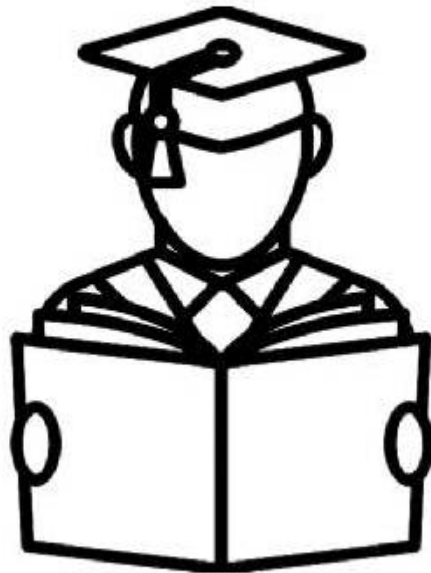


चौधरी **PHOTOSTAT**

"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

BioTechnology (BT)
for JAM
(Gyanbindu)

Immunology

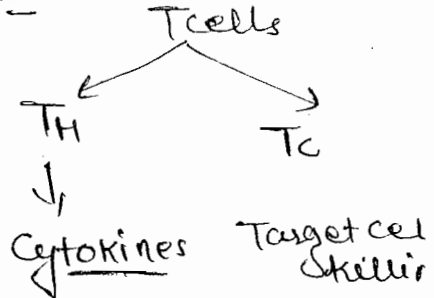
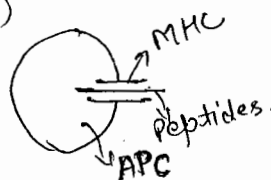
Science that is concerned with immune response to foreign challenge

* Innate Immunity

- Mechanical barrier
- Chemical barrier
- Secreted complement (In blood)
- Cellular component

* Adaptive Immunity

a) cell mediated



Processes:

1) Phagocytosis & Opsonisation (make pathogen & susceptible)
(eat cells)

2) PRR signalling. (Pattern Recognising receptor).

3) Inflammation

4) Antigen presentation

b) Humoral immunity

= B cells → Ab's

→ Humour → body fluid

Innate Immunity

→ 1st line defense

1) It is a broad non specific immune response present from birth.

2) It act as 1st line of defense against foreign pathogen

3) Important components of innate immunity are →

(i) Mechanical barrier : or (Physical barriers) →

- It includes impervious skin surface.

- Epidermis layer of the skin is composed of epithelial cells held together by different types of junctions.

- Dermis region is made up of connective tissue, blood vessels, and antigen presenting cells.

* Conjunctiva → conjunctiva : specialised mucus-secreting epithelial membrane.

(ii) Chemical barrier :

- It includes Acidic pH of stomach, Intestinal and respiratory secretions, tears, saliva, Mucus etc.

- Defensin is an imp. antimicrobial peptide which is secreted in the intestine.

* It is bacteriolytic in nature.

- Other antimicrobial peptides includes Reg III, Mucin 2, Relm β etc.

* In the intestine Paneth cells are good source for antimicrobial peptides.

(iii) Secreted complement ^{Composed of 30 serum proteins} System \rightarrow (Complement proteins are soluble proteins Glycoprotein synthesized by liver & circulate in Blood & ext. fluid.)

- Complement system is an imp. innate immune part which is produced by hepatocytes.

- It is present in the blood & participates in killing pathogen, removing cell debris, Activating adaptive immune response.

- It act as a bridge b/w innate and adaptive immunity.

(iv) cellular component :

- Imp. immune cells participating in innate immunity are neutrophils, basophils, monocytes, Macrophages and antigen presenting cells (APC).

Phagocytic (Blood)

Basophils \rightarrow

Release - Histamine \rightarrow Play imp role in allergic reactn.

Neutrophils - Phagocytic cell.
- 1st cell to arrive at the site of an infection.
- Toxic for bacteria & fungi.

- Important processes :

1) Phagocytosis :

o) This process removes foreign pathogen, cell debris and apoptotic cells.

o) Neutrophils and Macrophages are the two important phagocytic cells.

Neutrophils are present in blood.

Where as Macrophages are present in the tissue.

o) During Phagocytosis, Lysosome plays a crucial role and participates in the formation of phagolysosome.

Phagocytes + Lysosome.

* Mycobacteria inhibits phagolysosome formation due to the presence of Mycolic acid on the bacterial surface.

* Protozoa like Leishmania (Kalaazar) \rightarrow survives in the (Informal term for single-celled eukaryotes)

acidic pH of lysosome. It replicates in lysosome. Therefore treatment is difficult.

→ Important enzymes activated during phagocytosis are:

(i) NADPH-oxidase - It is an oxygen dependent membrane bound enzyme.

- It causes formation of Superoxide anion (O_2^-).
- Superoxide anion act as a oxygen free radical.
- Nicotinamide adenine dinucleotide phosphate.

(ii) Super oxide dis-mutase (SOD) - It converts superoxide anion into hydrogen peroxide (H_2O_2).

(iii) Catalase - It converts H_2O_2 into O_2 & water.

- More O_2 released in the process, is further utilized by NADPH-oxidase. Therefore Phagocytosis requires very high oxygen & the process is like Respiratory burst.

