2:

Biological Molecules

→ Bio-elements → Biomolecules.

→ 92 naturally occurring elements → 25 bio elem
out of 25 only 16 occurs in human.

Major: 99%.

→ O → 65%, C → 18%, H → 10%] 95%.
→ N → 3%, Ca → 10%, P → 1%.

Minor: (1%)

→ K → 0.35%, S → 0.25%, Na → 0
→ Mg → 0.05%, Cl → 0.15%, Fe
→ Zn, Cu, Mn, I] 0.01%

Biomolecules:

→ CARBS → C, H, O
→ Lipids → C, H, O
→ Proteins → C, H, O, N
→ Nucleic Acid → C, H, O, N, P

Diversity:

→ Nature of bond
→ Ratio
→ Functional

Size: micro, macro

Nature: Inorganic, Organic

Metabolism:

Ana:

Micro → macro
→ Build up
→ Condensation
H_2O → Release
e.g: Photosynthesis
→ ATP use

Cata:

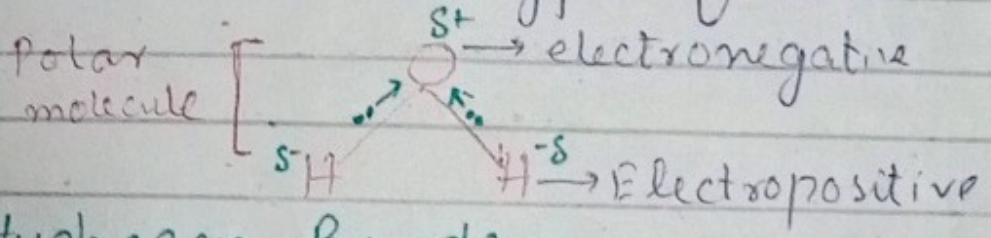
→ Macro → Micro
→ Cut off
→ Hydrolysis
H_2O → Add
e.g: Respiration
→ ATP produce.

Bio Importance Of H_2O:

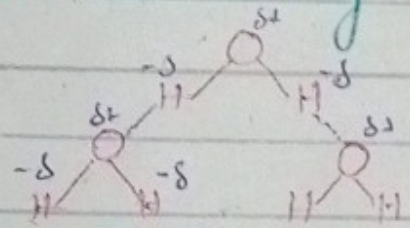
→ 70-90% → body
→ 20% → Bone cells, 85% → Brain cell
→ 99% → Jelly fish
→ 90% → Cytoplasm, blood and semen.
→ 10% < Death

Structure Of Water:

→ Triatomic, two types of atom

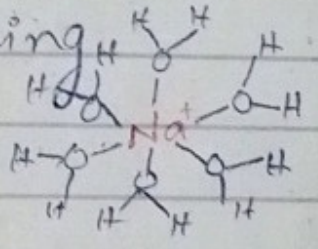


Hydrogen Bonding:



Universal Solvent:

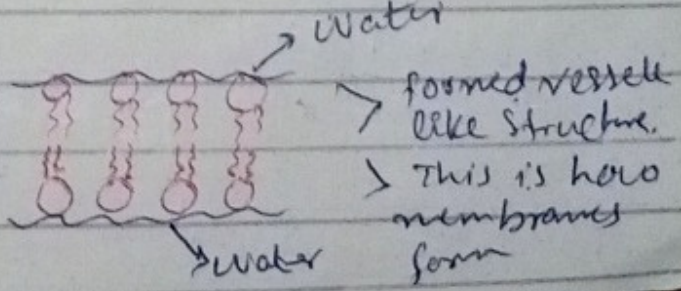
→ Dissolves almost everything
- → Polar: Alcohls
- → Ionic: NaCl
- → Covalent:



→ Mineral uptake in plants
→ Nonpolar → Insoluble
→ Oils → Barriers / vessels

Hydrophobic Exclusion:

Oils $\xrightarrow{\text{least contact}}$ H_2O



→ Specific Heat:

$1g\ H_2O \xrightarrow{\Delta T} 1g\ H_2O$
$15C^\circ \qquad 16C^\circ$

→ Very high → 4.180 J/g

→ Resist ΔT → Temprorature stabalize.

