BIOMOLECULES

C-compounds obtained from living tissue - **Biomolecules**

Living tissue + Cl_3CCOOH trichloro acetic acid —grind in mortar→ Obtained a thick slurry → Strain the slurry through a cheesecloth

Retentate → (Acid insoluble pool) → Macromolecules and lipids + M.wt > 10000 Da (Polymers)

Filterate → (acid soluble pool) → Ions (inorganic)

Biomolecules (18-800 Da)

To analyse inorganic elements

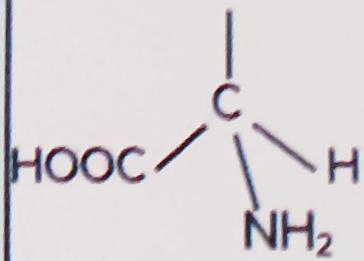
Living tissue —dry→ dry weight —burn→ carbon compounds oxidised → 'ash' → Contains inorganic elements (Ca, Mg, etc)

Usually Found

Na^+, K^+, Ca^{+2}, Mg^{+2}, H_2O, NaCl, $CaCO_3$, PO_4^{3-}, SO_4^{2-}

α- Amino Acids - Substituted Methanes

variable group or (R) → 20 types of Amino acid

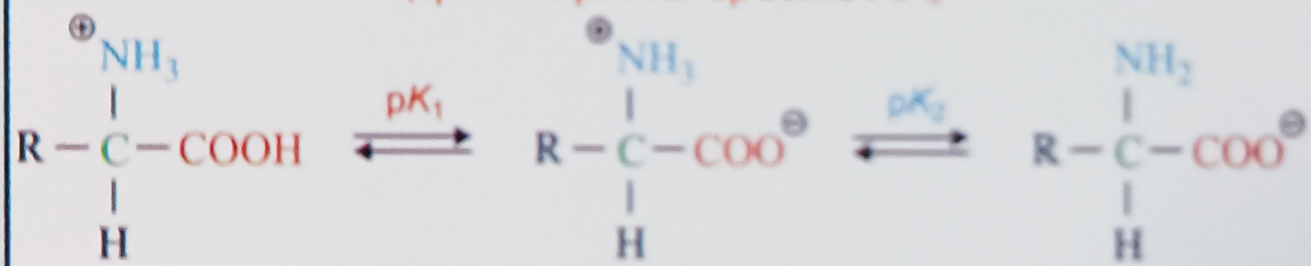


R group	H	CH_3	CH_2OH
Amino acid	Glycine	Aniline	Serine

Acidic AA	Basic AA	Aromatic AA
Glutamic acid	Histidine, arginine, Lysine	Tyrosine, tryptophan, Phenylalanine

Amino acids are ionisable (due to $-NH_2$ & -COOH)

cation — zwitterion (specific pH for specific AA) — anion



low pH — pH — high pH

FATTY ACIDS- water insoluble ; (R-COOH) form

- **Chain lengths**
  - Palmitic acid = 16-C → $H_3C-(CH_2)_{14}-COOH$
  - Arachidonic acid=20-C
- **Fatty Acids**
  - Unsaturated (with atleast 1 double bond)
  - Saturated (without multiple bonds)

Lipids (Esters of Fatty acids)

Monoglycerides (1FA)	Diglycerides (2FA)	Triglycerides (3FA)

Fats — High MP (Solid in winters)

Oils — Low MP (Liquid in winters)

Phospholipids : E.g. Lecithin (cell membranes)

Lipids that have phosphorus/phosphorylated organic compound

NUCLEIC ACID

Polynucleotides. ⟶ DNA/RNA (genetic material)