(iv) iNOS (Inducible nitric oxide synthase).

- During phagocytosis GPCR signalling is also involved.
- PIP₂ (Phosphatidylinositol 4,5 bisphosp) pathway is activated upon pathogen entry leading to nitric oxide products.
- NO is later converted into different types of reactive Nitrogen species (RNS) like NO_2^- (Nitrite), NO_3^- (Nitrate) etc.

→ ROS & RNS interferes with the metabolism of bacteria.

Q → A plant metabolite X is known to promote phagocytosis in macrophages. In an experiment macrophages were infected with *E. coli* and X was added in the cultured vessel. Which of the following X-activity statement will not directly show

- Estimating RNS conc.
- checking mRNA copies of iNOS.
- ✓ Proliferation of macrophages.
- Estimating nitric oxide production.

- Opsonisation - is a process in which pathogen becomes highly susceptible for phagocytosis.

- Opsonin is any molecule which interacts with the bacteria and promotes phagocytosis.
Ex Complement factors and Antibodies.

2.4
Page No. →
467
PRR signalling : Pattern Recognising Receptor

→ Innate immune cells express different types of PRR which recognize surface molecules of pathogen known as PAMP (Pathogen associated molecular pattern).

- Among PRR, Toll like receptor (TLR) ^{1st class in chordophila.} are the most important family.

- Diff. types of TLR expressed on Innate Immune cells are (i) TLR-1 → It recognizes Triacyl lipopeptide of Mycobacteria.

(ii) TLR-2 → It recognizes Peptidoglycan of bacterial cell wall,

(iii) TLR-3 → Double stranded RNA virus. TLR-3 is expressed on endolysosomal compartment.

Emp
(iv) * TLR-4 → Recognizes LPS (Lipopolysaccharides) → endotoxins, they are found in outer membrane of Gram -ve bacteria.

(v) TLR-5 → Recognizes Flagella (Bacterial flagellin) (segalla - non motile bacteria of intestine) Salmonella - motile.)

(vi) TLR-6 → Chitin layer of fungus & Diacyl lipopeptide of Mycobacteria.

(vii) * TLR-7 & 8 → Recognizes single stranded RNA virus,

(viii) * TLR-9 → Recognizes unmethylated residues of Herpes virus (Genome of Herpes virus - DNA)

→ TLR-9 → Hemozoin (P. falciparum)
* Virus mRNA don't have Poly A tail & Methyl. caps

→ But human mRNA have capping & tailing. }
}

→ TLR recognizing viral genome are present in endolysosomal compartment. (TLR3, 7, 8, 9)

* Other than TLR ^{imp.} other member of PRR family includes:

(i) NLR (Nod like receptor) → They are present in the cytosol which recognizes degraded component of peptidoglycan.

- Inside the cell they are responsible for activating inflammation
- son-tory pathway to restrict bacterial replication.
- They also regulates Autophagy. (self eating).

(ii) RIG-I like receptors → [RLR's]

- It is ~~retroviral~~ ^{retroviral} acid inducible gene like receptor.
- In the cytoplasm it recognizes ds RNA virus & participates in the production of Type 1 Interferons. (eg. Interferon α & β).

(Antiviral)

- Type 1 interferon is antiviral in nature. It causes degradation of viral genome and inhibits cellular translation.

(iii) C-Type Lectin Receptor : [CLR's].

- It is expressed on the PM and recognises β -glucan of fungus cell wall.

Q → Which of the following response is most likely to occur ^{infective E. coli} in ~~THE~~ TLR-4 knockout mice, infected with typhoid.

(i) Enhanced phagocytosis.

(ii) Less inflammation.

(iii) High rate of tissue injury.

(iv) Increased production of ROS.

→ Acute phase proteins → Heterogenous group of plasma proteins mainly produced by liver as a result of microbial stimulus. It includes C-reactive protein (CRP), serum amyloid protein A (SAA) & mannose binding protein (MBP).

→ Cytokines →

Antigen Presentation

→ In animals nearly all nucleated cells are Antigen-presenting cells (APC).

→ Two diff. types of Antigen processing are:

(i) Endocytic pathway (Endocytosis)

- Exogenous antigen is involved.

- Processing occurs in lysosome via Endocytic pathway.

- Peptide is represented by MHC-II.

- MHC-II interacts with T-helper cells.

- This pathway mainly occurs in professional antigen presenting cell like dendritic cells (DC's), macrophages, B-cells.

