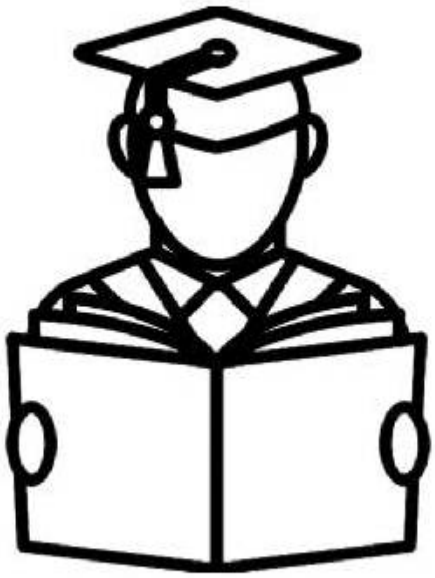
चौधरी PHOTOSTAT

"I don't love studying. I hate studying. I like learning. Learning is beautiful."



"An investment in knowledge pays the best interest."

Hi, My Name is

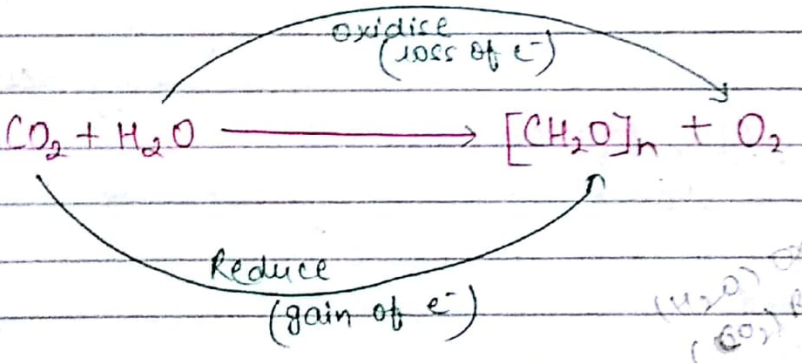
Life Science for CSIR NET

Gyanbindu

PHOTOSYNTHESIS

(Synthesis using light)

- Photosynthesis is a energy absorbing process / endothermic proces or endergonic process in which light energy is utilized.
- It is an anabolic process in which smaller inorganic mol. (CO_2 and H_2O) is converted into larger organic mol.
- Photosynthesis is a redox reaⁿ in which H_2O is oxidised (loss of e^-) and CO_2 is reduced that means in PS H_2O act as a e^- donor.



- PS is completed into two diff. steps
  1. Light Reaction
  2. Dark Reaction

"Photosynthesis is a physiological process in which smaller inorganic mol. is converted into larger mol. by using various enzymes and their activity is regulated by light directly (in light reaⁿ) and indirectly (in dark reaⁿ)."

*Significance of PS

- PS is the only physiological process that can harvest solar energy into chemical (bio) energy which is universal source of energy of earth surface.

• It is the ultimate source of O_2.

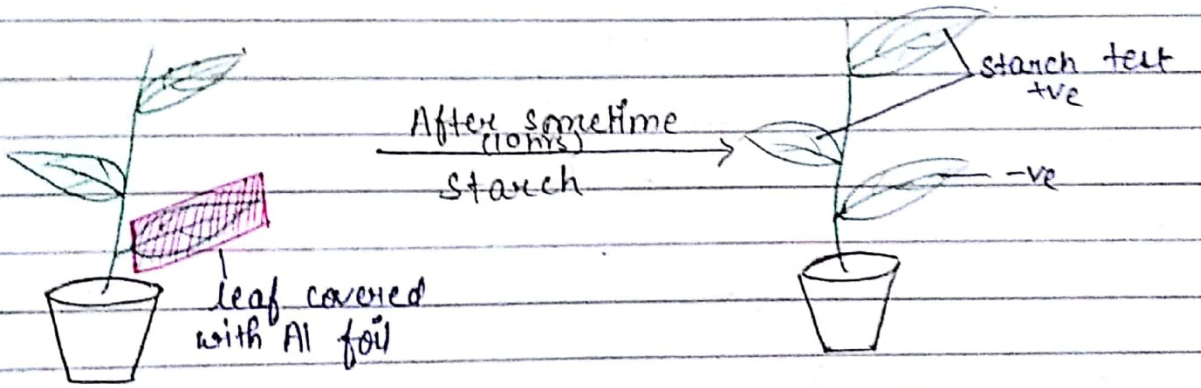
Significance of O_2

• O_2 enhaces metabolic efficiencies upto 15-16 times. That facilitate energy conservation.

• It is responsible for formation of ozone layer that protects the earth surface against harmful rays

