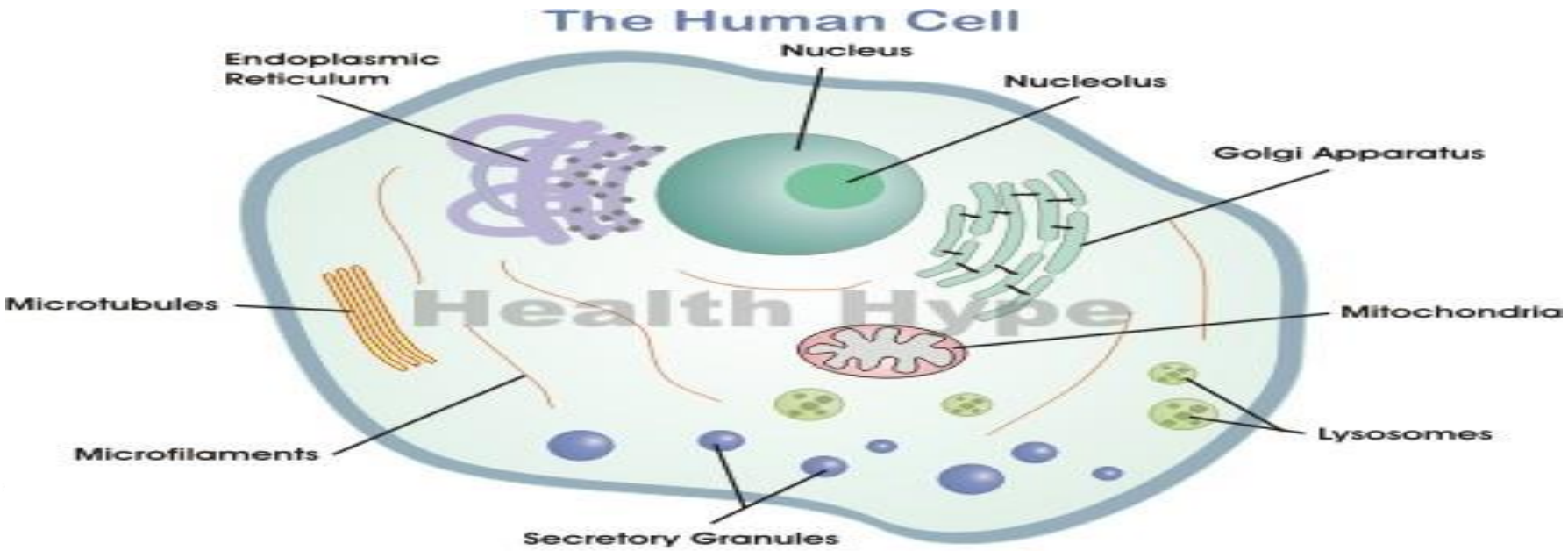
INTRODUCTION

INTRODUCTION TO BIOCHEMISTRY

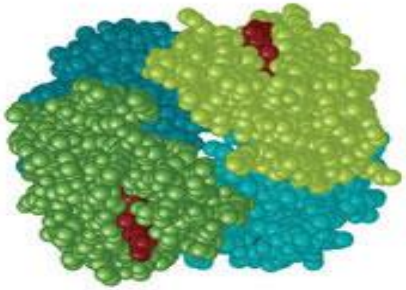
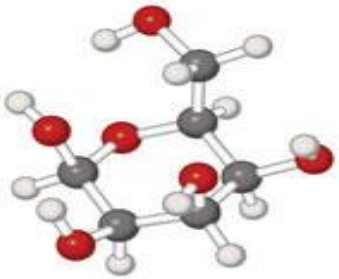
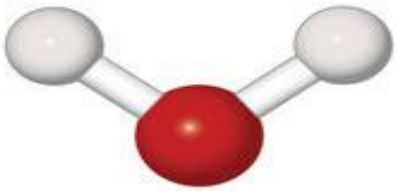
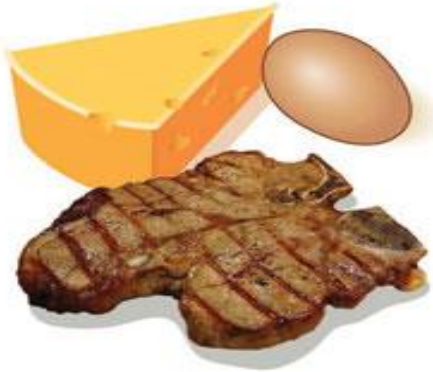
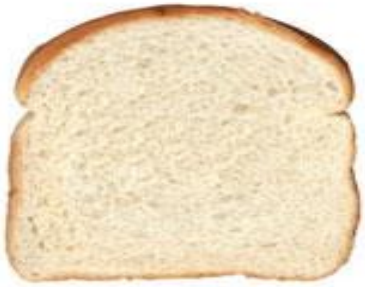
As the cell is the structural unit of the living organisms; the functional definition of biochemistry is the science concerned with the chemical constituents of living cells and with the reactions and the processes that undergo inside them.