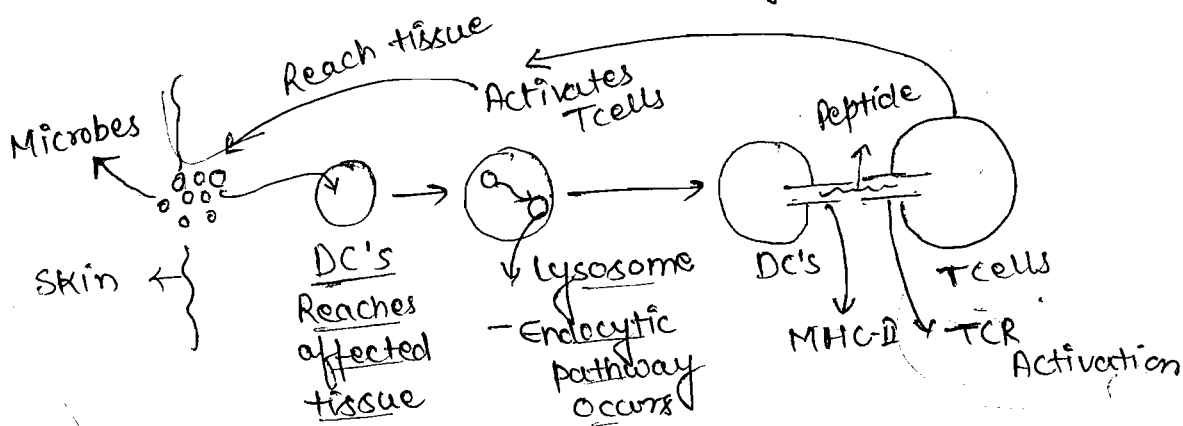
(ii) Cytosolic pathway

→ It involves endogenous antigen. For ex. Host protein, viral protein etc.

→ Processing occurs by Proteasome complex involving Ubiquitinylation.

→ Antigen is expressed by MHC-I.

→ MHC-I interacts with T-cytotoxic cells.



Blood

①
30-07-2018

- Blood
- Gradulatory system
- Respiration system
- Excretory system
- Nervous system
- Digestive system
- Endocrinology

Q. I A, B, O blood group of the organism is governed by surface antigen Ant on the Plasma membrane of RBC. What is the nature of that surface antigen.

- [a] Sphingomyelin
- [b] Sphingo phospho lipids
- [c] Glycerospingo lipids
- [d] Glycospingo lipids. ✓

Q. II Which of the following Plasma protein is mainly responsible for colloidal osmotic pressure -

- [a] α -globulin
- [b] γ -globulin
- [c] Fibrinogen
- [d] Albumin ✓

Q. III :- The cardiac output of a person is 6 litre and kidney receives 20% of the cardiac output. Calculate the renal plasma flow.

- [a] 1200 ml

[b] 600 ml

[c] 660 ml ✓

[d] 450 ml

Q. IV Serum has the same component as blood plasma but it lacks

[a] Ca^{+}

[b] Glass factor

[c] antihemophilic factor ✓

[d] thromboplastin

Q. V which of the following mature blood cells don't contain nucleus.

[a] RBC ✓

[b] WBC

[c] Thrombocyte ✗

[d] Neutrophils.

Blood ⇒

→ Blood is specialized fluid.

connective tissue

Blood cells
[Formed elements]

Matrix

↓
Fluid

↓
Plasma

Blood

①
30-07-2018

- Blood
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- Respiratory System
- Excretory System
- Nervous System
- Digestive System
- Endocrinology

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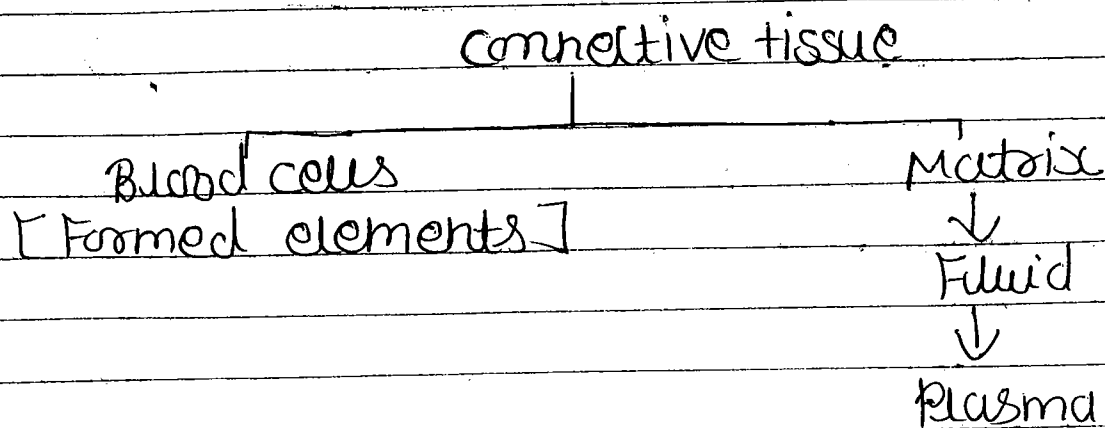
[b] WBC

[c] Thrombocyte ✓

[d] Neutrophils.

Blood ⇒

→ Blood is specialized fluid.