Nucleotide = Nucleoside ---(ester bond)--- Phosphate group

Nitrogenous Base + Monosaccharide

Purines: Adenine, Guanine

Pyrimidine: Cytosine, Uracil, Thymine

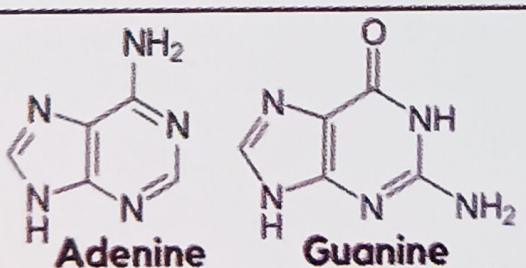
Learn by **CTU**

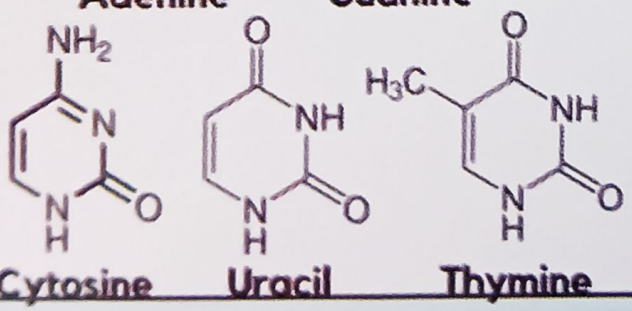
Uracil ⟶ RNA

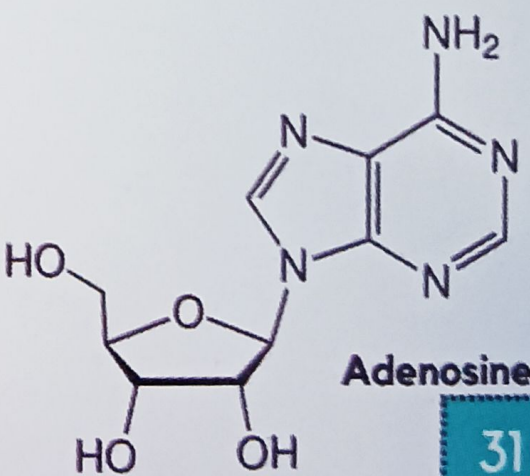
Thymine ⟶ DNA

Linkage (b/w 2 nucleotides)

Phosphodiester linkage







WATSON-CRICK MODEL

- Describes structure of B-DNA
- Antiparallel polynucleotide chains (move in opposite direction)
- Sugar-phosphate backbone
- A-T (2H-bonds) and G-C (3H-bonds) [∴ A+G=T+C]
- Each base pair turns strand to 36° (1 full turn = 10 base pairs)
- Pitch = 34 A° (per base pair - 3.4A°)

METABOLITES

1° Metabolites	2° Metabolites
• Identifiable functions (physiological processes) e.g.- Amino acids, nucleic acids, Carbohydrates etc.	• Not involved in 1° metabolism • No direct function in growth & development • Useful for human welfare & also have ecological importance e.g.-Flavonoids, essential oils etc.

Pigments-Carotenoid, Anthocyanin
Alkaloids-Morphine, Codeine
Terpenoids-Monoterpenes, Diterpenes
Essential oils-Lemon grass oil
Toxin-Abrin, Ricin
Lectins-Concanavalin A
Drugs-Vinblastin, cucurmin
Polymeric substance-Rubber, gums, cellulose

PROTEINS

Amino acids linked by **peptide bonds** (hetropolymer)

(20 type of AA's)

→ COOH of one amino acid + NH_2 group of other aminoacid (dehydration)

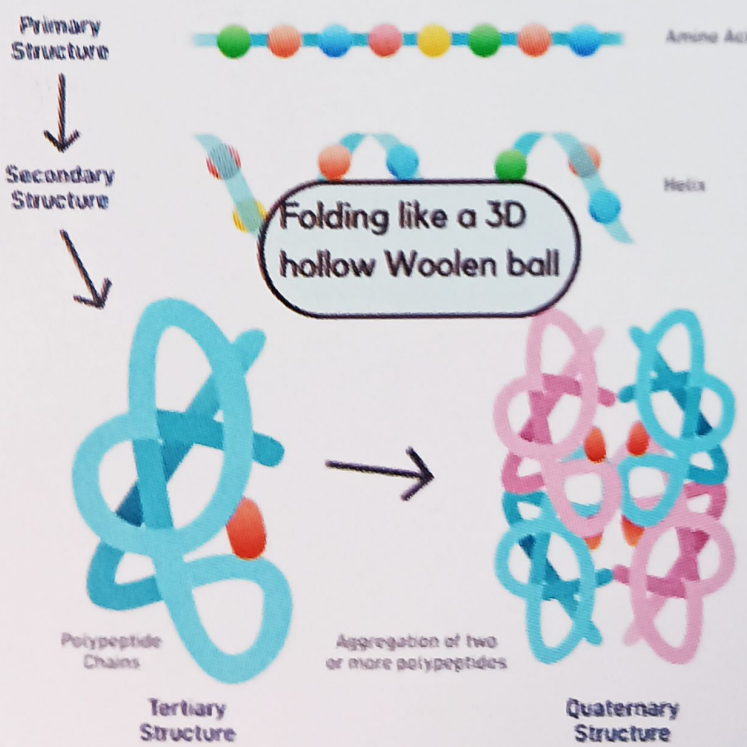
- Collagen- most abundant animal protien
- RuBisCO (Ribulose biphosphate Carboxylase Oxygenase) most abudant protein of Biosphere