These chemical reactions can be summarized as those occurring to:

1. Carbohydrates.
2. Lipids.
3. Proteins.

Which are the main substances taken in Diet.

Proteins	Carbohydrates	Lipids	Water
			
			

You Are What You Eat

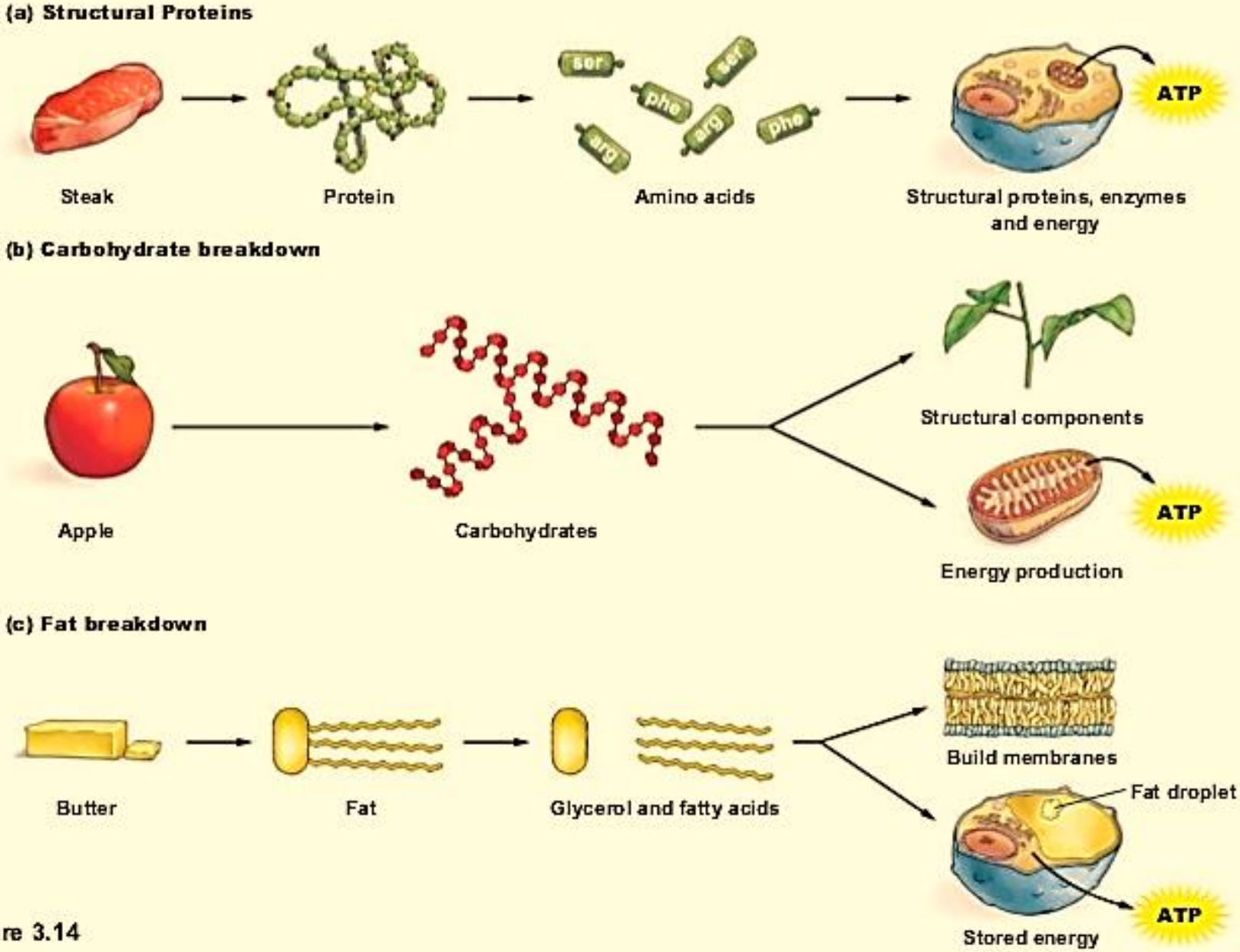
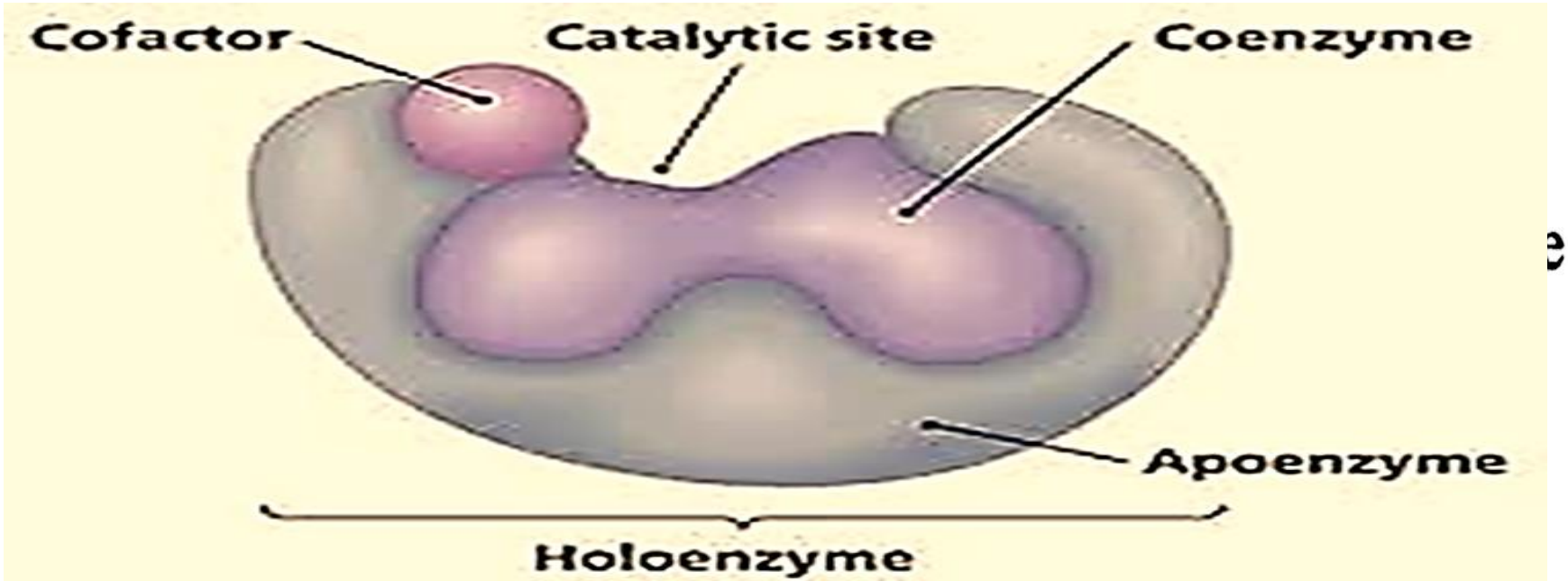