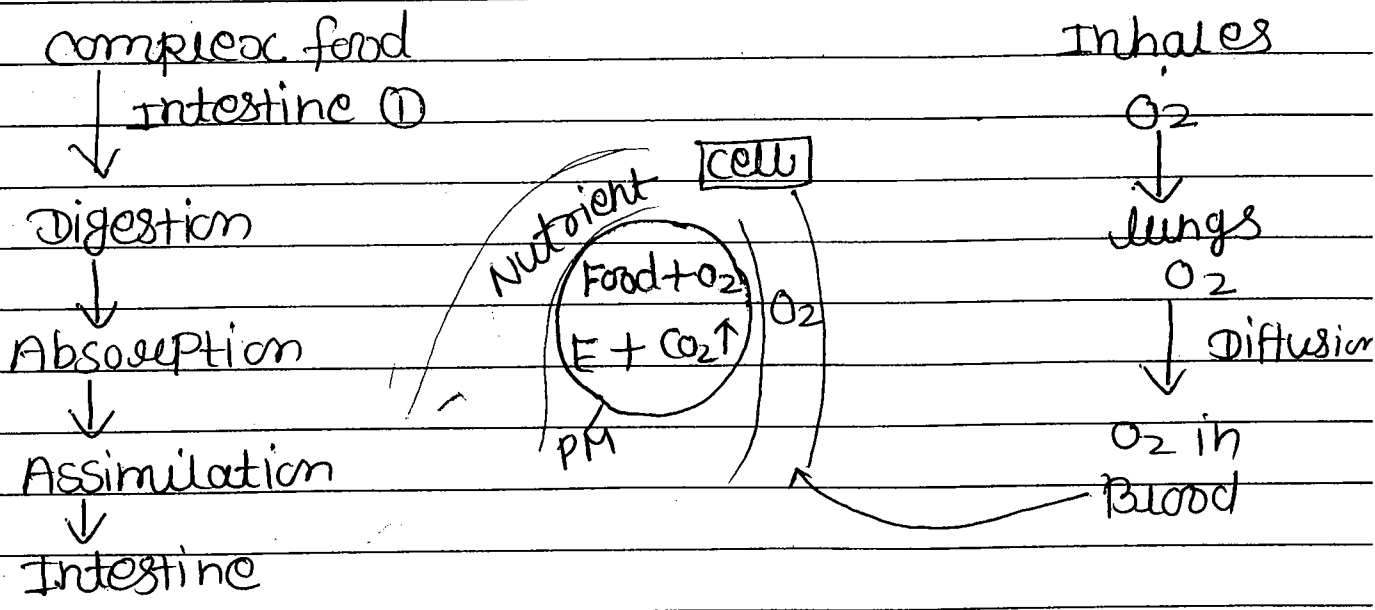


→ Blood is considered as connective tissue for two basic reasons -

① Embryologically it has the same origin (Mesodermal) as do the other connective tissue.

② Blood connects body system together bringing the needed oxygen, Nutrients, hormones, other signaling mol. and also removing the waste (CO₂)

Cell - Aquas compartment surrounding by P.M.



- It is the softage tissue of the body.
- In adult human 5-6 ltr blood (5.6 adiant)
- The normal total circulating blood volume is about 8% of the body weight.

NPN = Non Proteinous Nitrogenous sub. (urea, creatinine)

→ PH = 7.4 (slightly alkaline)

→ 4-5 times viscous than water.

→ Help of transportation of nutrient and gases.

Blood Composition

Waterly Substant

Formed element
[Blood cells] (45%)

Blood Plasma [55%]

- water [92%]

- protein [7%]

- α-globulin

- β-globulin

- γ-globulin

- Other (1%) [immunoglobulins]

RBC

[Red blood corpuscles]

Erythrocytes

WBC

[White blood cells]

Leucocytes

Platelets

[Thrombocytes]

① Electrolytes

② Clotting factors

③ Hormones

④ Nutrients

⑤ NPN substances

⑥ Cholesterol

Normal count → 4.5 mill. to 5.5 mill. / mm³ of blood

6000 to 8000 / mm² of blood

1.5 to 3.5 lakh / mm³ of blood

Mature RBC -

Nucleus, mit-
Ent

Nucleus
Ent

Nucleus
Ent

Role - O₂ transport

Provides immunity

Clotting

99%

0.2%

0.8%

→ Nucleus -nt hence Red blood corpuscles.

Cell - biology

60-80
marks

①

[a] Transport across plasma membrane

[b] Action potential - electrical charge

[c] Intracellular protein sorting

[d] Cytoskeleton

[e] Membrane structure

[a] Transport of molecules across Eukaryotic cell membrane :-

Lipid bilayer was 1st use to understand with permeability of molecules across the complex.

Biological membranes are made of lipid bilayer and integral PM proteins.