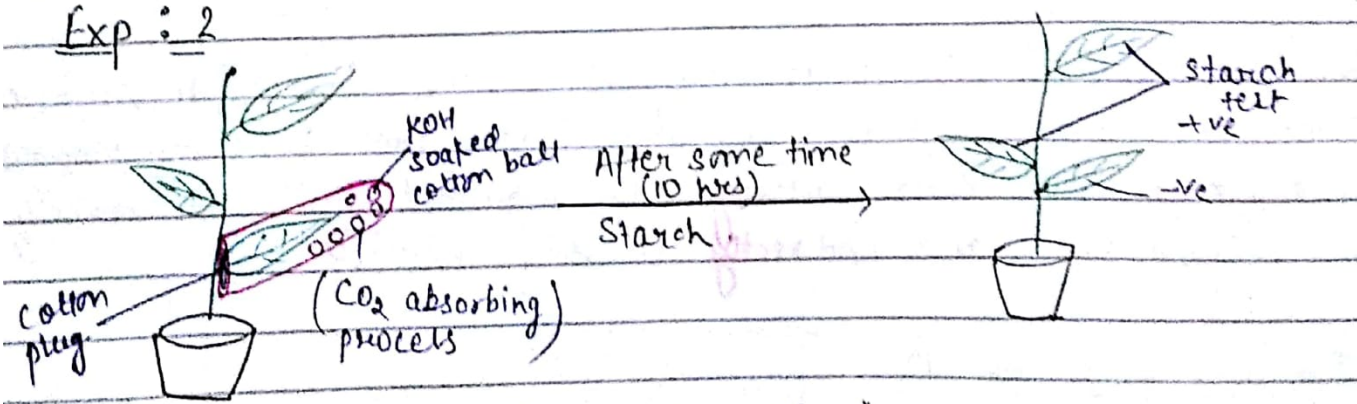
Some exp. regarding Photosynthesis —

Exp : 1



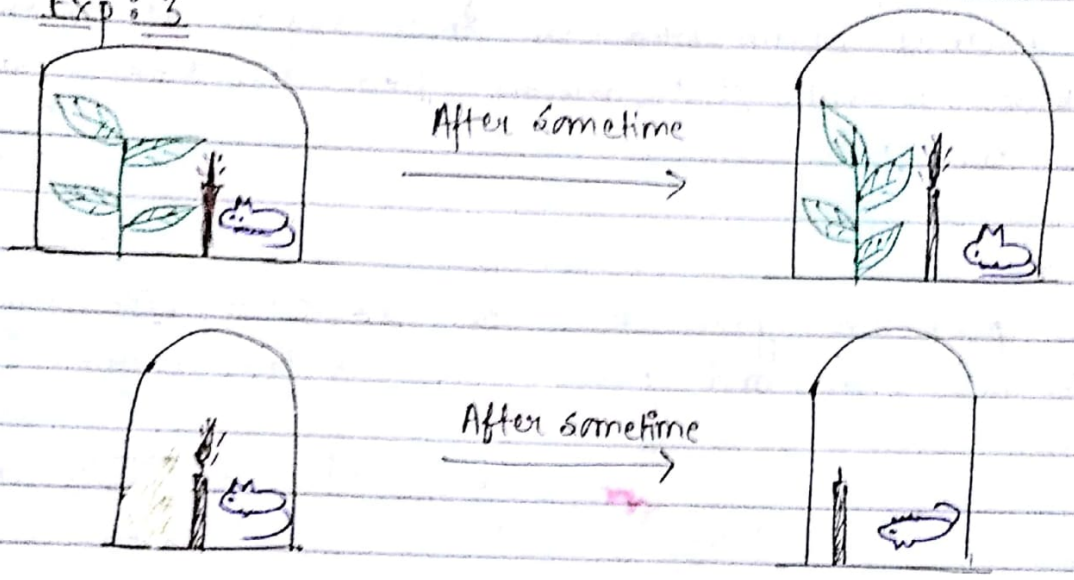
According to this exp. sunlight and Chloro is essential for ls

Exp : 2



CO_2 is essential for photosynthesis.

Exp : 3



A/C to this exp plant convert phlogiston (impure) air into dephlogiston air (pure).

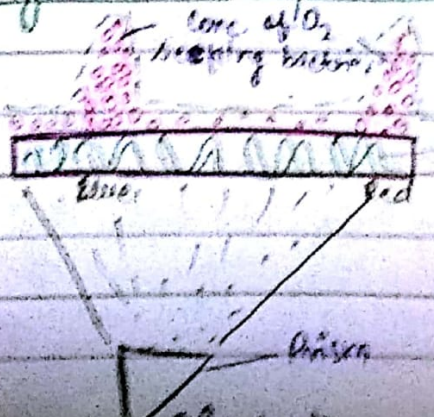
Exp : 4 C.V. Van Niel experiment

$$CO_2 + H_2S \xrightarrow[\text{Bacteria}]{\text{Anoxygenic photosynthetic}} [CH_2O]_n + S$$

$$CO_2 + H_2O \xrightarrow[\text{photosynthetic bacteria}]{\text{oxygenic}} [CH_2O]_n + O_2$$

This exp prove that O_2 is derived from H_2O not from the CO_2

Exp : 5 Englemann's experiment



17/09/18

→ BLOOD ←

Q If 'A' blood gp. blood is transfused to a person with 'B' blood gp., then minor and major agglutination reaⁿ. will occur b/w respectively –

a) Agglutinins of the Recepient and agglutinogen of the donar for minor reaⁿ and agglutinogen of recipient to agglutinin of donar for major reaction.

b) Agglutinins of donar and agglutinogens of recipient for minor and agglutinins of recipient to agglutinogens of donar for major reaⁿ. ✓

Q. Which one is the best suitable statement for defining the serum -

(a) Plasma – prothrombin (II) and fibrinogen (I)