Figure 3.14

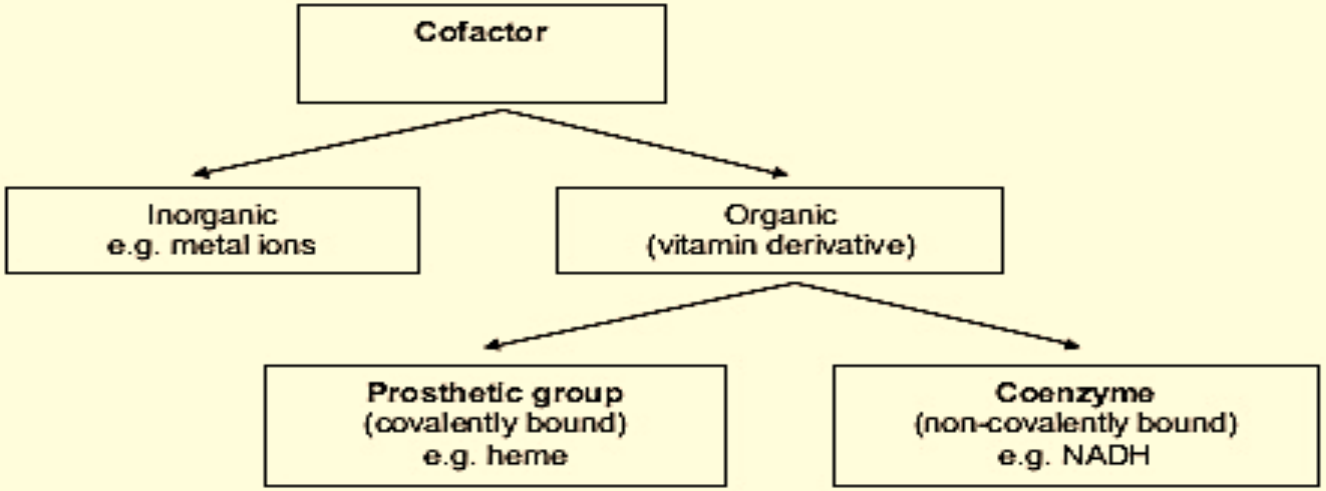
These chemical reactions are catalyzed by substances called enzymes, most of enzymes need co-factors (factors to help enzymes in their action) are either:

subdivided into

1. Coenzymes derived from vitamins.
2. Inorganic ions as Fe, Cu, Zn, Mg, these ions are called minerals and act as prosthetic groups for enzymes.