→ Heat of Vapourization:

$1g\ H_2O_{(l)} \xrightarrow{\Delta T} 1g\ H_2O_{(g)}$

→ 2260 J/g.

→ -80C° → Boil

→ -100 C° → Freeze.

→ Anamolous Behaviour:

Desity:

Increase ↓ ↑ → Decrease

4C° → Water is maximum dense or heavy

Decrease ↓ ↑ → Increase

0C° ICE

→ Ionization: $K_w = 10^{-14}$

$H_2O \xrightarrow{\Delta T} H^+ + OH^-$
$\qquad\qquad 10^{-7} \qquad 10^{-7}$

→ Acidic / Basic → Amphoteric

→ pH balance

→ Raw Material:

→ Reactant → photosynthesis

→ Lubricant: Friction↓ (eyelids)

→ Protection:

→ CSF

→ Pelvral fluid

→ Pericardial fluid.

→ Synovial fluid.

Carbohydrates: (sugars)

→ Hydrates of carbon → When water is chemically combined with carbon.

((H_2O)

← but — 2:1 ——————→ CARBS

Non Carb:

CH_3COOH

$C_2H_4O_2$ but it is not 2:1 CARB

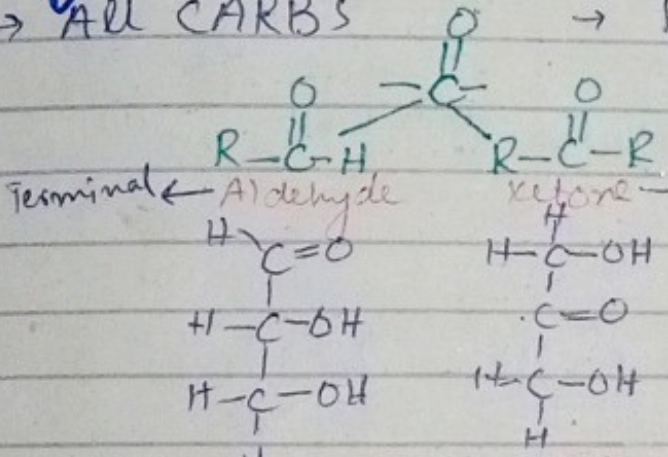
$C_3H_6O_3$ → but it is 2:1, not CARB

$C_5H_{10}O_4$ → but it is CARB (5:2)

$C_6H_{12}O_5$ → not 2:1 but it is CARB (RHAMINOSE)

Definition:

→ All CARBS → Poly Hydroxy.



both are simplest Carbohydrates.

Composition:

→ Usually CARBS consist of C_3H_6O except Chitin which also includes "N".

Source: Photosynthetic Organisms

$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

→ For 10g of glucose 717.6 KCal (sunlight E).

→ For 1g of glucose 71.76 KCal

Occurrence:

→ Fruits, seeds and cereals
→ cell wall
→ Grapes → 27% sugar

Blood → 0.08g sugar

Classification:

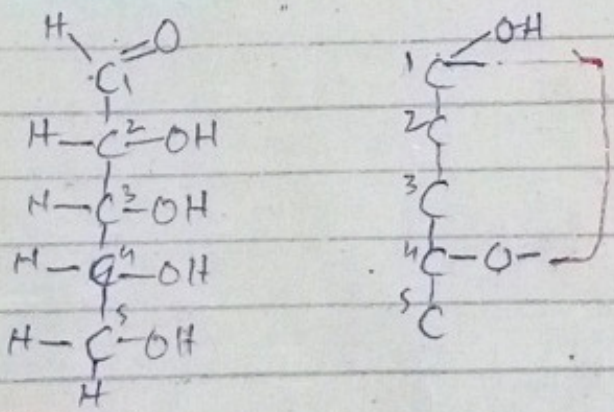
On the base of complexity.

