FREE NOTES · NCERT + NEET LEVEL

Bio molecules

Chemical analysis of tissues, primary and secondary metabolites, carbohydrates, proteins, lipids, nucleic acids, protein structure, enzymes, factors affecting enzyme activity, inhibition and classification.

01 Chemical composition & metabolites
02 Carbohydrates and lipids
03 Amino acids, proteins, nucleic acids
04 Structure of proteins
05 Enzymes: how they work
06 Classification and co-factors
07 Extra + tricks
08 Important Q&A
09 Common mistakes
10 Practice (NEET style)
11 Quick revision

01 Chemical composition & metabolites

- Living tissue + trichloroacetic acid: **acid-soluble pool** (small molecules, <1000 Da: amino acids, sugars, nucleotides) and **acid-insoluble** fraction (macromolecules: proteins, nucleic acids, polysaccharides; lipids are here though small, because they form membranes that break into vesicles).
- Water is the most abundant chemical in living organisms (70–90%).
- **Primary metabolites**: known roles (amino acids, sugars). **Secondary metabolites**: alkaloids (morphine, codeine), terpenoids (monoterpenes, diterpenes), essential oils (lemongrass oil), toxins (abrin, ricin), lectins (concanavalin A), drugs (vinblastine, curcumin), polymers (rubber, gums, cellulose), pigments (carotenoids, anthocyanins).

02 Carbohydrates and lipids

- Polysaccharides: **cellulose** (homopolymer of glucose; plant walls; no complex helix, cannot hold I_2), **starch** (helical, holds I_2 → blue), **glycogen** (animal storage), **inulin** (fructose polymer), **chitin** (complex polysaccharide with amino sugars; exoskeleton of arthropods).
- Reducing end on the right, non-reducing on the left of a polysaccharide chain; glycosidic bond links monosaccharides.
- Lipids: fatty acids (R–COOH; saturated or unsaturated with C=C; palmitic acid has 16 C including carboxyl C, arachidonic 20 C), glycerol (trihydroxy propane); mono/di/triglycerides; oils have lower melting point (gingelly oil). **Phospholipids** (lecithin) in membranes; neural tissue has complex lipids.

03 Amino acids, proteins, nucleic acids

- Amino acid: α-carbon with H, –COOH, $–NH_2$ and R group. 20 types; acidic (glutamic acid), basic (lysine), neutral (valine), aromatic (tyrosine, phenylalanine, tryptophan). **Zwitterion** form changes with pH.
- Proteins: heteropolymers of amino acids joined by **peptide bonds** (dehydration). **Collagen** is the most abundant protein in animals; **RuBisCO** is the most abundant protein in the biosphere.
- Functions: transport (GLUT-4), hormones (insulin), enzymes (trypsin), antibodies, receptors, fibrous structure (collagen).
- Nucleotide = nitrogen base + pentose sugar + phosphate. Purines: adenine, guanine; pyrimidines: cytosine, uracil, thymine. Nucleoside = base + sugar (adenosine). Phosphodiester bond links nucleotides.

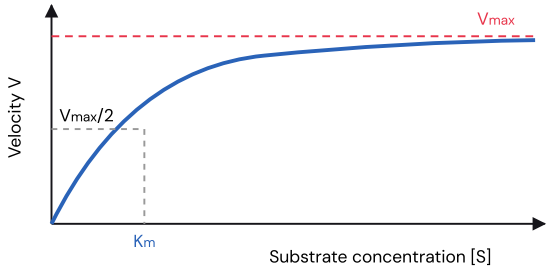
04 Structure of proteins

Level	What it is
Primary	Sequence of amino acids (N-terminal first, C-terminal last)
Secondary	Folding into α-helix (right-handed, most common) or β-pleated sheet
Tertiary	3-D folding of the helix; gives biological activity
Quaternary	Arrangement of two or more polypeptide subunits; e.g. haemoglobin = 2α + 2β

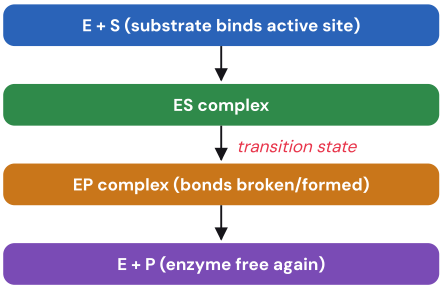
DNA (Watson–Crick model): double helix, antiparallel strands, A=T (2 H-bonds), G≡C (3 H-bonds), 10 bp per turn, pitch 3.4 nm, rise 0.34 nm per bp (B-DNA).