Types of Cofactors



1. Coenzymes derived from vitamins.
2. Inorganic ions as Fe, Cu, Zn, Mg, these ions are called minerals and act as prosthetic groups for enzymes.

The Aim to study biochemistry

Is to describe and explain in molecular terms, all the chemical processes of living cells.

To achieve these objectives:

1. Biochemists isolate the numerous molecules found in cell, determine their structures and analyze how they function.
2. Study how the body derives energy for normal days work.
3. Study the regulation of the activities of genes and enzymes.
4. Study the molecular bases of immunological reactions against bacterial and viral infections.

Relationship between Biochemistry and Health:

1. Understanding and maintenance of health.
2. Understanding the effective treatment of disease.
3. To maintain good health is by taking the optimal dietary intake of number of chemicals e.g. vitamins, amino acids, fatty acids, minerals and H_2O, Any nutritional imbalance will produce deficiency disease.
4. All diseases have a biochemical bases.
5. Biochemistry studies contributes in the diagnosis, prognosis and treatment of diseases.

The Use of Biochemical Investigations in Relation to Diseases Summarized as Follows:

a. Reveal the site of the defect and the causes of disease.
b. Suggest the treatment and its effect.
c. Make available screening tests for early diagnosis.
d. Help in monitoring the progress of disease.
e. Help in assessing response to therapy.

Examples of the Interrelation of Biochemistry and Diseases:

- Carbohydrates ⟶ Diabetes Mellitus.
- Lipids ⟶ Atherosclerosis.
- Proteins ⟶ Hyperamonemia
- Amino acids ⟶ Inborn Error.
- Nucleic acids ⟶ Genetic diseases.

Main functional groups in biochemistry

Functional groups are parts of an organic molecule commonly involved in chemical reactions that maybe polar or non-polar.

Seven common functional groups:

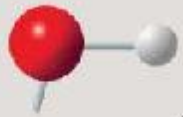
- Hydroxyl (alcohol) – OH
- Carbonyl = O
- Carboxyl – COOH (ionized at body PH)
- Amino – NH_2
- Sulfhydryl – SH
- Phosphate – PO_4 (ionized at body PH)

1. Hydroxyl Group:

Class	Structure	Properties	Examples
Alcohols	OH	Polar Hydrophilic	Ethanol Sugars Glycerol

Hydroxyl

STRUCTURE



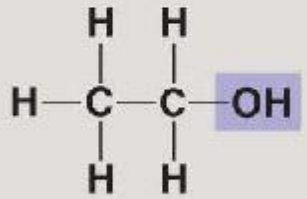
—OH

(may be written HO—)

NAME OF COMPOUND

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

EXAMPLE

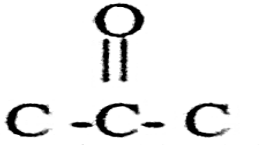


Ethanol, the alcohol present in alcoholic beverages

FUNCTIONAL PROPERTIES

- Is polar as a result of the electrons spending more time near the electronegative oxygen atom.
- Can form hydrogen bonds with water molecules, helping dissolve organic compounds such as sugars.

2. *Carbonyl Group:*

Class	Structure	Properties	Examples
Aldehydes (terminal carbonyl)		Polar Hydrophilic	Formaldehyde Sugars
Ketones			Acetone Sugars

Carbonyl

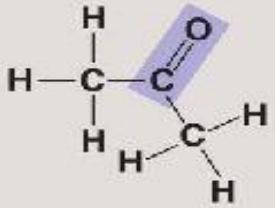
STRUCTURE

NAME OF COMPOUND

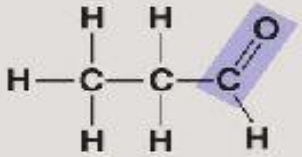
Ketones if the carbonyl group is within a carbon skeleton

Aldehydes if the carbonyl group is at the end of the carbon skeleton

EXAMPLE



Acetone, the simplest ketone



Propanal, an aldehyde

FUNCTIONAL PROPERTIES

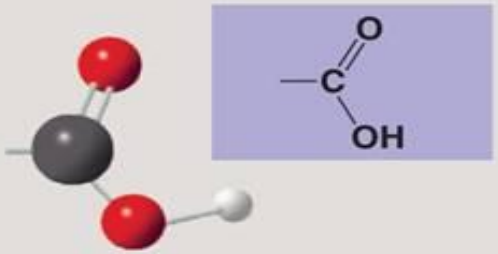
- A ketone and an aldehyde may be structural isomers with different properties, as is the case for acetone and propanal.
- These two groups are also found in sugars, giving rise to two major groups of sugars: aldoses (containing an aldehyde) and ketoses (containing a ketone).