1: Monosaccharides.
→ simplest sugars
→ Can't hydrolyze.
→ Carbon → 3-7
- C-3 → Trioses
- C-4 → Tetroses
- C-5 → Pentoses
- C-6 → Hexoses
- C-7 → Heptoses

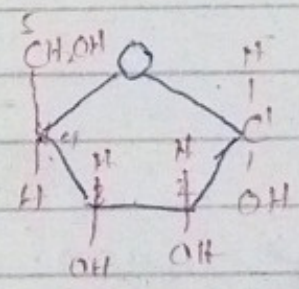
→ Highly soluble
→ sweetest
→ Crystalline solids
→ Reducers

	Aldoses:	Ketoses:	
C-3 → Trioses	Glyceraldehyde	Dihydroxyacetone	Photosynthesis & Respiration
C-4 → Tetroses	Erythrose	Erythrulose	Rare → bacteria
C-5 → Pentoses	Ribose	Ribulose	Nucleic acid
C-6 → Hexoses	Glucose, Galactose	Fructose	→ Energy source → polysaccharide → monomer
C-7 → Heptoses	Gluco heptose	sedo-heptulose	→ RUBP regeneration

Ribose:



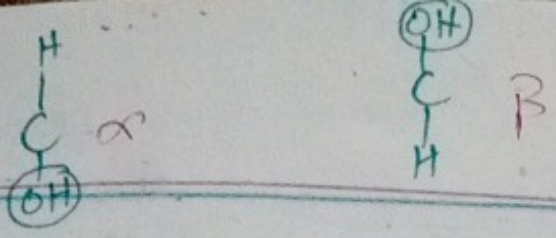
Linear
↓
Dry



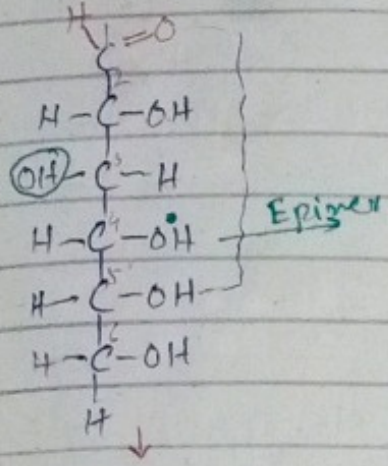
Ring
↓
Aqueous

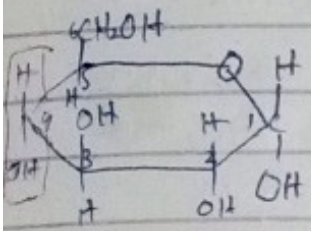
Furan
C1 & C4
C5 X

Hexoses:



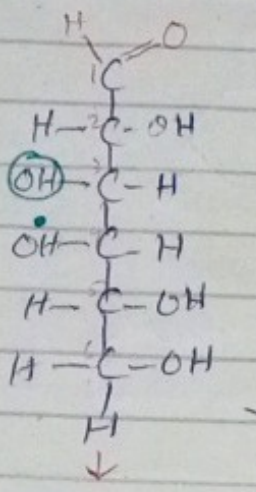
Glucose

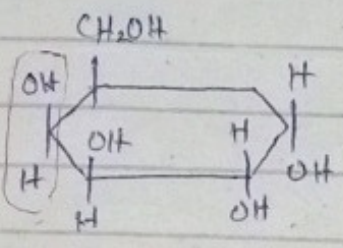




Gluco Pyranose

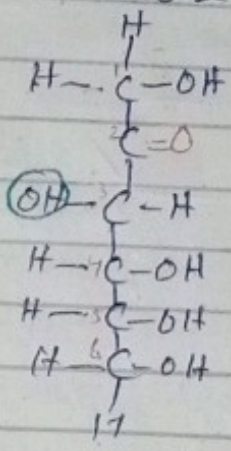
Galactose





Galacto-pyranose

Fructose



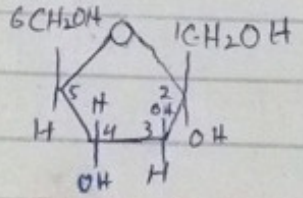
→ 6C ring

Pyran

$C_1 - C_6$

5 ×

→ Fructose $C_2 - C_5$



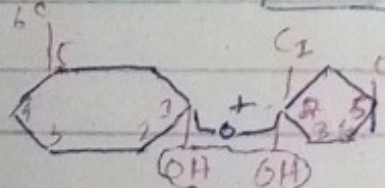
Fructo-Furanose

2: Oligosaccharides:

→ 2-10 monosaccharides units

→ 2-units → Disaccharides

3: Sucrose: Glucose + Fructose.



α-1-2 glycosidic bond

∴ glycosidic bond is simple covalent bond.