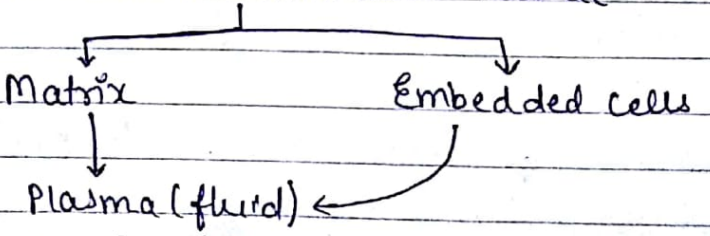
(b) Plasma – all clotting factors

(c) Plasma – Some clotting factors

(d) Plasma – Clotting factor I, II, V, VIII ✓

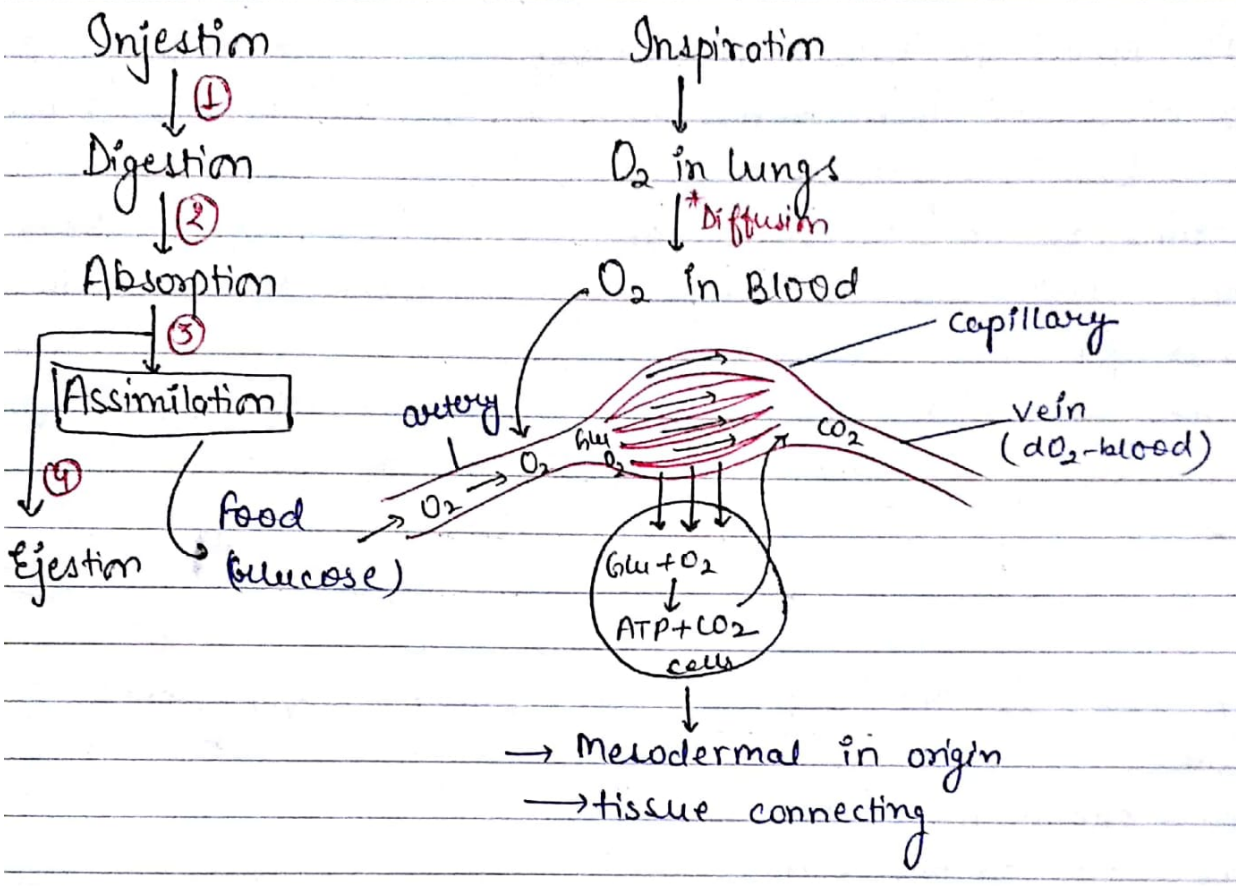
→ Blood ←

- Study – Haematology
- Specialized fluid connective tissue



- Slightly alkaline 7.4 pH.
- viscous in nature.
- The normal total circulating Blood volume is about 8% of the body weight.

• 5-6 lit blood in human (adult).

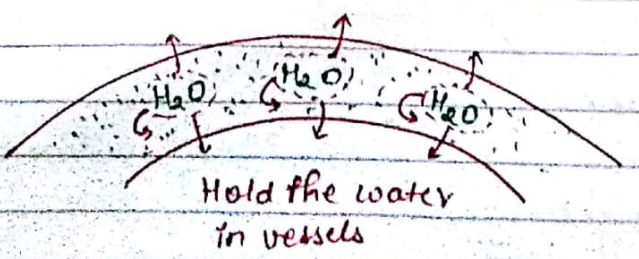


→ Melodermal in origin
→ tissue connecting

• Blood is considered as connective tissues for 2 basic reasons-
1→ Embryologically it has the same origin (melodermal) as do the other connective tissues
2→ Blood connects body system together bringing the needed O_2, nutrients, hormones etc. and removing the waste

Blood Compocition

• Albumin – Responsible for colloidal osmotic pressure (oncotic pressure).



Blood composition

- Blood Plasma (55%)
  - Water (92%)
  - Majr plasma protein (6-7%)
    - Albumin (most abundent in plasma – 4%)
    - Globulin (~2%)
    - Fibrinogen (~1%)
  - Others
    - ions
    - Nutrients
    - NPN (Non-proteinaceous nitrogenous substances)
    - Hormones
    - Cholesterol
- formed elements (Blood cells – 45%)

→ Oncotic pressure or colloidal osmotic pressure - Osmotic pressure exerted by proteins notably albumin in a blood vessels that usually tends to pull water into the circulatory sys.

- Globulin — α- Globulin, β- Globulin } Act as carrier transport for hormones vitamins etc.
  γ- Globulin — Immunoglobulin → Adaptive immunity
- Fibrinogen- Role in hemostasis (prevention of Blood loss)
- fibrinogen is the largest (in size) among 3 major plasma proteins.