05 Enzymes: how they work

- Almost all enzymes are proteins (ribozymes are RNA enzymes). Have an active site (pocket) where substrate fits.
- Lower the **activation energy**; e.g. carbonic anhydrase speeds $CO_2 + H_2O \rightarrow H_2CO_3$ about 10 million times.
- Factors: **temperature** and **pH** (optimum; denatured by high temperature), **substrate concentration** (velocity rises to V_{max}, then plateaus).
- **Competitive inhibitor**: resembles substrate, binds active site; e.g. malonate inhibits succinic dehydrogenase. Used to control bacterial pathogens.



Effect of [S] on enzyme velocity



Catalytic cycle of an enzyme

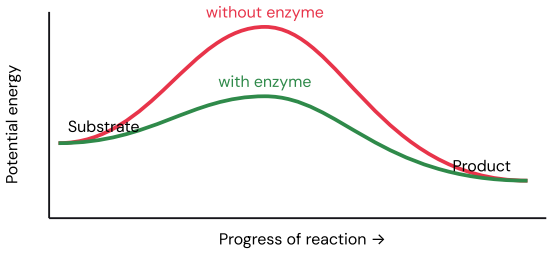
06 Classification and co-factors

Class	Reaction
1 Oxidoreductases / dehydrogenases	S reduced + S′ oxidised ⇌ S oxidised + S′ reduced
2 Transferases	Transfer a group (not H) between substrates
3 Hydrolases	Hydrolysis of ester, ether, peptide, glycosidic bonds
4 Lyases	Remove groups forming double bonds
5 Isomerases	Inter-conversion of isomers
6 Ligases	Join two compounds (C–O, C–S, C–N, P–O bonds)

Co-factors: **prosthetic groups** (tightly bound organic; haem in peroxidase, catalase), **co-enzymes** (loosely bound; NAD, NADP contain niacin), **metal ions** (Zn^{2+} for carboxypeptidase). Apoenzyme (protein part) + cofactor = holoenzyme.

07 Extra + tricks

- Elements: C, H, O, N most abundant in living tissue (human: O 65%, C 18.5%, H 9.5%, N 3.3%); earth crust rich in O, Si.
- Amino acids: **alcoholic** (serine, threonine), **sulphur-containing** (cysteine, methionine), **aromatic** (phenylalanine, tyrosine, tryptophan). Glycine simplest (R = H).
- Essential amino acids (8–10) must come from food; trick "**PVT TIM HALL**" = Phe, Val, Thr, Trp, Ile, Met, His, Arg, Leu, Lys.
- **K_m** (Michaelis constant) = [S] at half V_{max}; low K_m = high affinity.
- Models: **lock and key** (Emil Fischer) and **induced fit** (Koshland). **Non-competitive** inhibitor binds elsewhere (cyanide on cytochrome oxidase).



Enzymes lower activation energy

08 Important Q&A

Q1. Why do lipids appear in the acid-insoluble fraction?

Lipids are small but during grinding cell membranes break into vesicles that are insoluble, so lipids go with macromolecules.

Q2. Why does starch give blue colour with iodine but cellulose does not?

Starch forms helices that hold I_2; cellulose has no complex helices.

Q3. What is a competitive inhibitor? Example?

A molecule similar to the substrate that competes for the active site; malonate for succinic dehydrogenase.

09 Common mistakes

- Saying all enzymes are proteins (ribozymes are RNA).
- Writing collagen as most abundant protein of biosphere (it is RuBisCO).
- Counting palmitic acid as 15 C (16 including carboxyl).
- Mixing nucleoside (no phosphate) and nucleotide.

10 Practice (NEET style)

1. Polymer of fructose?
2. Bond between amino acids?
3. Haemoglobin subunits?
4. Co-enzyme NAD contains which vitamin?
5. Enzyme class joining two compounds?

ANSWERS

1) Inulin · 2) Peptide bond · 3) $2\alpha + 2\beta$ · 4) Niacin · 5) Ligases

11 Quick revision: 5 minutes before the exam

CARBS

- Starch helix + I_2 blue
- Cellulose no helix
- Chitin: exoskeleton

PROTEINS

- Peptide bond
- RuBisCO most abundant
- 4 levels, Hb quaternary

NUCLEIC ACIDS

- Purines A, G
- A=T 2, G≡C 3 H-bonds
- 0.34 nm per bp

ENZYMES

- Lower activation energy
- Malonate competitive
- 6 classes, holoenzyme

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.