∴ Sucrase → help to catabolize

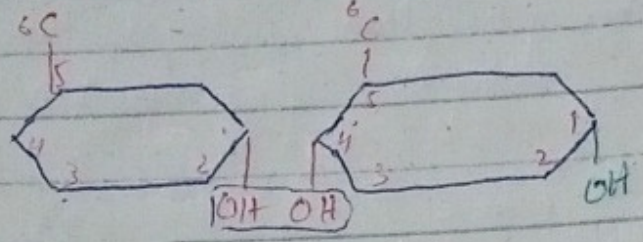
→ Non Reducer → Don't react → OH on C_2 is engaged in ring so it is stable.

→ Transporting Sugar

→ Table sugar.

Bond ?
structure ?
α or β ?

b: Maltose: Glucose + Glucose



Reducer → C1 has OH-

maltase
maltose → glucose + glucose

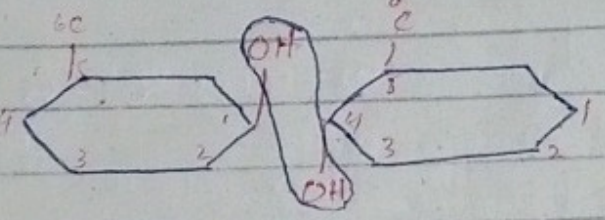
α-1-4 glycosidic.

→ Fruit sugar

→ starch and glycogen → amylase → maltose.

No. of OH in disaccharides? → 8

c: Lactose: Glactose + Glucose



Reducer → cause C1 has OH.

Lactase → enzyme

β 1-4 glycosidic

→ Milk sugar

3: Poly saccharides:

→ greater than 10 monosaccharides units.

→ Complex sugars

→ Insoluble → Hydrolyzable

→ Tasteless

→ Non-Reducers

a: Hetero:

Different monomers

→ Agar, Hemicellulose, pectin, peptidoglycan.

peptidoglycan → CARBS, short chain amino acid.

b: Homo:

→ Same monomers.

→ Starch, glycogen, Cellulose, Chitin.

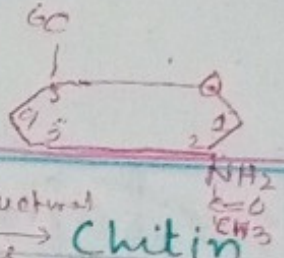
→ Amylose → straight chain

→ Amylopectin → Branched

2nd chain

1st chain

→ glycogen closely relat with amylopectin



Starch ← Functional role →	Glycogen	Cellulose ← structural role →	Chitin
α-glucose	α-glucose	β-glucose	N-acetyl glucose amine
→Amylose → α 1-4	→ α 1-4 & α 1-6	→ β 1-4	→ β 1-4
→Amylopectin → α 1-4 α 1-6			
• Plants, Algae photo-bacteria	→ Animals Protozoans bacteria	→ Plant C.W	Fungi → cell wall Arthropods → exoskeleton
→ Storage-Food	→ Storage-food	→ Cellwall	→ Cell wall
→ Amylase	→ Amylase	→ Cellulase	→ Chitinase
→ Digestable	→ Digestable	→ In digestion	→ In digestion.
Iodine → blue	→ I_2 → Red	→ I_2 → X	→ I_2 → X
→ wheat bread		→ cotton	

→ Most Abundant compound → H_2O

Proteins:

Proteus → Prime

→ Most Abundant organic Compound

→ 50% of dry weight.

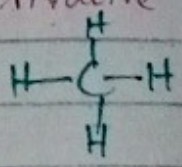
Definition:

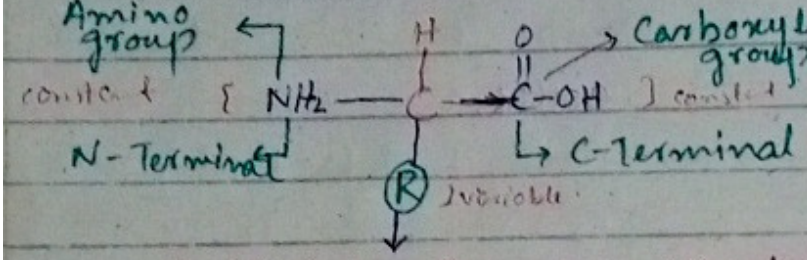
Polymers → a.a

Amino Acid:

Monomers → Protein

∴ All a.a are methane derivative





H, Aliphatic, Aromatics, Charged, Basic/Acids.