Permeability of mol. across lipid bilayer is as follow-

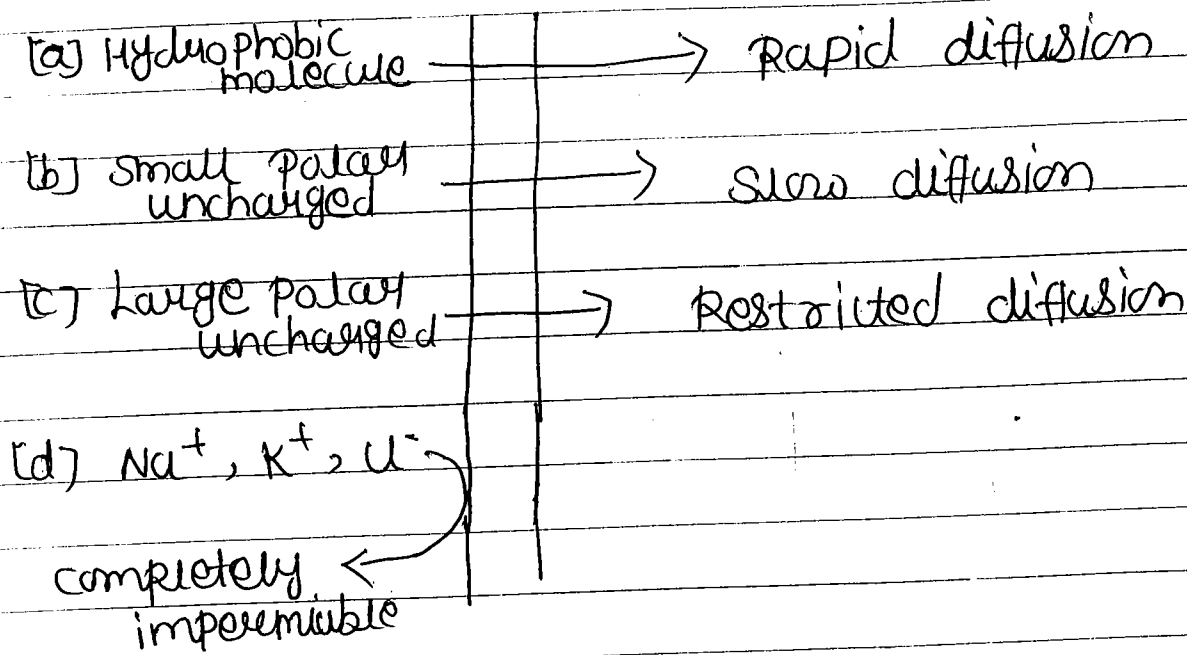
1. Hydrophobic mol. Steroids Hormones, Gases like ~~and~~ CO_2 , O_2 , Carbon mono oxide N_2 , rapidly diffuses along to lipid bilayer

2. Small Polar uncharge mol. like - water urea, glycerol shows slower diffusion.

3. Large polar uncharged mol. like - glucose shows restricted movement.

4. Ions like - Sodium, Potassium ions are completely impermeable across lipid bilayer.

Therefore lipid bilayer is completely impermeable for charged molecules.



Q. Carbon mono oxide and oxygen measurably shows p_2 diffusion but it also shows facilitated diffusion found with protein molecules. Explain??

Ans - Hemoglobin and myoglobin are the carrier for these gas case.
Animal PM is selectively permeable,

which ~~set~~ allows some mole. to rapidly cross the membrane and restrict ~~of~~ movement of some other molecules.

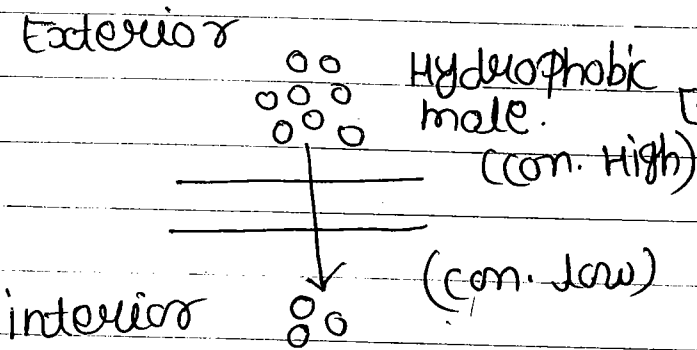
* Hydrophilic molecules and ions crosses the P.M with the help of transporters.

* on the basis of movement to different types of transport mechanism are present:

Passive movement \Rightarrow

passive movement

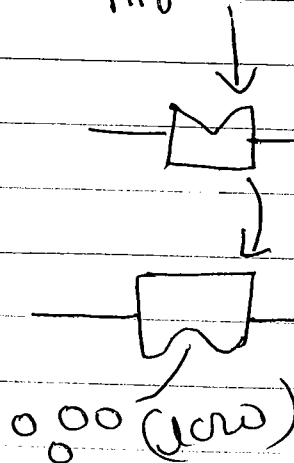
(i) simple diffusion



(II) Facilitated di ^{some (proteins)}

(a) carrier mediated Glucose

High

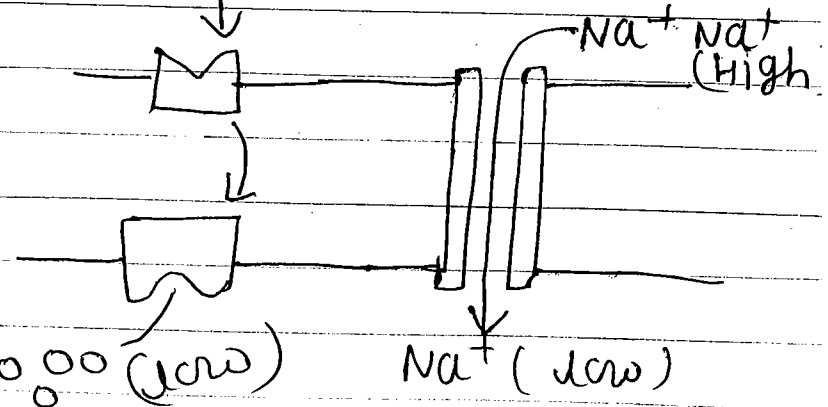


(b) Channel mediated [passive movement]

Na⁺ Na⁺

Na⁺ Na⁺ (High)

Na⁺ (Low)



(i) It is energy independent

(ii) It is along the chemical gradient or electrochemical gradient, that means from high conc. to low conc. It is also known as down hill movement.