3. *Carboxyl Group:*

Class	Structure	Properties	Examples
Carboxylic Acids	O ‖ -C-O-H	Polar Hydrophilic Weak acid	Acetic acid Citric acid Amino acids
Ionized at normal pH or basic pH	O ‖ -C-O		

Carboxyl

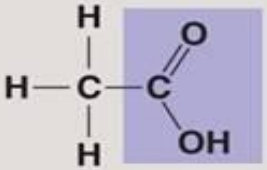
STRUCTURE



NAME OF COMPOUND

Carboxylic acids, or organic acids

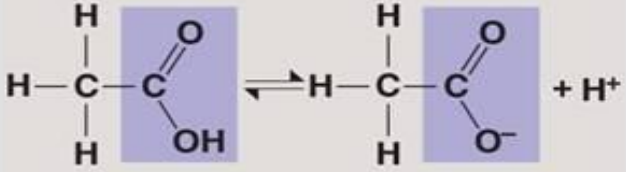
EXAMPLE



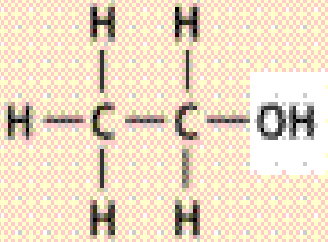
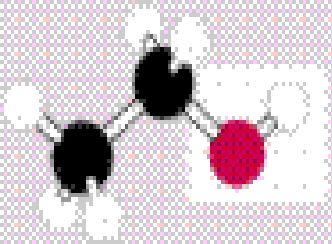
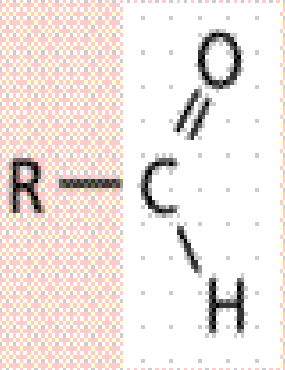
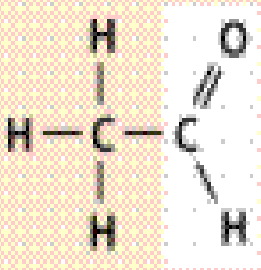
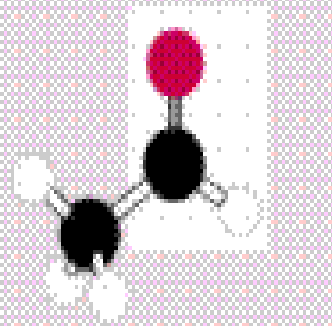
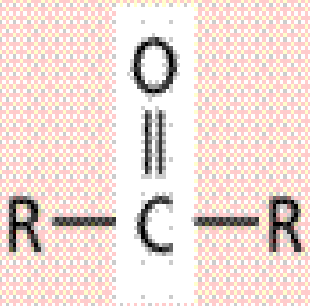
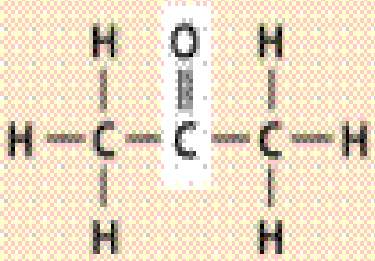
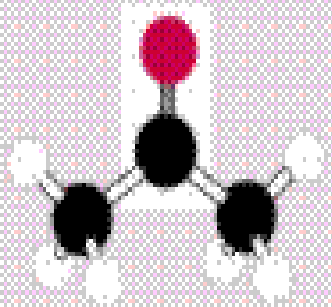
Acetic acid, which gives vinegar its sour taste

FUNCTIONAL PROPERTIES

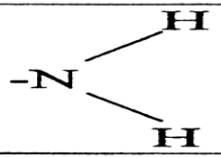
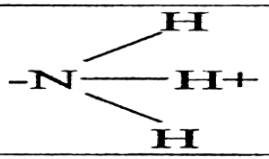
- Has acidic properties because the covalent bond between oxygen and hydrogen is so polar; for example,