→ There are 170 types of amino acids.

- 25 → protein synthesis
- 20 → most of proteins

Cystein, Methionine → sulphur containg

Plastocyanine → copper

Haemoglobin → Iron

Egg Albumin → Phosphorus.

composition:

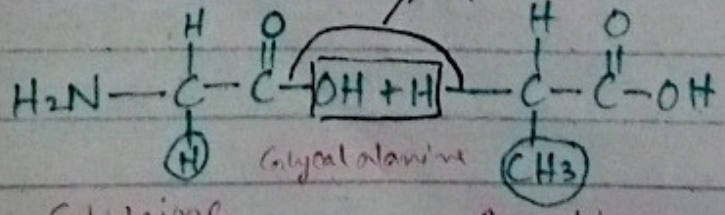
→ (C, H, O, N)

S, P, Fe, Cu, I

Polymerization:

→ a.a —Joining→ protein

→ Translation → N→C terminal peptide



Dipeptide: 2a.a + 1P.B

Glycine + Alanine ≠ Alanine + Glycine

-OH -H -OH -H

Glycine

↓

simplest a.a in world

Analine

↓

2nd simplest a.a in world

Number, Sequence & Structure:

→ Insulin

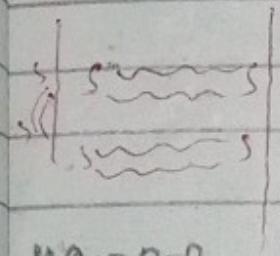
Harmone

51 a.a

Two chains

α — 21

β — 30



49 → P.P

Haemoglobin

→ Carrier

→ 574 a.a

4 – chains

α α β β

570 bonds

141 141 146 146

Normal:

O → } → biconcave

Defected:

O_2 → X → Point mutation

→ In β-chain on 6th position glutamic acid is replaced by valine.

Levels Of Protein:

→ Primary: No. and sequence — Linear -□-□-□- — Peptide bond — Insulin

→ Secondary: 1 turn = 3.6 a.a

Twisting/coiling → α-helix → H-bonding → Actin & myosin

→ β-pleated → Keratin

→ Tertiary: super/self coiling → globular → H-bond, Ionic, S≈S → Myoglobin

→ Quaternary: Grouping/Aggregation → H-bond, Ionic, Hydrophobic interaction → Hb

⇒ Least stable → Quaternary

⇒ most stable → primary

⇒ 1st str that will form → primary

Classification Of Protein.

Fibrous

→ Fiber like
→ Sec. structure
→ Insoluble → H_2O
→ Stable
→ Structural role
→ Can't crystallize
• Actin, myosin
Keratin, collagen
2nd most abundant protein (it is insoluble)

Globular

→ Globular/spherical
→ Tertitary structure
→ Soluble → H_2O
→ Least stable.
→ Functional role.
→ Crystalized.
• Enzymes, Harmones, Antibodies, transport storage → Albumin → Casein

Lipids: (oils & fats)

→ Heterogenous groups → containing different compounds
∴ Lipids can't classify on the basis of chemical properties only on physical properties.
Only 1 property is same that is hydrophobic

→ Acylglycerol → Insulation → Energy source.
→ Waxes → Protection → Water proofing

Lipids are high energy
C-H↑ C-O↓
($C_{57}H_{110}O_6$)
Tristearin

→ Phospholipids → Biological membrane.

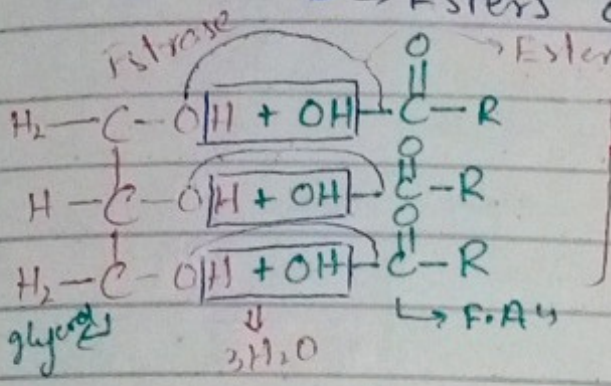
→ Terpenoid → Vitamin A → Chlorophyll tail → Carotenoids → Rubber
↳ (5C) 9 isoprenoid units

→ Prostaglandons → Local harmones → defense.