(III) Different types of passive movement processes are :-

① Simple diffusion -

Hydrophobic mol.

get cross the PM without involving trans-
porters. this process depends upon con.
of the molecules.

② Facilitated diffusion - It is also involving along the con. ~~giving~~ gradient

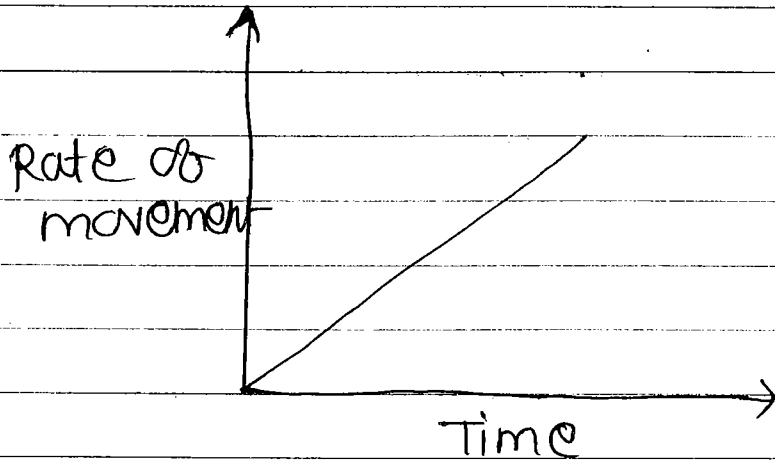
PM. content facilitators to transport the mole. across the membrane, This process is of two different types -

(i) carrier mediated transport -

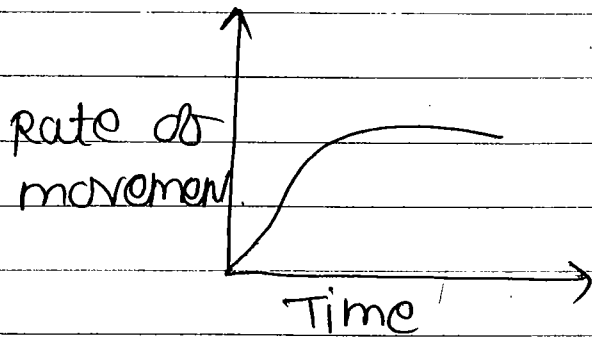
→ carrier is also known as permeases
→ They bind to the solute from one side and undergoes conformation changes, which is responsible for transporting solutes along the con. gradient

→ stereo specific interaction occurs between a carrier and its solute.

→ carriers are saturable in nature, that means further increase in the solute conc. will not increase rate of transport

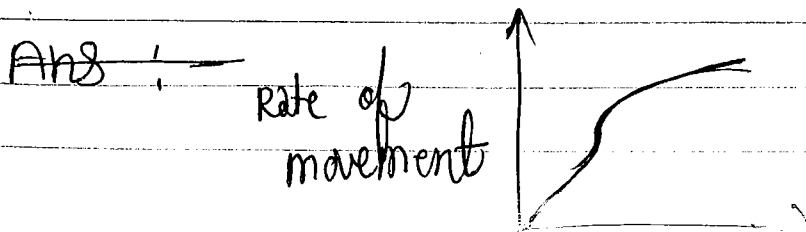


simple diffusion



facilitated diffusion

que: The movement of lactose across the animal cell membrane is shown in the following graph.



- lactose movement occur by simple diffusion
- initial uptake is ~~carrier~~ independent.
- initial ~~u~~ lactose ✓
- Lactose movement occurs only by carrier mediated movement

Important carrier express in animal cells are - glucose transporters (GLUT)

→ In E. coli lactose permease is present.

2. Channel mediated transport

→ They are less stereospecific in nature

→ They exist in two alternate form open and closed.

→ They participate in the movement of charged ions polar molecule like water etc.

→ important channels express in animal cell membrane includes Na^+ channel, K^+ channel, aquaporins etc.

