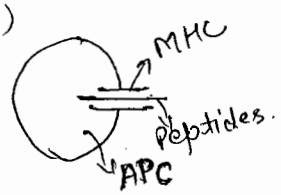
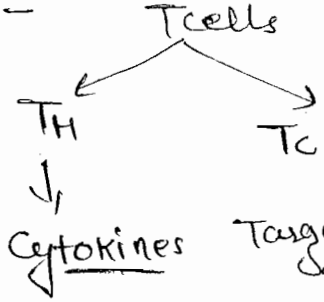
Immunology

"Science that is concerned with immune response to foreign challenge"

* Innate Immunity
  a) Mechanical barrier
  b) Chemical barrier
  c) Secreted complement (In blood)
  d) Cellular component



* Adaptive immunity
  a) cell mediated



  b) Humoral immuni
  - Bcells → Ab'
  → Humour → body fluid

- Processes :-
  1) Phagocytosis & Opsonisation (make pathogen susceptable) (eat cells)
  2) PRR signalling. (Pattern Recognising receptor).
  3) Inflammation
  4) Antigen presentation

Innate Immunity → 1st line defense

- It is a broad non specific immune response present from birth.
- It act as 1st line of defense against foreign pathogen
- 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 epithe -al cells held together by different types of junctions.
  - Dermis region is made up of connective tissue, blood vessels, and antigen presenting cells.
  - → Conjunctiva → conjunctiva :- specialized mucus-secreting epithelial membrane.

  (ii) chemical barrier :-
  - It includes Acidic PH of stomach, Intestinal and respirato 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 IIIγ, Mucin 2, Relm β etc.

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

(iii) Secreted complement → (composed of 30 serum protein) system → (complement protein are soluble protein Glycoprotein synthesized by liver & Circulate in Blood & Ext. fluid.

- Complement system is an imp. innate immune part which is produced by hepatocytes (liver).
  - It is present in the blood & participates in killing pathogen, removing cell debris, Activating adaptive immune respone.
  - It act as a bridge b/w innate and adaptive immunity.

(iv) Cellular component:-
- Imp. immune cells participating in innate immunity are neutrophills, basophills, monocytes → Macrophages and antigen presenting cells (APC).
  (Phagocytic (Blood)) (↓ Blood) (↓ Tissue) (Phagocytic)
  Basophills → Release - Histamine → Play imp role in allergic reactn.

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

- Important processes:-

1.) Phagocytosis:-
- This process removes foreign pathogen, cell debris and apoptotic cells.
- Neutrophills and Macrophages are the two important phagocytic cells.
  Neutrophills are present in blood.
  Where as Macrophages are present in the tissue.
- 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 (Kala azar) → survives in the
(Informal term for single-celled eukaryotes)

acidic ϕ 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 radicle.
- 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 klas Respiratory burst.

(iv) iNOS :- (Inducable nitric oxide synthase).
- During phagocytosis GPCR signalling is also involved.
- PIP_2 (Phosphotidyl inositol 4,5 bis phosp.) Pathway is activated upon pathogen entry leading to nitric oxide production.
- NO is later converted into different types of reactive Nitrogen species (RNS), like NO_2^- Nitrite, NO_3^- Nitrate etc.

→ ROS & RNS interfers with the metabolism of bacteria

ROS - Reactive Oxygen Species.

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 statement will not directly shows X-activity.

(i) Estimating RNS conc.
(ii) Checking MRNA & copies of iNOS
(iii) Proliferation of macrophages.
(iv) 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.Y PRR signalling :: Pattern Recognising Receptor ::
Page no. 467

→ Innate Immune cells expresses different types of PRR which recognizes surface molecules of pathogen k/a PAMP (Pathogen associated molecular pattern).

- Among PRR, Toll like receptor (TLR) (1st discovered in drosophilla) 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 recognises Peptidoglycan of bacterial cell wall.
  (iii) TLR-3 → Double stranded RNA virus. TLR-3 is expressed on endolysosomal compartment.
  (iv) * TLR-4 → Recognises LPS (Lipopolysaccharides); endotoxin; they are found in outer membrane of Gram -ve bacteria.
  (v) TLR-5 → Recognises 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 cap.
  → But human mRNA have Capping & Tailing.