→ Steroids → Cortical hormones
↳ 4 rings → 3 ring (6C) → 1 ring (5C)
→ A

Acylglycerol:

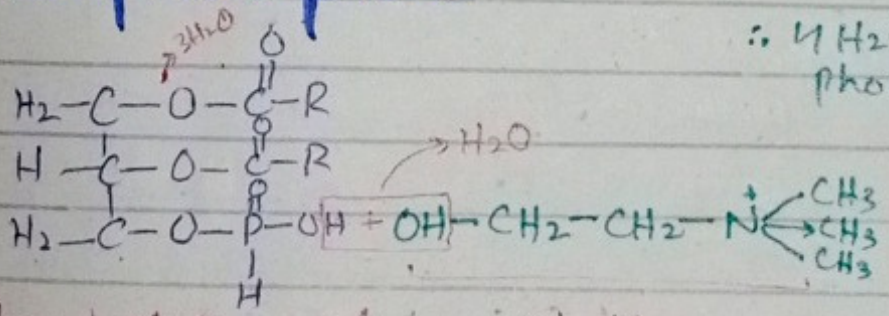
↳ Esters of fatty acid and alcohol.



Fatty acid:

- 20-30 C atoms → Even Number
- Saturation
  - Saturated → single bond → solid → Animals
    - Palmatic (C_{16}) acid
    - Stearic (C_{18}) acid
  - Unsaturated. (upto-6) → double bond → Unsat. liquid → Plants
    - Oleic acid (C_{18}) 1-double bond
    - Linoleic acid (C_{18}) 2-double bond
      ↳ Omega-6

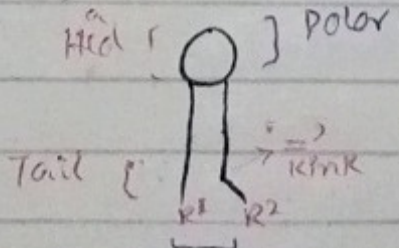
Phospholipids:



∴ 4 H_2O releases to make Phospholipids.

∴ 4 Ester bonds will form

Phosphatidic acid + Choline
Phosphatid choline (Lecithine)
+
Nitrogen containg base
↳ Choline
↳ Ethanalamine
↳ Inositol
↳ Serine

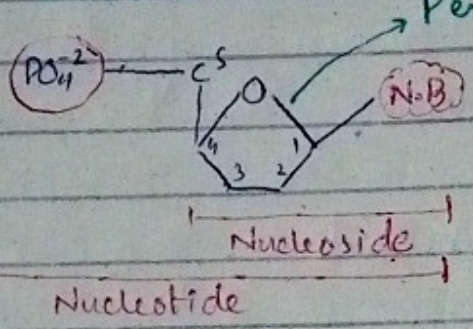


Nucleic Acid:

→ Extracted from nucleus → Nuclein (Named)
→ Acidic nature. that's why they call'd as nucleic acid.

Composition:

(Nucleotited)



Nitrogenous bases:

→ Purines: (N9 → glycosidic bond)
↳ Large and Double bonded
↳ Adenine & Guanine

→ Pyramidines: (N1 → glycosidic)
↳ Small and single ring
Cytosine; Thymine
Uracil

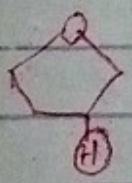
→ Aminogp on adenine is at C-6
→ Aminogp on guanine is at C-2
→ Aminogp on cytosine is at C-4.
→ Thyamine has methyl g

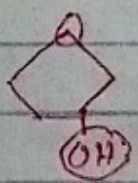
Types:

1: Mono:
ATP

2: Di:
NAD → Niacin (B_3)
FAD → Riboflavin (B_2)
} Coenzyme.
~~ADP~~

3: Poly;
DNA —transcription→ RNA





mRNA	tRNA	rRNA
→ messenger	Transfer	ribosomal
→ 3-4%	10-20%	80%
→ Nucleotids	Nucleotide	Nucleotids Protein