NOTE - Major plasma proteins are synthesized in the liver except γ- globulin (synthesized by B-cells)

11/9/18

Ecology and Environment

(1) Basics - Terms related to ecology and environment
- (i) Species
- (ii) Population
- (iii) Community / Biocenosis
- (iv) Factor
- (v) Environment
- (vi) Latitudinal div of earth
- (vii) Atmosphere
- (viii) Ecosystem
- (ix) Ecology
- (x) Autecology Vs Synecology
- (xi) Ecotone / tension zone
- (xii) Ecological equivalent
- (xiii) Ecosystem services
- (xiv) Technoecosystem
- (xv) Ecological foot print / EFP
- (xvi) Carbon foot print
- (xvii) Carbon Hand Print
- (xviii) Carbon Sequestration
- (xix) Ecological succession
- (xx) Ecological Niche

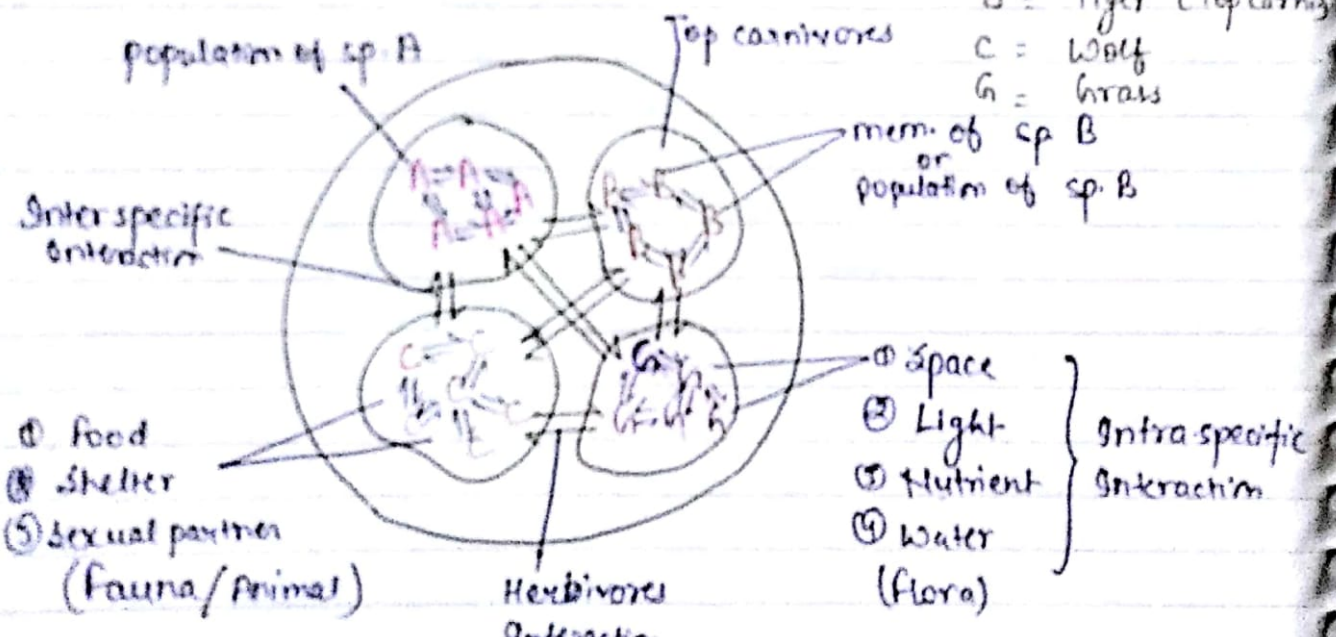
Miscellaneous

1. Species

- There are various concept of spp. like morphological given by Linneaus, genetic given by Lotsy and biological given by Mayr.
- In ecology and env., biological spp. concept given by Mayr is widely used.
- Spp. is a basic unit of Taxonomy. ie. deals with nomenclature and classification.
- A/c to Mayr when individual can interbreed/reproduce and can produce fertile offspring then they are said to be mem. of same spp.

2. Population

A = Wolf
B = Tiger (Top carni)
C = Wolf
G = Grass



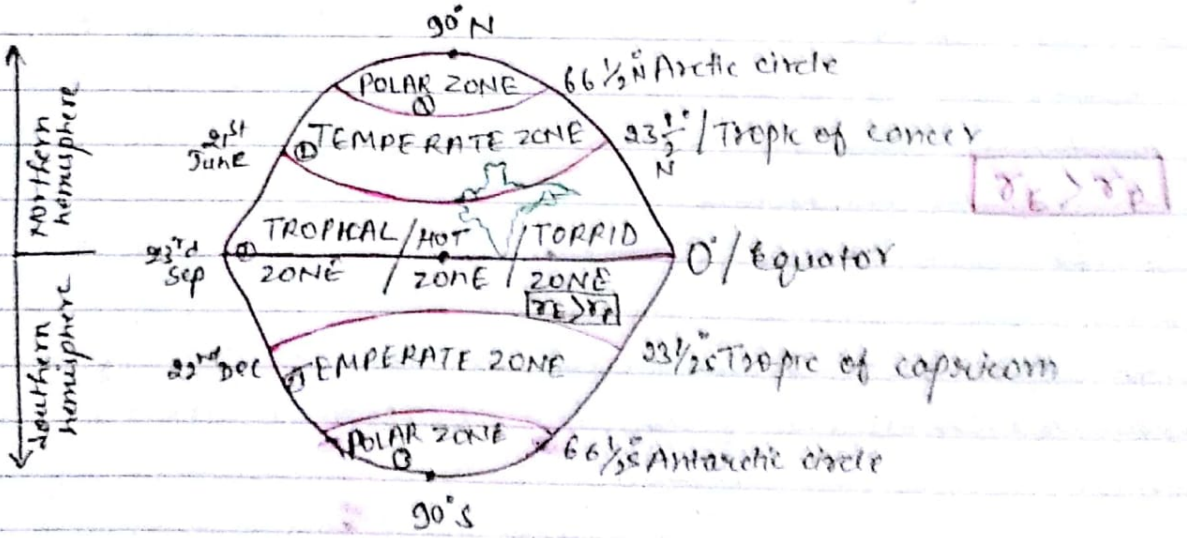
- It is defined as sum of all individuals that belongs to a given spp. ent in a given area.