→ TLR recognizing viral genome are present in endolysosomal compartment. (TLR 3, 7&8, 9)

* Other than TLR imp. member of PRR family includes :-

(i) NLR (NOd like receptor) → They are present in the cytosal which recognizes degraded component of peptidoglycan.
- Inside the cell they are responsible for activating inflamma-son- tory pathway to restrict bacterial replication.
- They also regulates Autophagy. (self eating).

(ii) RIG-I like Receptors → [RLR's]
- It is retenoic 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 degrad-ation of viral genome and inhibits cellular translation.

(iii) C-Type Lectin Receptor :- [CLR's].
- It is expressed on the PAM and recognises β-glucan of fungus cell wall.

Q→ Which of the following response is most likely to occur in TLR-4 knock out mice, infected with E.coli leishmania.
(i) Enhanced phagocytosis.
(ii) Less inflammation.
(iii) High rate of tissue injury.
(iv) Increased production of ROS.

→ Acute phase proteins → Heterogenous grp of plasma protein 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 (tissue).
- MHC-II interacts with T-helper cells.
- This pathway mainly occurs in professional antigen presenting cell like dendritic cells (DC's), macrophages, B-cells.

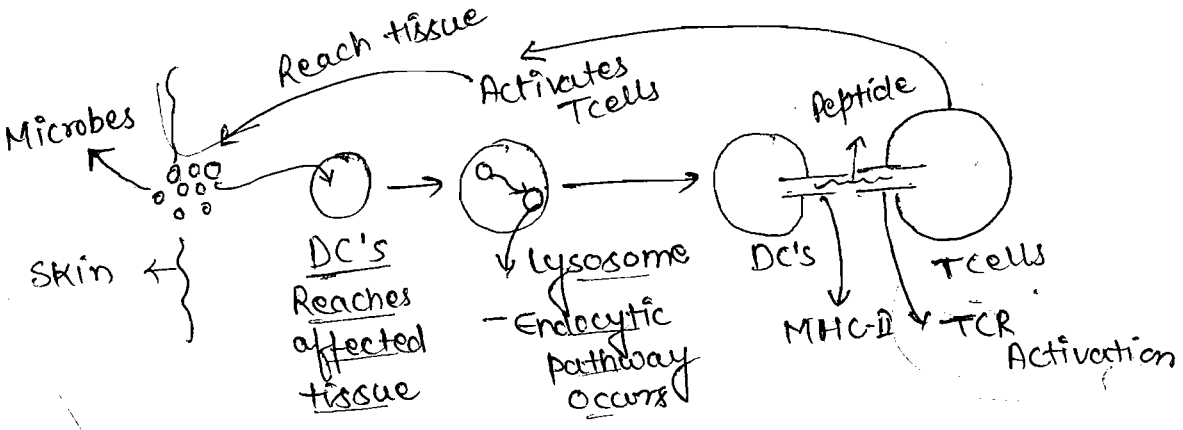
(ii) Cytosolic pathway :-

→ It involves endogenous antigen. Forex. 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

30-07-2018

- Blood
- Gradulatory System
- Respiration System
- Excratory System
- Nervous System
- Digestive System
- Endocrinology

Q.I A, B, O blood group of the organism is govern 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] Glycero spingo lipids
[d] Glycospingolipids. ✓

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 recives 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 specilized fluid.

Connective tissue

Blood cells [Formed elements] — Matrix → Fluid → Plasma

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Blood ⇒

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Connective tissue

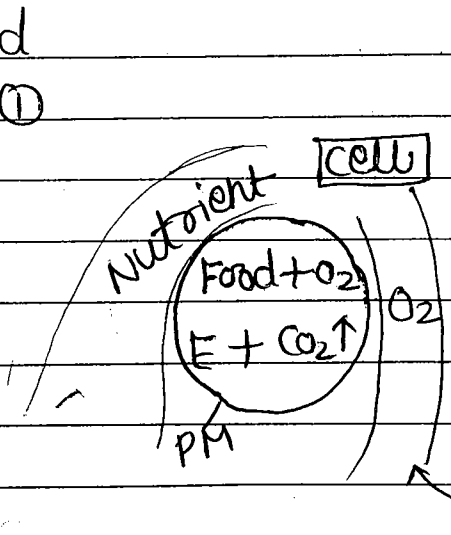
Blood cells [Formed elements] — Matrix → Fluid → Plasma

→ Blood is considerd 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 (CO_2)

Cell — Aquas compartment surrounding by P.M.