→ DNA → GAA
↓
mRNA CUU
↓
tRNA GAA
exactly same.

mRNA

→ 3 nucleotides
=
1 codon

1 codon = 1 a.a

variable length
↓ ↓
genes proteins

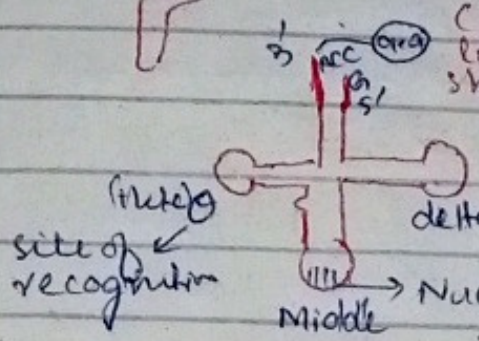
tRNA

75-90

3D

2D

Clover leaf shape



Delta → Activation of enzyme

site of recognition

→ Nucleotides

Anticodon
↳ complementary to codon
↓
Reads codon

→ 20 a.a → Atleast 20 tRNA

→ 415 types → human

→ 60 types → discovered in world.

rRNA

two subunits
smaller + larger
↳ Fixed.

Enzyme:

→ All enzymes are considerd as biological catalyst.

→
- → Globular Proteins
- → RNA (Ribozymes)

→ Speed up → $10^6 - 10^{14}$ (Efficiency)

→ Metabolism → 1000 Rxns at a time → Quickly

→ Aqueous medium

→ Ex-vivo & In-Vivo
- ↳ outside body
- ↳ Inside of the body

→ specific

→ Sensitive

→ Small Quantity → Large reaction

→ Activation Energy → Low

$$2H_2O_2 \xrightarrow[\text{Catalase } 1KJ/mol]{36 KJ/mol} 2H_2O + O_2$$

Composition:

Activated Enzyme

Holo enzyme

Protein Part (Apo enzyme)
- Active site
  - → Charge bearing site
  - → 3-12 a.a
    - Aldolase ← Glycine, Histidine, Alanine
- Allosteric site
  - → Rest of enzyme
  - → Framework of enzyme

Active site
- Binding site
  - → Birds
  - → Identify
- Catalytic site
  - S ⇝ P

Non-protein part (co-factor)
- ~~Rest of enzyme~~
- ~~Framework enzyme~~
- → Bridge b/w enzymes & substr
- → Catalases
- → Chemical energy
- → 3 types

Cofactor

Activator
→ Loosely attached inorganic metallic ion.
Mg^{++}, Zn^{++}, Fe^{+}

Coenzyme
→ loosely attached organic part
NAD
FAD
ADP

Prosthetic Gp
→ covalently bonded protein part
Fe^{++} → Porphyrin ring → Hb
Mg^{++} → Porphyrin ring → Chlo opty
Fe^{++} → Cytochrome

Mechanism:

$$E + S \longrightarrow \underset{\text{transition}}{ES\ \text{complex}} \longrightarrow E \cdot P\ \text{complex} \longrightarrow E + P$$

Lock & Key:
→ E. Fischer
→ specific key → specific lock
→ Specific Substrate → Specific Enzyme
→ Active site → Rigid
  ↳ Inflexible
  ↳ Template

Induce Fit:
→ D. Koshland
→ Active site → Flexible
S $\xrightarrow{\text{Induce changes}}$ E

Carbonic Anhydrase

$$H_2O + CO_2 \longrightarrow H_2CO_3$$
$$H_2CO_3 \longrightarrow H^+ + CO_3^-$$

Sucrase, Maltase, Urase } Non-regulatory Enzymes
↳ Absolute specific

Inhibitor:

→ Chemical substance that replaces substrate.

E + S + I ⟶ EI complex ⟶ S + No product.