3. Community / Biocenosis

- It is sum of all diff. population ent in a given area i.e it

- Includes population of all plants i.e flora, animals i.e fauna and micro-organisms.
- Community forms biotic component of the locality.

Note - • Competition can be both inter and intraspecific.
• When there occurs competition among mem. of same spp. it is called intraspecific
• When competition occurs among mem. diff. spp. it is called as interspecific.
• In flora intraspecific competition can be for light, space, moisture, nutrient.
• In fauna intraspecific competition can be for food, shelter and sexual partners.
• Competition is exp. of intraspecific interaction.
• Carnivores, Predation, top carnivores are exp. of interspecific interaⁿ



Shape of Earth = GEOID / Oblate spheroid

4. Factor

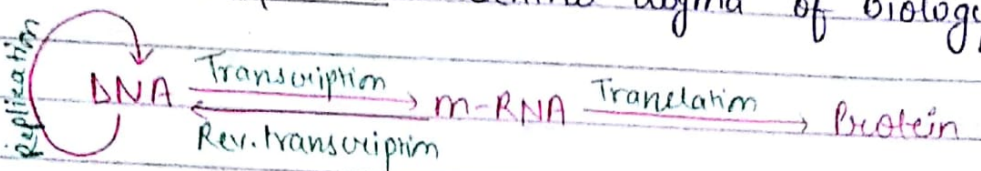
- Factor is defined as any force, substance or condition that effects individual in any way. for ex. light, rainfall, competition

Pedigree Analysis
Law of inheritance
Binomial theory by Mendel.

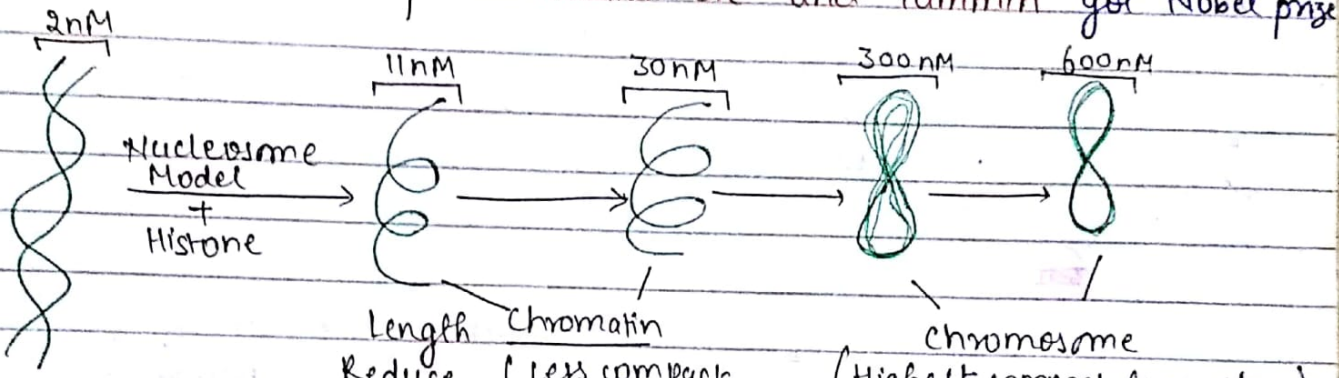
11/07/18

Genetics – Classical / Molecular / Evolutionary

Classical Genetics – Central dogma of Biology



Rev. transcription – Baltion ore and Tammin got Nobel prize



B-DNA

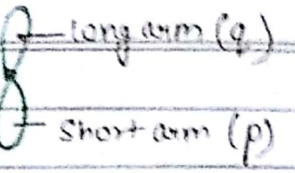
In a eukaryotic cell, DNA is tightly wound with histone proteins (forming chromatin) and when a cell prepared for division, the chromatin coils upon itself multiple times to form compact chromosome.

Q. Which of the following types of chr. is not found in human cells?

a) Metacentric chr./ Chromatin
b) Sub-metacentric chr.
c) Acrocentric chr.
d) Telocentric chr.

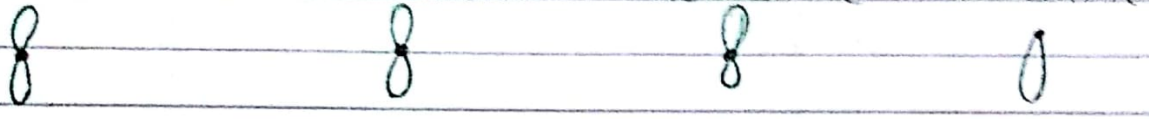
Ans- d (Not in Mouse)

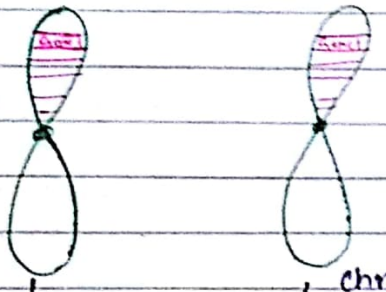
gene - a unit of DNA that is usually located on a chr. and that controls the development of one or more traits. It is the basic unit by which genetic information is passed from parent to offspring.