TYPES OF AMINO ACIDS

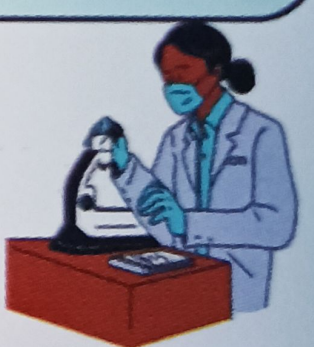
ESSENTIAL	NON ESSENTIAL
• Important for health • Supplied via diet	• Produced by body itself • Not supplied via diet

PROTEIN STRUCTURE

Amino Acids attached as line/chain
Left : N-Terminus(1st AA)
Right : C-Terminus(Last AA)



Right Handed Helix formed



More than one polypeptide chain arranged with respect to each other

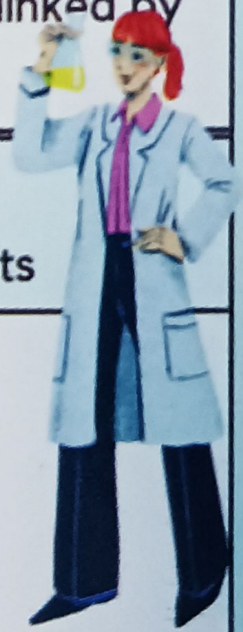
eg - Haemoglobin is made of 4 subunits (2α + 2β)

PROTEINS AND THEIR FUNCTIONS

1. Collagen	• Intercellular ground substance
2. Trypsin	• Enzyme
3. Insulin	• Hormone
4. Antibody	• Fight Infectious Agents
5. Receptor	• Sensory Receptors (Smell, taste etc.)
6. GLUT-4	• Enables glucose transport in cells

Polysaccharide

Long chain of carbohydrates / monosacharides (linked by glycosidic bond) (formed by dehydration)



Homopolysaccharide- same monomer units
Heteropolysaccharides - different monomer units

1. Cellulose	• Homopolymer of Glucose
2. Insulin	• Homopolymer of Fructose
3. Glycogen	• Homopolymer of Glucose
4. Starch	• Amylose and Amylopectin
5. Chitin	• N- Acetyl Glucosamine

- Glycogen & Starch give Red & Blue colour with I_2 respectively.
- Plant cell wall is made of cellulose
- Exoskeleton of arthropods is made of chitin

METABOLISM

- Biomolecule tend to turnover (dynamic transformation to other biomolecules) through chemical reactions [Process - Metabolism]
- Such chemical reactions are linked forming a metabolic pathway.
- Flow of metabolites → dynamic state of body constituents.
- Types of metabolic pathways

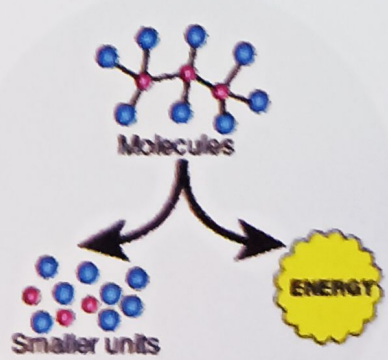
Catabolic	Anabolic
• Degradation	• Biosynthesis
• Complex to simple	• Simple to complex
• Energy released.	• Energy used
Glucose → lactic acid	Acetic acid → cholesterol
Glucose → Ethanol	Amino acid → Proteins.
Glucose → Pyruvic acid	

*Living state is a non-equilibrium steady-state to be able to perform work.

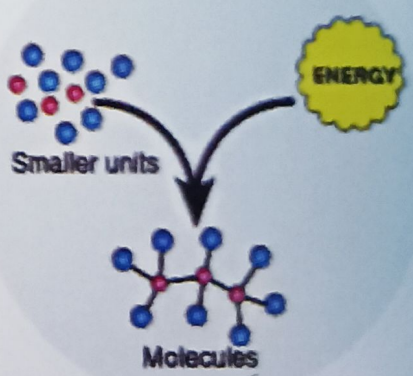
↓

(Related to conc.of biomolecules) Blood conc. of glucose : 4.2-6.1 mmol/L

Catabolic



Anabolic



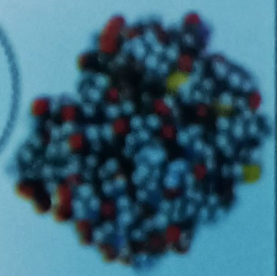
ENZYMES

- Proteins with catalytic action (fastening metabolic processes)
- Some nucleic acid are also enzymes-ribozymes
- Tertiary structure, remain unchanged at the end of reaction.
- Active site-specific sites to fit the particular substrate
- Enzymes denature at high temp. (may have specific optimal conditions to work) **Rate** = $\delta P/\delta T$