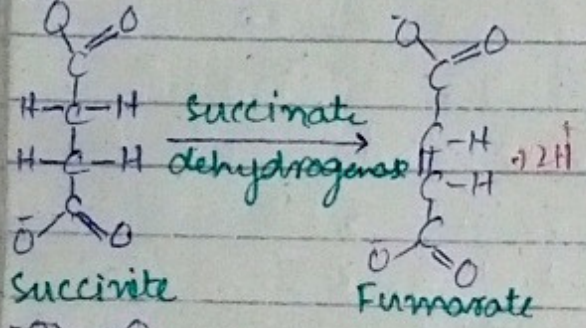
Competative

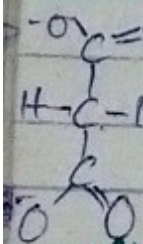
S —(Structural similarity)→ I

→ Binding site —(Bind)→ I

→ Active site → Block.

Normal reaction:





→ I

malonate

→ Antibodies
Penicillin
sulpa drugs

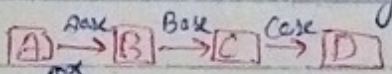
Non Competative.

S —(No structural similarity)→ I

I —(Bind)→ Allosteric site ⟶ Globular structure disturb

↓ Reversible.

→ Metabolic Pathway



→ Final product —(Inhibitor)→ First enzyme

↓ Irreversible

→ Destroy globular structure → permanently

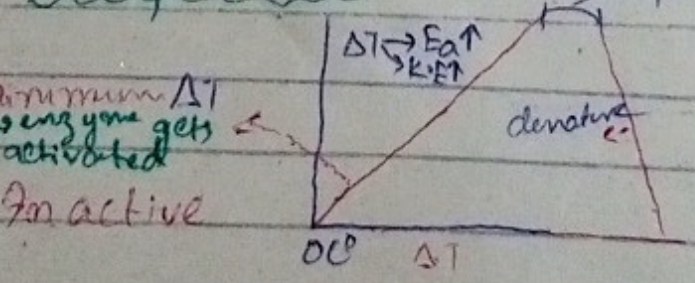
→ Cyanides → Cytochrome

→ Heavy metals → S—S

→ Venoms → Blood / Nerve / Flesh

Factors Effecting Enzyme

Temperature:



Every 10C° rise increase rate of rxn 2 times.

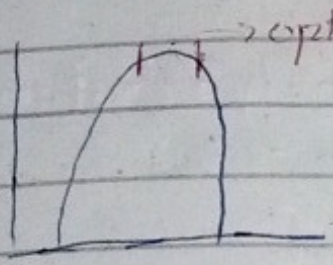
Mamals → 40 C°

Humans → 37 C°

TAQ polymerase → 94 °C

Arctic → -ive

PH:



Slight change → Ionization substrate & Enzyme.

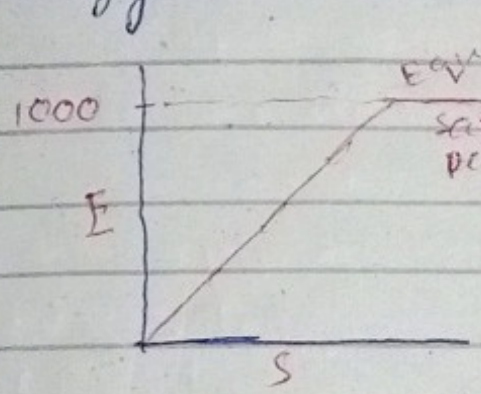
Greater change → Denature (Ionic bond)

Concentration:

Substrate:

Subs → variable

Enzyme → Constant

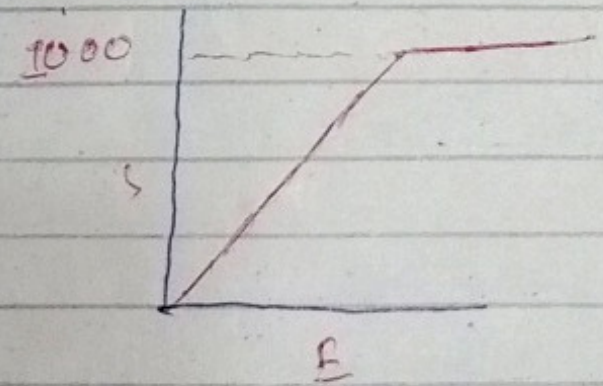


→ all active sites are occupied.

Enzyme:

Subs → Constant

Enzyme → Variable



∴ There is no saturation point.

∴ When substrate is unlimited there will be no 'Ke' or equilibrium attained.