Chromatins / Chromosome

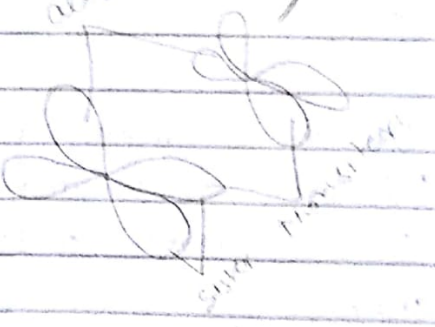
- With centromere (Centromeric chr.)
  - Monocentric
    - Metacentric
    - Sub-metacentric
  - Polycentric
    - Acrocentric
    - Telocentric
- Without centromere (Acentric chr.)





1 - chr = 1 DNA

(alternative forms of genes called Alleles)



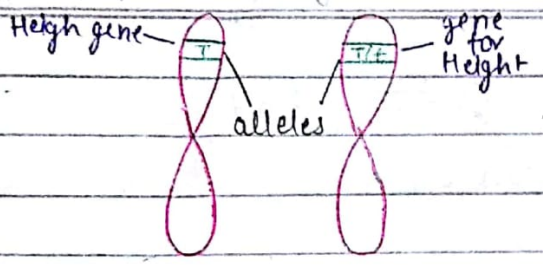
Human cell (Diploid)
46 chr.

- Autosomes = 44 chr. (other than X & Y chr.)
- Allosomes = 2 chr. (Sex chr. X & Y chr.)

Human cell (Diploid)
46 chr.

- Homologous chr.
  #1 #1
  #10 #18
- Non-Homologous Chr.
  #1, #5
  #7, #10
- Homologous Chr.
  #X #Y

Gene — (T) height
allele- TT
Multiple alleles - TT, Tt, tt (genotypes)
physical appearance by allele - phenotype



⇒ TT, Tt, tt } combination of alleles is kh genotype

T = Dominant form
t = Recessive form

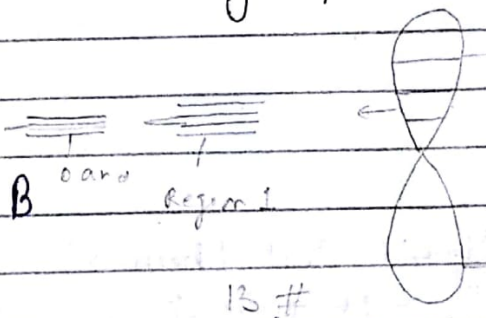
Genotype - TT — Tall
Tt — Tall
tt — Dwarf
} Phenotype is governed by genotype

Physical appearance (Phenotype)

Q- Which of the following is the right position of Retinoblasto-ma gene in human chr.

a) 17 q 18.2
b) 13q 14.2 ✓
c) 13p 14.2
d) 17p 14.2

Ans - B



Q. Find out the right statement for any diploid cell.

a) There are two pair of chr.
b) There are two chr.
c) There are the two basic sets of chr.
d) There are 23 pairs of chr.

(i) A & c
(ii) Only a
(iii) Only c ✓
(iv) c and d

Ans - (iii)

(1)

→ Enzymology ←

Enzymes are biocatalyst which have effeciency, specificity & regulation.

→ Effeciencies

- Collision theory states that the rate of reaction is directly proportional to effective collision.
- Most of the reaction are slow due to the ineffective collision.
- Max. collision possible / sec is K/a diffusion limit. which is 10^8/sec.
- Catalase have efficiency constant of 6×10^7 which is very close to the diffusion limit.

→ Specificity

- There are 3 type of specificity

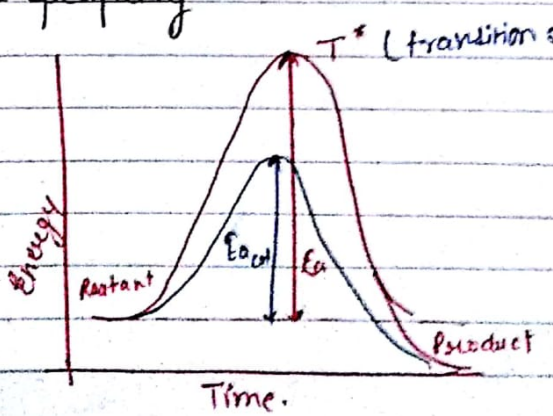
(a) Bond specificity.

Many enz. req. specific bond in the substrate for catalysis. for eg. Proteases req. amide bond, Glycosidases req. ether linkage Lipases req. ester linkage, Nucleases req. phosphoanhydride bond.

(b) Group specificity

Many enz. req. specific grp in the substrate for catalysis. for eg. Kinases req. hydroxyl gp

(c) Stereo specificity



V_0 = initial velocity of the Reaⁿ
V_{max} = maximal rate of Reaⁿ

- A/c to the transition state theory most of the reaⁿ are slow b/c of the "unavailibility of activation energy."
- Activation energy is the energy diff. b/w transition state and substrate.
- Enz. facilitate the rate of reaⁿ. by -

(i) Stabilizing the transition state -
(ii) By producing the binding energy
(iii) Enz. does not alter the energy of reactant and product hence does not have any effect on equilibrium const.

- Enz. also has stereospecificity which shows that if enz. recognize L amino acid it will not recognize D- amino acid and vice versa.
- Stereospecificity in the enz. arises due to the gp. topology of ~~effective~~ active site.