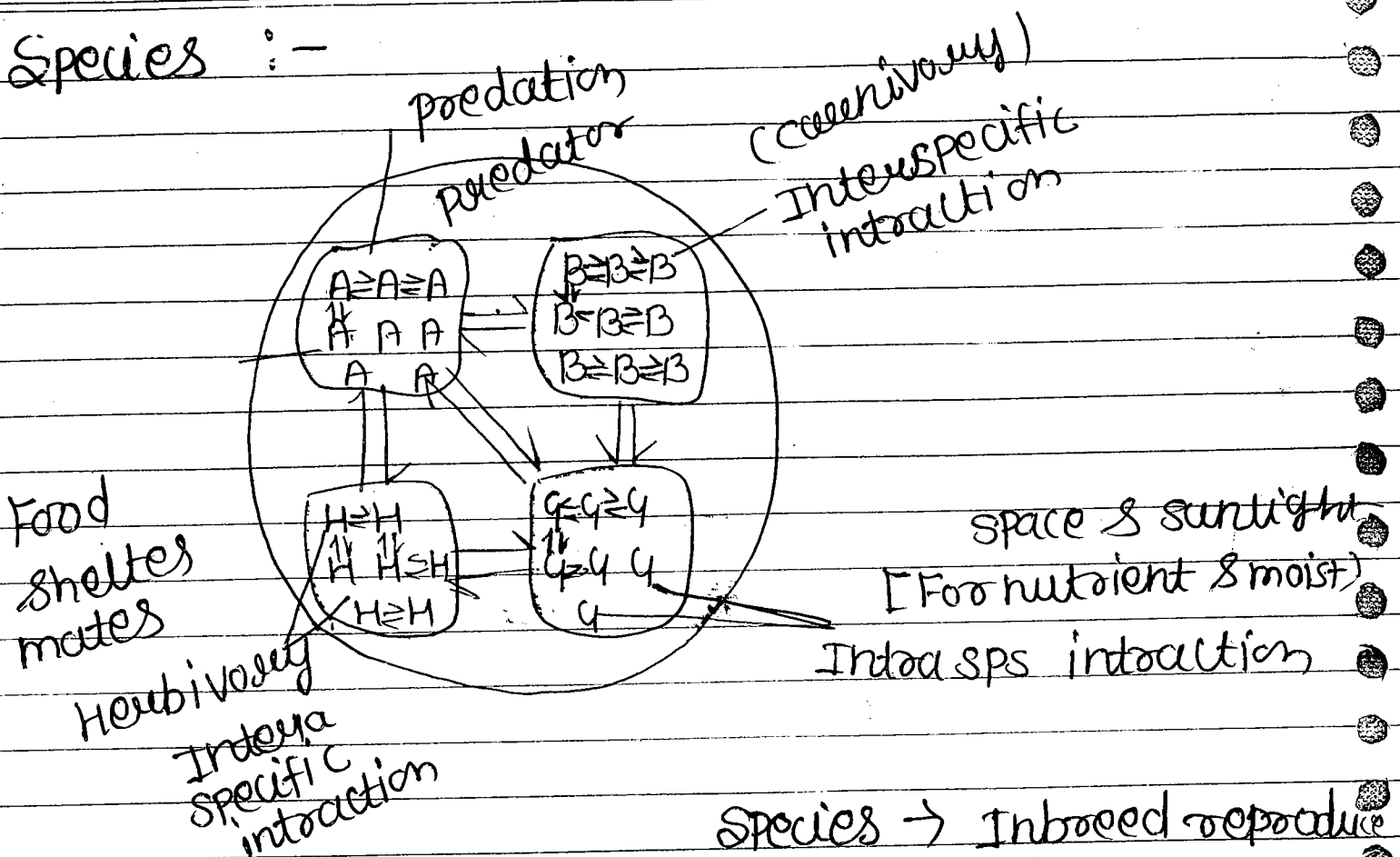
→ The 3 imp. types of channels mediating ion movement are :-

23-08-2018

Basic concepts of ecology and environment ^①

1. Species
2. Population
3. Community (Biocoenosis)
4. Factors
5. Latitudinal division of earth
6. Ecosystem (Geobicoenosis)
7. Ecology
8. Autecology / Synecology
9. Natural capital (Ecosystem services)
10. Technoecosystem
11. Ecological foot print
12. Biocapacity
13. Carbon sequestration
14. Ecological guild
15. Ecological equivalent
16. Ecotone
17. ecosphere
18. Biosphere & ~~bioreserve~~ sphere - 2
19. carbon foot print
20. carbon foot print miscellaneous,
hand

Species :-



Species → Inbreed reproduce Fertile

- SPS is considered as basic unit of taxonomy that deals with nomenclature and classification.
- They are different concepts of species like - morphological (given by Linnaeus), genetic species concept (given by Mayr) and biological species concept (given by Mayr).
- A/c to him when individuals can interbreed or reproduce or produce fertile offspring, then they belong to same species.