Rate usually doubles with every 10° rise in Temp

$CO_2 + H_2O \rightleftharpoons H_2CO_3$ (carbonic anhydrase)

carbonic acid



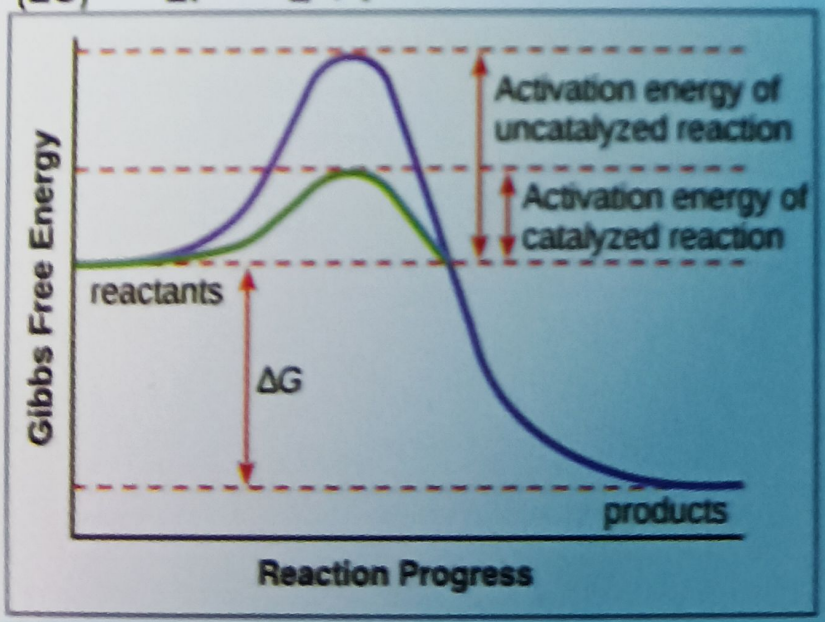
enzyme (-) → 200 molecules/hour

enzyme (+) → 600,000 molecules/sec

10 million times

Action substrate 'S' binds to enzyme 'E' forming an obligatory 'ES' complex (transient phenomenon); making & breaking of bonds convert substrate to product, later releasing the product & unchanged enzyme

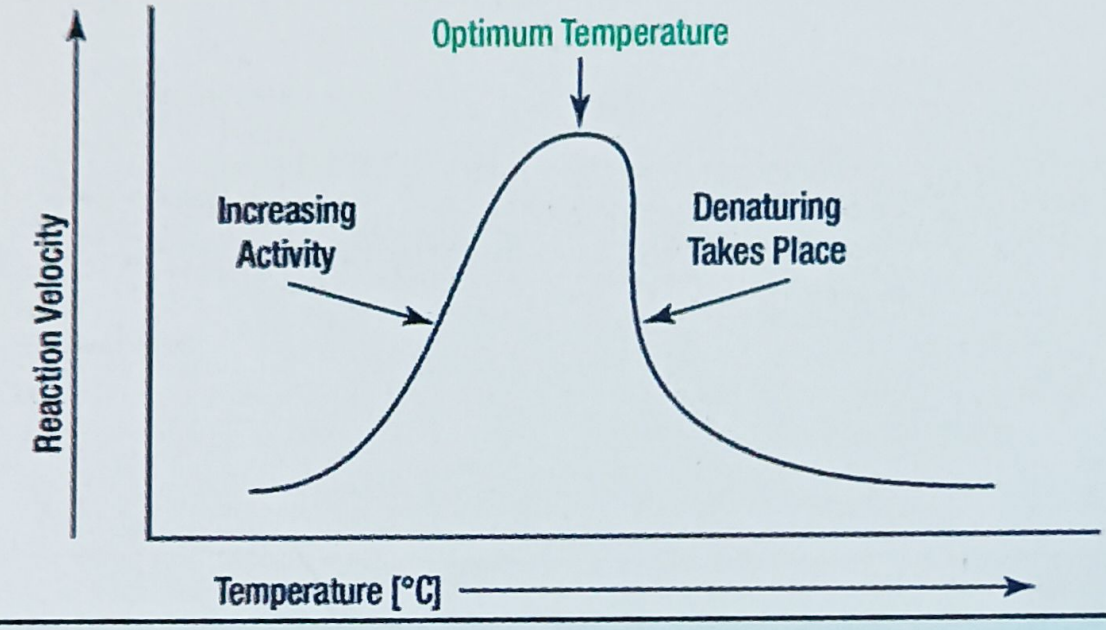
$E + S \rightleftharpoons \{ES\} \rightarrow EP \rightarrow E + P$