→ It is the storage tissue of the body.
→ In adult human 5-6 ltr blood (5.6 adult)
→ 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 viscus than water.
→ Help in transportation of nutrient and gases.

Blood composition

- Watery Substant
  - Blood Plasma [55%]
    - water [92%]
    - protein [~7%]
      - α-globulin
      - β-globulin
      - γ-globulin
    - Other (~1%) [immunoglobulins]
      - ① Electrolytes
      - ② Clotting factors
      - ③ Hormones
      - ④ Nutrients
      - ⑤ NPN substances
      - ⑥ Cholestrol
- Formed element [Blood cells] (45%)
  - RBC [Red blood corpales] — Erythrocytes
    - Normal count → 4.5 mill. to 5.5 mill/mm³ of blood
    - Mature RBC – Nucleus, mitochondria
    - Role – O₂ transport
    - 99%
  - WBC [white blood cells] — Leucocytes
    - 6000 to 8000/mm² of blood
    - Nucleus present
    - provides immunity
    - 0.2%
  - Platelets [Thrombocytes]
    - 1.5 to 3.5 lakh /mm³ of blood
    - Nucleus present
    - Clotting
    - 0.8%

→ Nucleus -nt hense Red blood corpuscles.

Date
25-07-2018

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

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

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

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

Permiability of mol. across lipid bilayer is as follow—

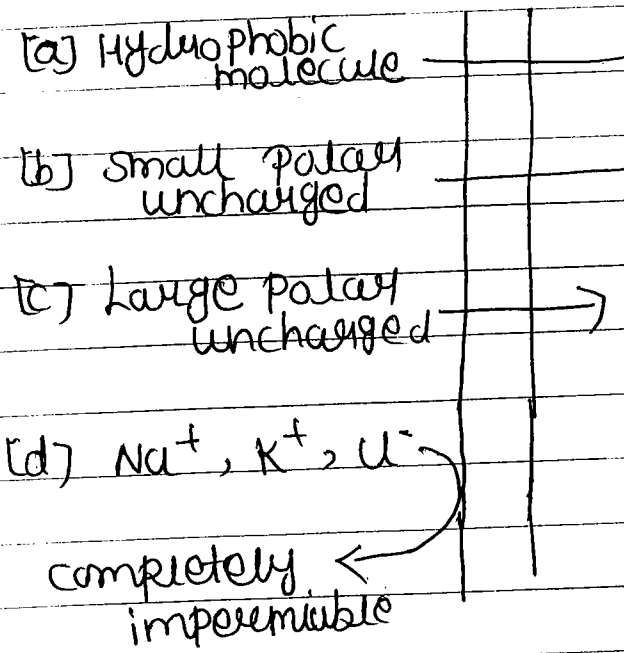
1. Hydrophobic mol. steroids Hormones, Gases like CO_2, O_2, Carbon mono oxide N_2, rapidly diffuses along be lipid bilayer

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

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

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

- Therefore lipid bilayer is completely impermiable for charged molecules



Q. Carbon mono oxide and oxygen measurely shows pre diffusion but it also shows facilitated diffusion found with Protein molecules. Explain??