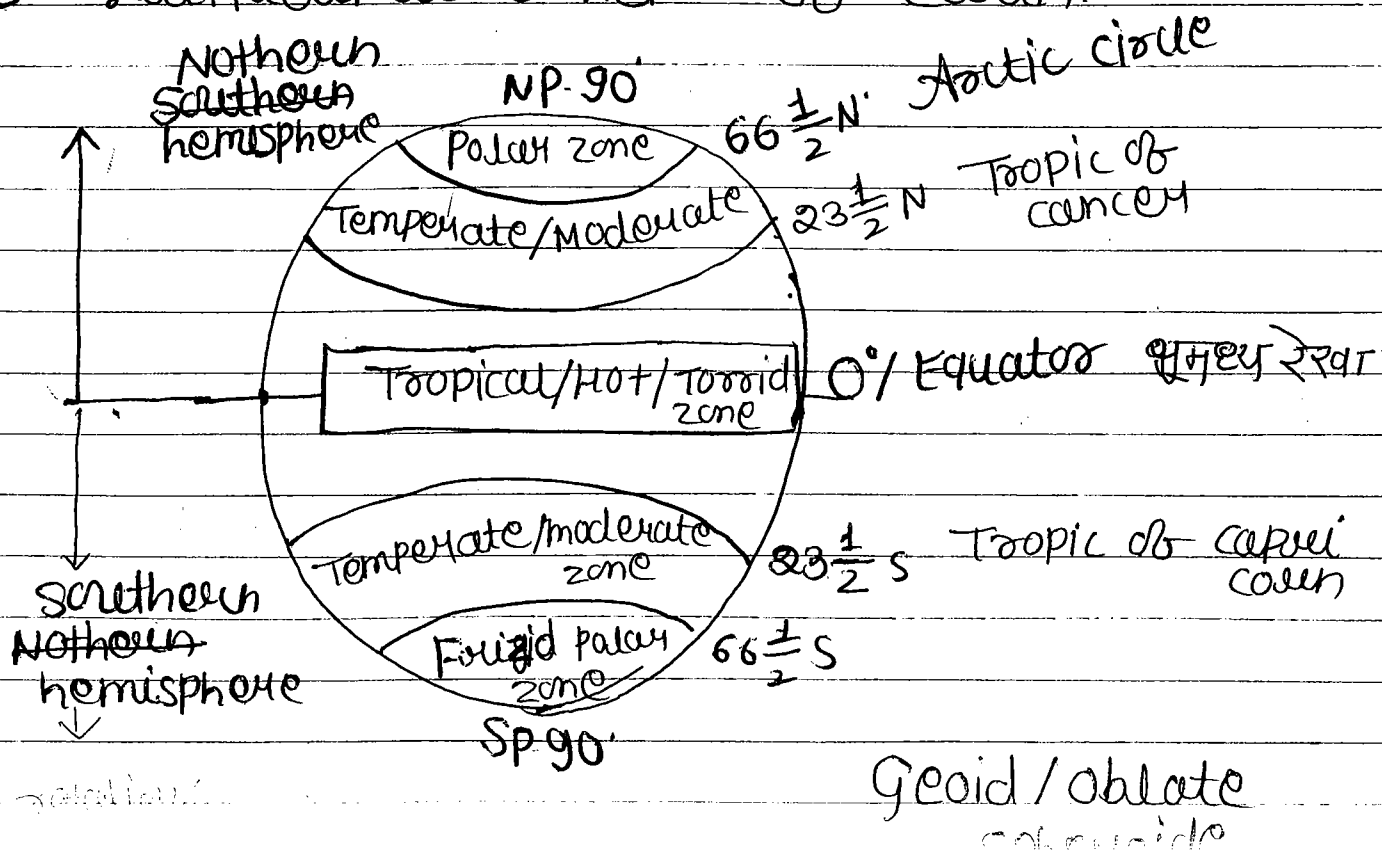
2. Population

- It is sum of all individuals that belongs to a given species present in a particular area.

3. Community / Biocoenosis

- Community is sum of all different populations present in a given area.
- Community includes populations of all plants (flora) animals (fauna) and microorganisms.
- Thus community forms biotic component of the locality.

3. Latitudinal division of earth.



Factor \Rightarrow

- Factor is any force, substance or conditions that affects individuals in any way
Exa- light, temperature, rainfall are abiotic factors
- competition (intra specific & inter specific) Herbivory, commensalism are example of biotic factors.

Environment -

- It is sum of all biotic & abiotic factors

Atmosphere :-

- Atmosphere is thin gases envelope or surrounding the earth surface as it is held by means of force of gravity which is maximum at the surface of earth.
- origin of earth's atmosphere is endogenous (from interior of earth)

Note - Moon has no atmosphere like that of mercury

- presence of atmosphere is responsible for maintenance of habitable condition and low

diurnal range of temperature.

- The difference in temperature b/w day and night is called as diurnal range of temperature.

Ecosystem ⇒

- British plant ecologist A.G. Tansley gave the term ecosystem.

- A/c to Tansley it is a system formed by interaction b/w interactive biotic component with that of interacting abiotic component.

- Note - Sun is the main source of energy (not only source of energy)

Note - India is the 1st country in the world that have provision for protection and conservation of environment in its constitution

- 5th June 1972, "environment" was 1stly discussed as an item of international agenda in the UN Conference of human environment, Stockholm (Sweden) and thus 5th June is celebrated all over world WED (World Environment Day) this conference is called as Stockholm declaration.

- on 5th June, India was the host country and theme was Beating Plastic Pollution

Ecology -

- German scientist Haeckel gave the term ecology, it was Persian called by Ziter as oekology.
- Odum gave the term ecosystem development
- Dr. Ramden Mishra (B.H.U) is known as Father of Indian ecology.
- Ecology is study of structure and function of ecosystem.
- while performing ecological studies when focus is on single individual species about its geographical distribution, morphology, taxonomic position, ecological role, ecological niche it is called as auto ecology.
- while performing ecological studies when entire community or biotic components are taken into consideration it is called as syn ecology
- syn ecological approach is more accurate as it gives two picture of ecosystem.