Enzyme Kinetics

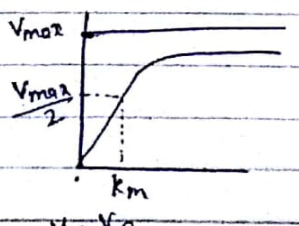
$$E + S \underset{K_{-1}}{\overset{K_{+1}\ (Km)}{\rightleftharpoons}} ES \xrightarrow[(Km/Kcat)]{K_{+2}\ (Kcat)} E + P$$

Equilibrium state

1. Enz. follows saturation ~~constant~~ kinetics
2. $K_{-1} >> K_{+2}$, that means there is equilibrium in formⁿ of ES complex and breakdown.

$$V_0 = \frac{V_{max}[S]}{K_S + [S]}$$

$$K_S = \frac{K_{-1}}{K_{+1}}$$



Steady state

Enz. follows saturation kinetics

2. $K_{+2} >> K_{-1}$, in this condition there is a stablishment of steady state of ES complex - i.e

$$\frac{d[ES]}{dt} = 0$$

$$V_0 = \frac{V_{max}[S]}{K_m + [S]}$$

$$K_m = K_S + \frac{K_{+2}}{K_{+1}} \Rightarrow \frac{K_{+2}\ K_{+1}}{K_{+1}}$$

Kinetic parameter

There are 4 kinetic parameter

(i) K_m (ii) V_{max} (iii) K_{cat} (iv) $\frac{K_{cat}}{K_m}$

1. K_m – K_m gives idea about how much substrate conc. is req. to achieve a fraction of V_{max}.

$$V_o = \frac{V_{max} * [S]}{K_m + [S]}$$

$$\boxed{\frac{V_o}{V_{max}} = \frac{[S]}{K_m + [S]}}$$

$$V_o = \frac{1}{2} V_{max}$$

$$\frac{\frac{1}{2} \cancel{V_{max}}}{\cancel{V_{max}}} = \frac{[S]}{K_m + [S]}$$

$$\frac{1}{2} = \frac{[S]}{K_m + [S]}$$

$$K_m = [2S] - [S]$$

$$\boxed{K_m = [S]}$$

$\boxed{K_m = 1[S]}$ when $V_o = \frac{1}{3} V_{max}$ (or 33% V_{max} achieved)

$\boxed{K_m = \frac{1}{3}[S]}$ when $V_o = \frac{3}{4} V_{max}$ (or 75% V_{max})

OR.

$\boxed{K_m = 0.33[S]}$

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Cell Biology

Cellular Organization

a) Transporters - Active and Passive
b) Intracellular trafficking - Cytosol
- Mitochondria
- Chloroplast
- ER - Golgi
- Plasma membrane (PM)
- Lysosome etc.

c) Cytoskeleton movement

d) Plasma membrane - Components
- Cholestrol
- Fluid mosaic model
- FRAP etc.

→ Transports across PM in animal cells - ① To understand the movement of mol. across the PM / lipid bilayer, protein free PM was used.

② Permeability of diff. mol. was tested which is as follows.

(i) Hydrophobic mol. like steroids hormons rapidally diffuses.
(ii) Hydrophobic gases like O_2, CO_2, NO & CO also rapidly diffuses.
(iii) Small polar uncharged mol. like H_2O, urea and glycerol diffuses slowly.
(iv) Large polar uncharged mol. like glucose shows restricted movement.

(v) Synthetic lipid bilayer was completely impermeable to charged ions like Na^+ and K^+. No matter what is the size of the ions.

* Therefore, above exp. proves that lipid bilayer of the PM is selectively permeable. for the mov. of charged ions transporters are ent in the PM.

* Smaller the size of hydrophobic mol. higher will be the diffus.

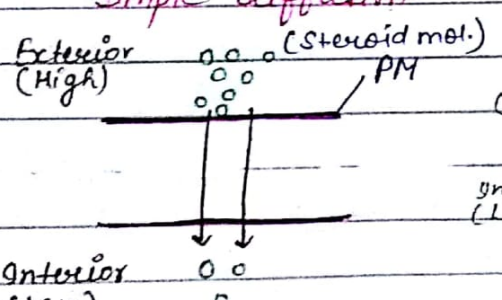
Q. Two hydrophobic mol. are used for cancer treatment. Mol. A is 5 Kilo dalton and mol. B is 200 kilo dalton. It was seen Mol. B can not cross PM. Explain?

A. Size and shape of the hydrophobic mol. is imp for crossing the PM.

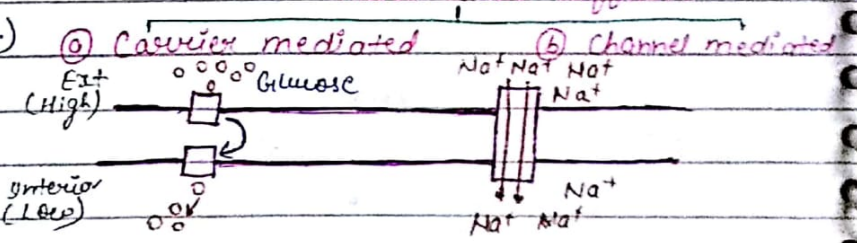
Types of Mol. movements –

Passive Movement – (Down hill or along the conc. gradient)

Simple diffusion



Facilitated diffusion



Carriers – GLUT (carrier protein) channels – Na^+, K^+, Cl^-, Ca^{2+} etc

(Stereospecific) (Glucose, Fructose)

- Aquaporins (H_2O, NH_3 etc.)