Factors Affecting Enzyme Activity

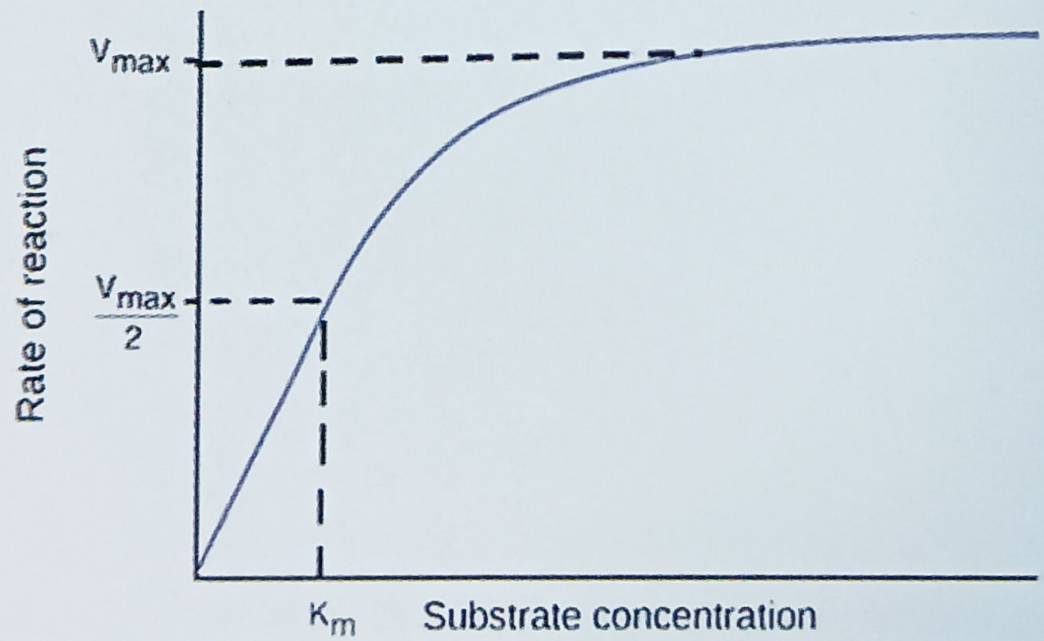
1. Temperature & pH optimum temp, and pH → (best activity)

activity decreases **Optimum Temperature** activity decreases



2. Substrate Concentration

On increasing substrate conc → enzyme inc. reaction speed → till saturation is attained (V max) → No free enzyme → constant velocity



Co-Factor

Enzymes

- **Apo-enzymes** (protein part)
- **Co-factor** (Non-protein part) → imp. for catalytic activity

Co-factor (Non-protein part) →

Prosthetic group	**Co-enzyme**	**Metal ions**
• Organic • Binds to apoenzyme eg- Haem is prosthetic group for catalase & peroxidase	• Organic • binds to apoenzyme (loose-bonding) for small amount of time (transient period) • eg - NAD, NADP (contain vit. niacin)	• Forms 1 coordinate bond with active site & another coordinate bond with substrate eg - Zn for enzyme carboxypeptidase

Classification of Enzymes

Classification of enzymes - Basis-function (6-classes)

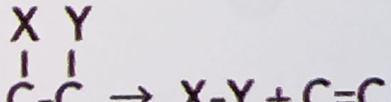
1. Oxidoreductase/dehydrogenase - catalyses simultaneous oxidation & reduction

   S reduced + S'oxidised → oxidised + S'reduced

2. Transferase-catalyses group transfer (∴ S & S' are substrates)

   S-G + S' → S + S'-G

3. Hydrolases - catalyses hydrolysis of ester, ether, peptide etc.
4. Lyases - Catalyses group removal, forming double bonds

   $$\overset{X}{\underset{|}{}}\overset{Y}{\underset{|}{}}\\ C\text{-}C \rightarrow X\text{-}Y + C{=}C$$

5. Isomerases - catalyses interconversion of different isomers (optical, geometrical, etc.)
6. Ligases - catalyses linking of 2 component (forming C-0, C-S, C-N etc bonds)