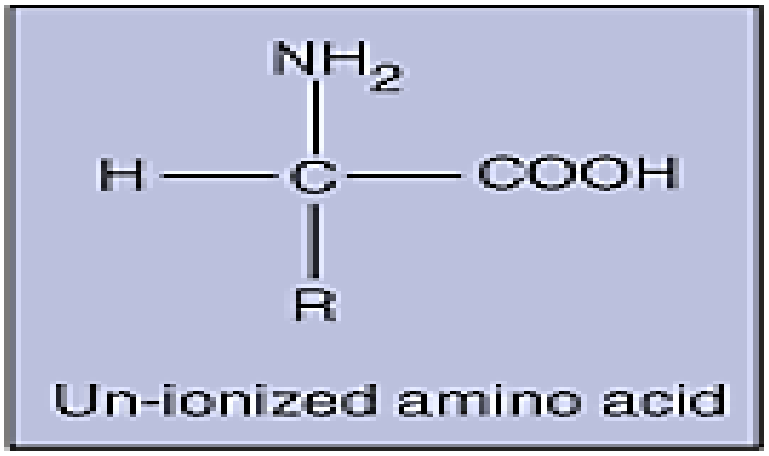


Acetic acid Acetate ion

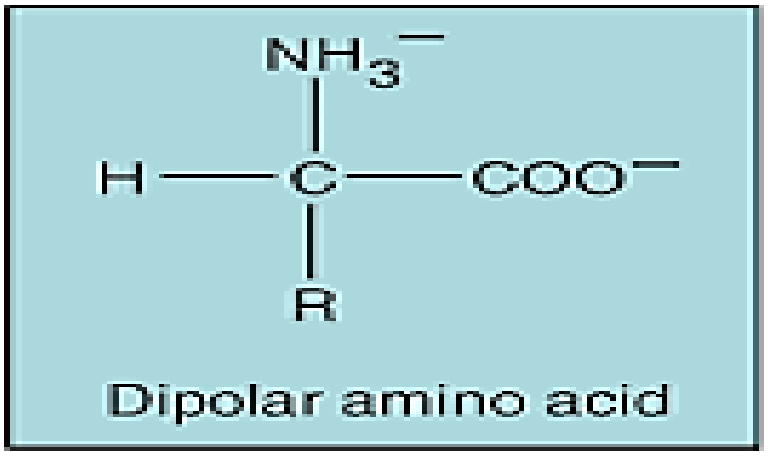
Functional group	Class of compounds	Structural formula	Example	Ball-and-stick model
Hydroxyl –OH	Alcohols		 Ethanol	
Carbonyl –CHO	Aldehydes		 Acetaldehyde	
Carbonyl 	Ketones		 Acetone	

4. *Amino Group:*

Class	Structure	Properties	Examples
Amines		Polar Hydrophilic Weak acid	Amino acids Amino sugars
Ionized at normal pH or basic pH			