(Less stereo selective)

A) Passive Movement – • It is an energy independent process

• It involves mov. of the mol. along the conc. gradient / down hill.

along - High → low

- It may involve transporters for the mov. of charged ions.
- Broadly it is classified into two different types -

② Simple diffusion -

- It involves movement of hydrophobic mol. across PM. They are non-saturable in nature b/c they do not involve transporte (Protein)

⑤ Facilitated diffusion -

- It is a type of passive mov. which involves PM proteins.
- It is further categorised into two diff. types -

(i) Carrier mediated transport -

- A carrier is a protein also K/a permease which interacts with its target solutes in a stereospecific manner.
- Binding of solute induces confirmational change in the carriers and is responsible for the mov. of solute along the conc. gradient.
- Carriers are saturable in nature that means if all carriers are bound to the solute, ↑se in solute conc. will not ↑se the movement.

for exp. GLUT (glucose transport) for transporting glucose fructose

~~Aquaporins transported~~ H_2O, NH_3 etc.

(ii) Channel mediated transport

- They are less stereospecific in nature and allows the mov. of charged ions. for er - Na^+, K^+, Cl^-, Ca^{2+} etc.

Aquaporins - H_2O, NH_3 etc.
(water transporter)

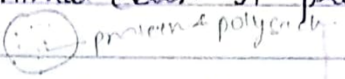
Cell comm., cell signalling, Cancer, Immunology.

CELL COMMUNICATION

a) Cell – cell attachment
b) Cell – ECM attachment

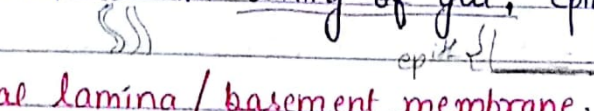
1) Homophilic interaction
2) Heterophilic interaction

- Cell communication is a process in which cell attach with each other, exchange signals, regulate gene expression etc.
- The two imp. building processes in animals are
1. Extracellular Matrix (ECM) – It is a complex network of proteins and polysaccharides secreted by animal cells. It provide strength to the organisms.



2. Cell-cell adhesion – Several intracellular cytoskeleton proteins participates in this process and provides strength to the organism by holding large no. of cells together.

- In plant cells strength is provided by cell wall instead of ECM.
- Two imp. tissues in animals are –
1. Connective tissue – It includes bones and tendons. (muscle with bone attach)
- Complex network of ECM is +nt-. (protein + polysaccharides)
- No. of cells are limited.
- Mechanical stress is provided by a matrix protein k/a collagen.
2. Epithelial tissue – It is +nt as the lining of gut, epidermal covering of skin etc.



- ECM is limited k/a basal lamina / basement membrane.
- Large no. of cells involves cell to cell adhesion.
- Diff. types of cytoskeleton filaments are +nt inside the cell which communicates with cell adhesion molecules (CAM)
- Two diff. modes of interactions are +nt b/w cells and cell + ECM.
1. Homophilic interaction – Same protein in the adjacent is involved. For eg – Cadherins.

- It occurs in cell to cell attachment.

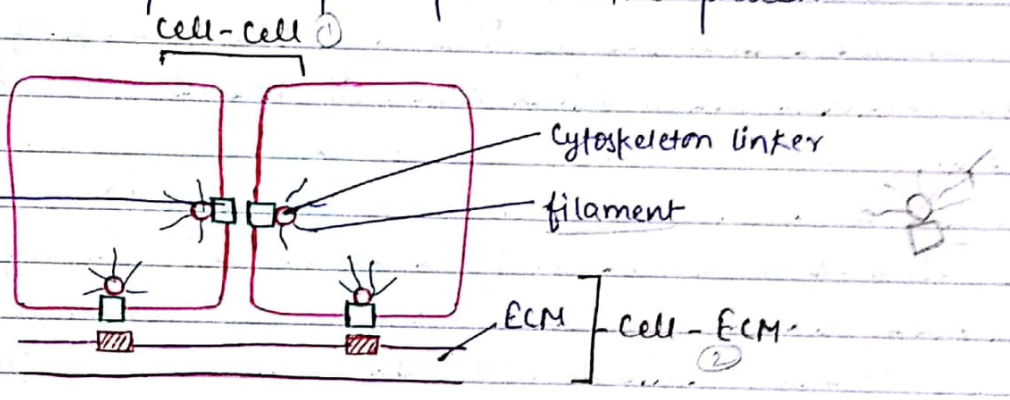
Anchoring → actin / Intermediate
actin → cell-cell (Cadherin), cell-ECM
Intermediate → cell-cell (Desmosom), cell-ECM (Hemidesmo)
actin based ECM

Anchoring → Cadherin → cell-cell / cell-ECM
Occluding → occludin/claudins → cell-cell
Channel → Connexin → cell-cell
Signal → cell-cell

2. Heterophilic interaction - 2 diff. proteins interact with each other.
• It is common in cell and ECM attachment.

• On the basis of architecture and protein involvement 4 diff. types of junctions are ↑nt -

1. Anchoring junction - It involves cell to cell adhesion and cell to ECM attachment.
• Diff. cytoskeleton proteins participates in the process.



On the basis of filament two diff. types of anchoring junctions are ↑nd.
(a) Actin filament attachment
(i) Cell - cell → adherens junction
(ii) Cell - ECM → Actin based ECM adhesion
(b) Intermediate filament
(i) Cell - cell → Desmosomes
(ii) Cell - ECM → Hemidesmosomes

2. Occluding Junction - It involves tight junctions which seals the gap b/w epithelial cells.
• They are responsible for maintaing impermeable barrier b/w epithelial cells.
• Protein like occludins and claudins participates in the process.
• It is a cell to cell attachment.