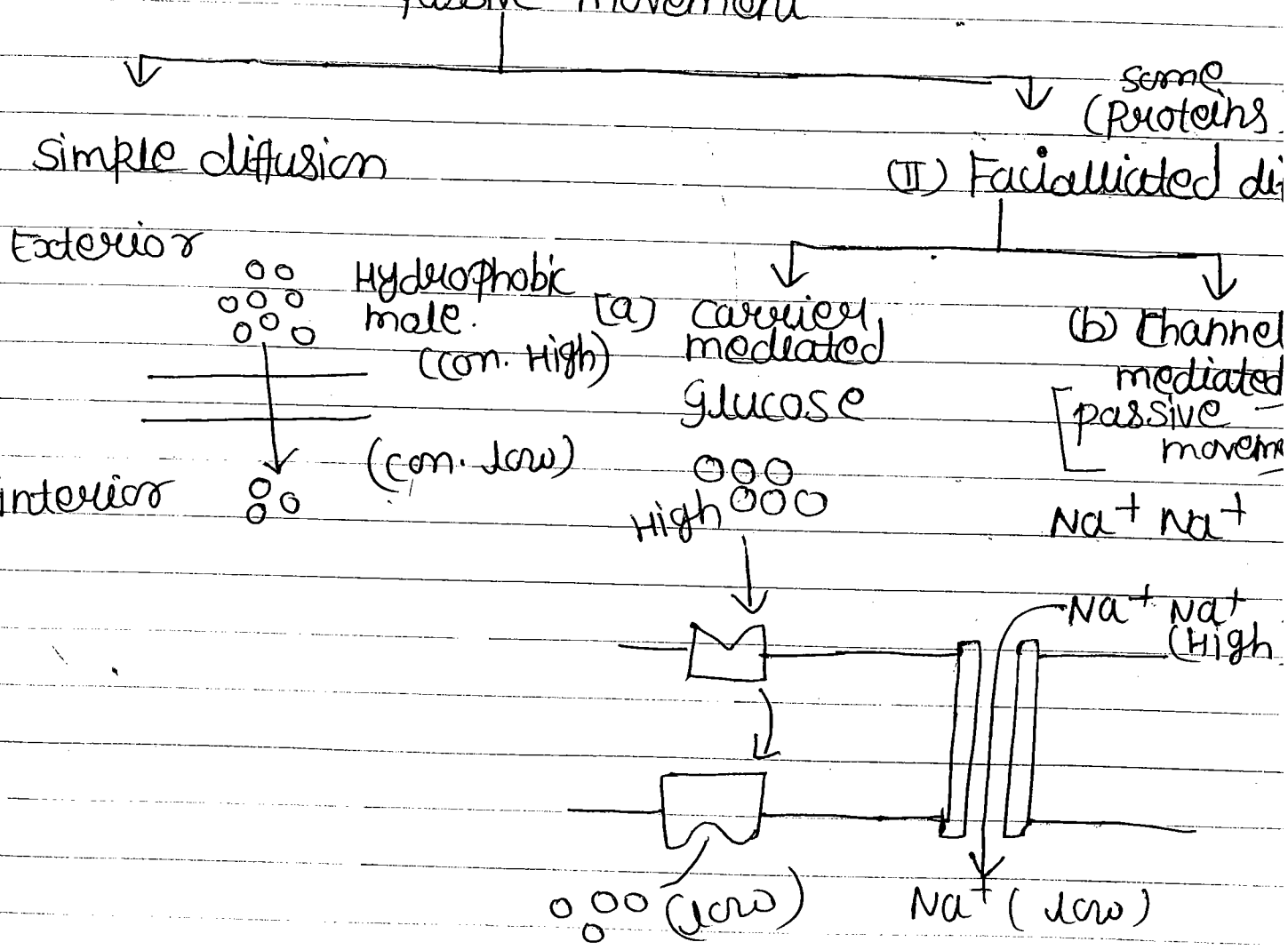
Ans - Heamoglobin and myoglobin are the career for these gas case.
Animal PM is selectively permiable,

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

★ Hydrophilic molecules and ions crosses the P.M with the help of transpotars.

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

Passive movement ⇒



(i) It is energy independent
(ii) It is along the chemical gradient or electro chemical gradient, that means from high conc. to low conce.. 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-potars. this process depends upon con. of the molecules.