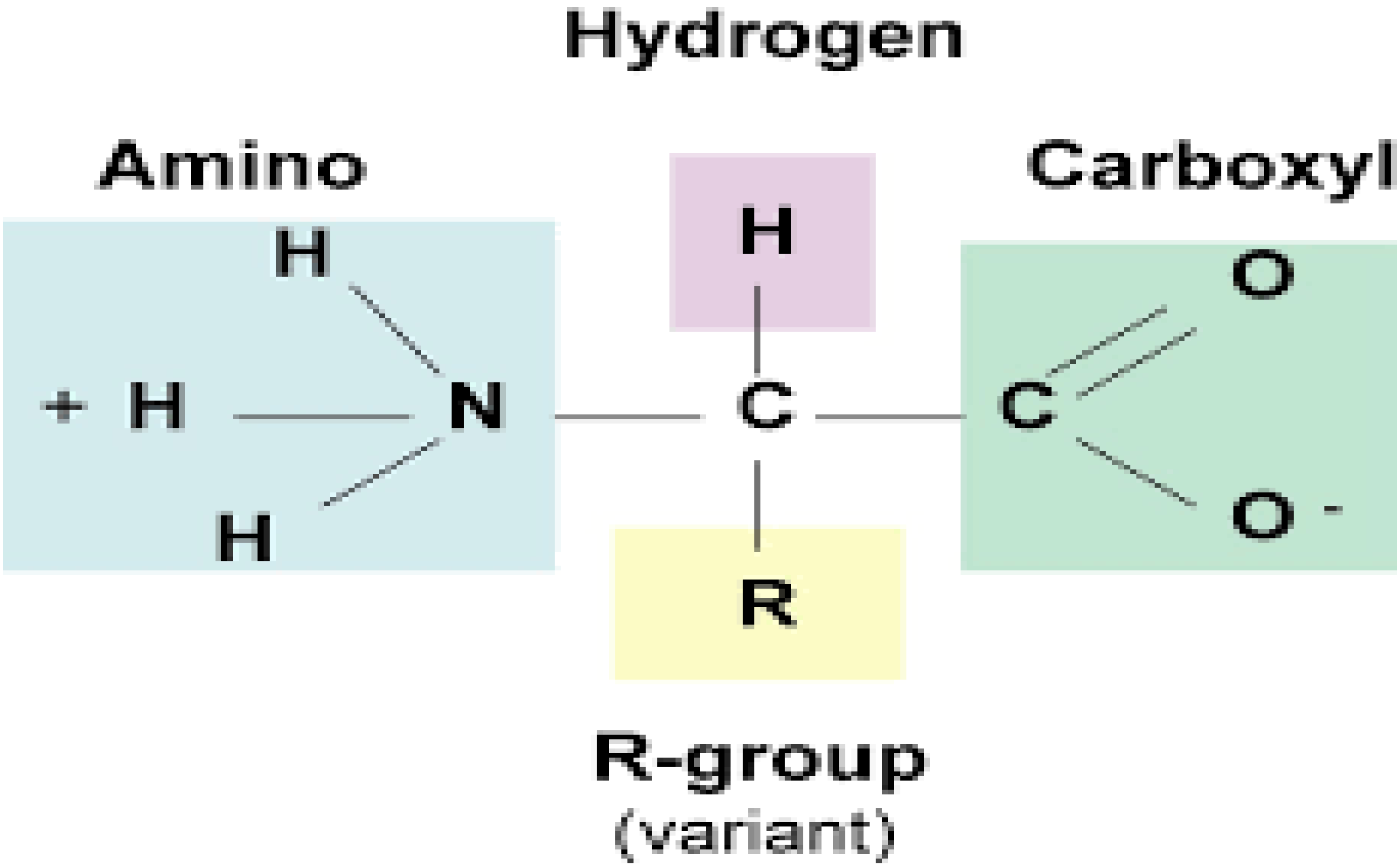
Un-ionized amino acid



Dipolar amino acid

- In acidic medium ; the amino acid is positively charged, so it behaves as a base (proton acceptor).
- In alkaline medium ; the amino acid is negatively charged, so it behaves as an acid (proton donor).

Amino Acid Structure



5. Sulfhydryl:

Class	Structure	Properties	Examples
Thiols	-S-H	Polar Hydrophilic Weak acid	Amino acids

Sulfhydryl

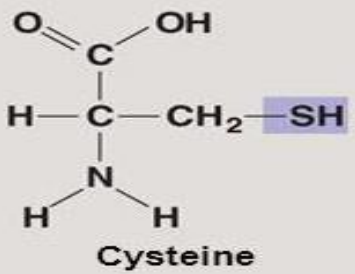
STRUCTURE

(may be written HS—)

Thiols

NAME OF COMPOUND

EXAMPLE



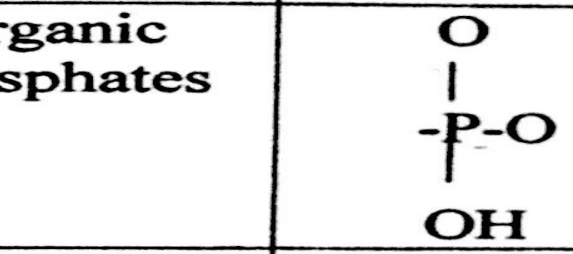
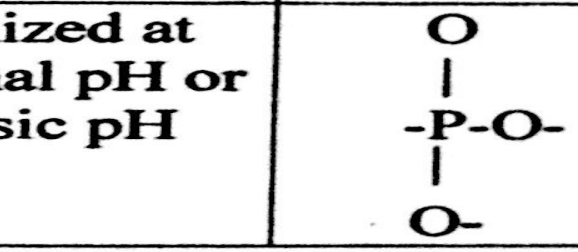
Cysteine

Cysteine is an important sulfur-containing amino acid.

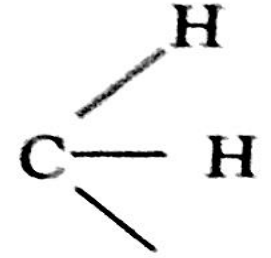
- Two sulfhydryl groups can react, forming a covalent bond. This "cross-linking" helps stabilize protein structure.
- Cross-linking of cysteines in hair proteins maintains the curliness or straightness of hair. Straight hair can be "permanently" curled by shaping it around curlers, then breaking and re-forming the cross-linking bonds.