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

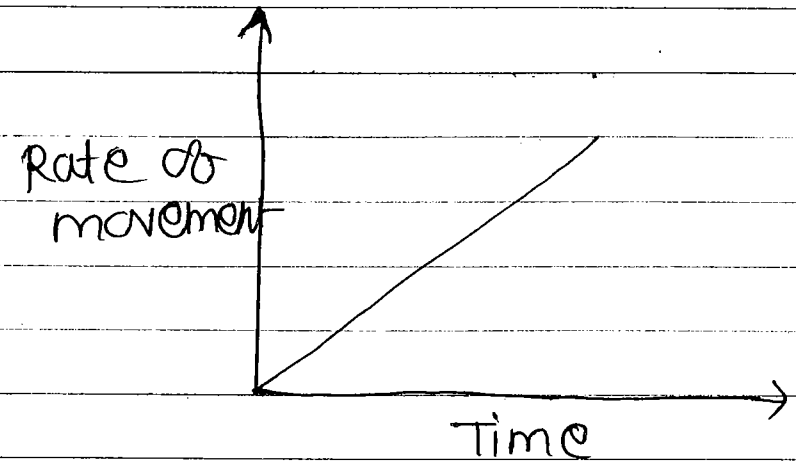
PM. content facilitaters to transport the mole. across the membrane, This process is of two different types -

(i) carrier mediated transport -

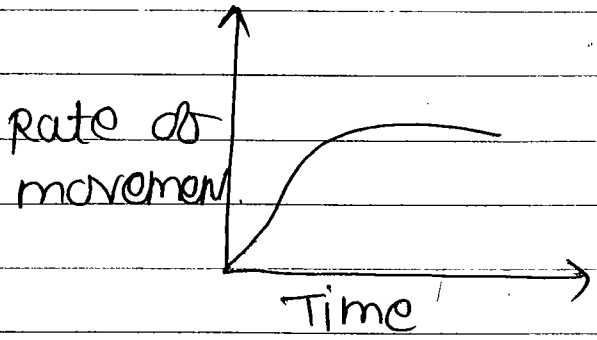
→ carrier is also known as permiases
→ They find to the solute from one side and undergoes conformation changes, wich is responsible for transporting solutes along be con. gradient

→ steric 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



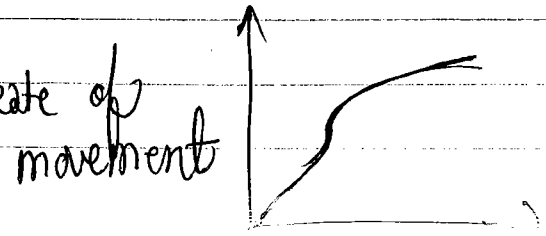
Simple diffusion



Facilated diffussion

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

Ans :—



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

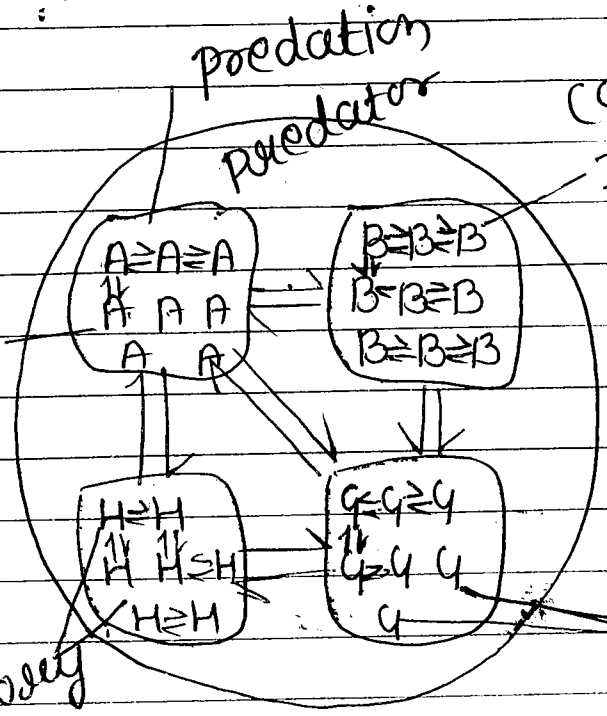
→ The 3 imp. types of channels mediating ion movement are :-

23-08-2018

Basic concepts of ecology and environment

1. species
2. population
3. community (Biocoenosis)
4. Factor
5. Latitudinal division of earth
6. Ecosystem (Geobicoenosis)
7. Ecology
8. Autecology / synecology
9. Natural capital (Ecosystem servies)
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~~ hand print miscellanous.