FUNCTIONAL PROPERTIES

6. *Phosphate Group:*

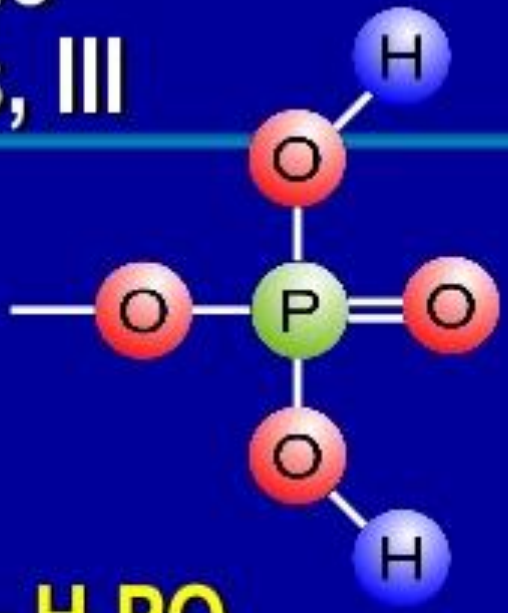
Class	Structure	Properties	Examples
Organic phosphates		Polar Hydrophilic Weak acid	DAN, RNA Phospholipids ATP
Ionized at normal pH or basic pH			

7. *Methyl Group:*

Class	Structure	Properties	Examples
Hydrocarbon *Alkanes Ethyl, Propyl		Nonpolar Hydrophobic	Fatty acids Oils Waxes

Example Groups, III

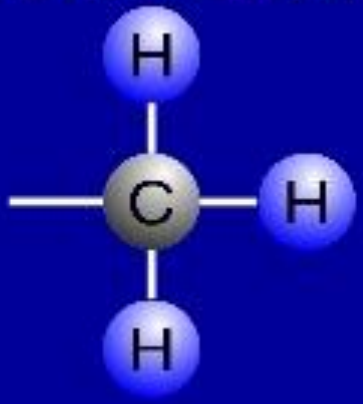
Phosphate



$=H_2PO_4$

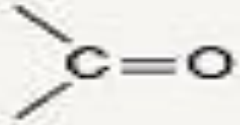
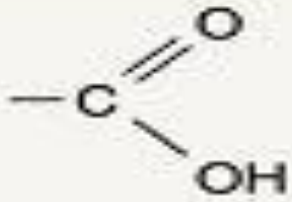
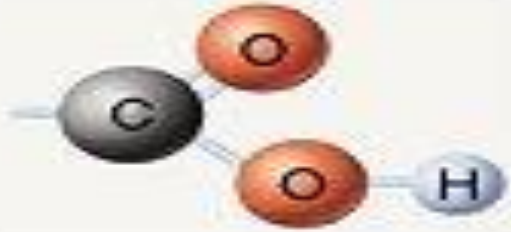
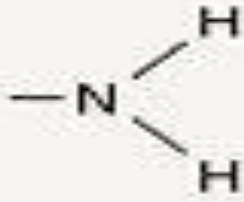
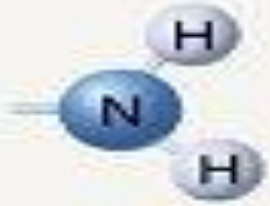
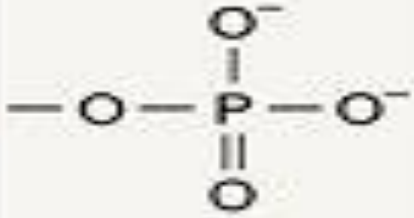
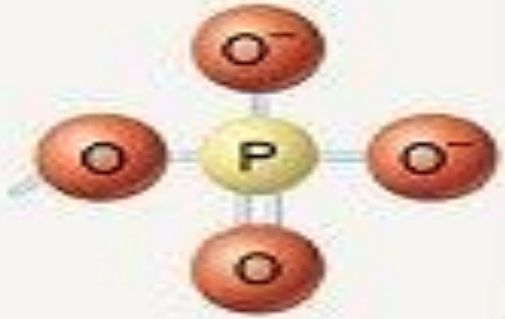
- Acidic & polar
- Energetic bonds; Links nucleotides
- DNA; ATP; Phospholipids

Methyl



$-CH_4$

- Nonpolar
- Hydrophobic
- Many, especially lipids

Group	Structural Formula	Ball-and-Stick Model	Found In
Hydroxyl	—OH		Carbohydrates
Carbonyl			Lipids
Carboxyl			Proteins
Amino			Proteins
Phosphate			DNA, ATP