Species :-



Species → Inbreed reproduce Fertile

- SPS is considerd as basic unit of taxonomy that deals with nomenclature and classificati
- Their are different concept of species like- morphological (given by linius) genetic species concept (given by lotsy) and biological species concept (given by myer)
- A/C to him when individuals can inter-breed or reproduce or produce fertile offspring than they beongs to same species

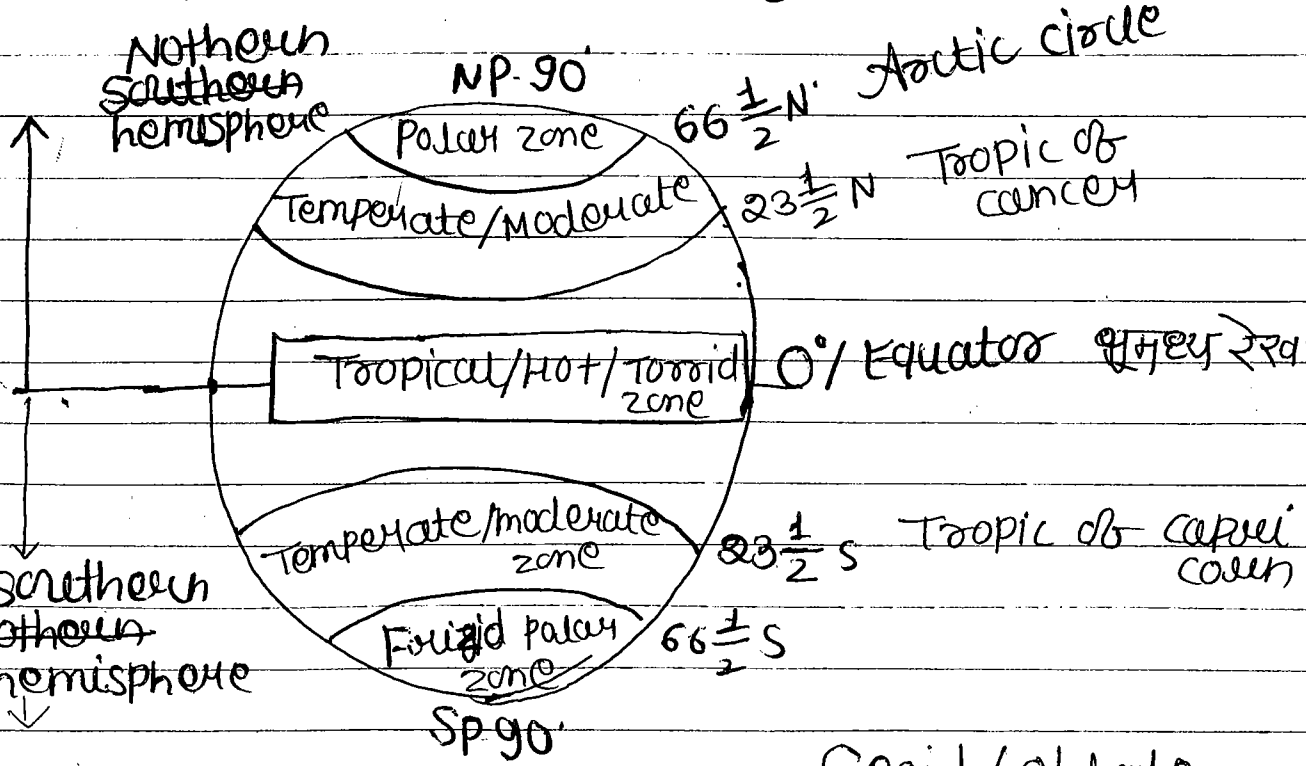
2. Population

- 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 micro organisms
- Thus community forms biotic component of the locality

3. Latitudinal division of earth.



Geoid / oblate

Factor ⇒

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

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 earths atmosphere is endogenous (From interior of earth)

Note – Moon has no atmosphere like that of mercury

- presence of atmosphere it responsible for maintance of Habitable cond'n 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 1st ly discuss as an item of international Agenda in the UN Conference of human environment, Stock holm (Sweden) and thus 5th June is celebrated all over world WED (world environment day) these conference is called as Stock holm declaration.

Rotation
Precession

- on 5th June, india was the host country and theme was ~~bitting~~ Plastic pollution Beating

Ecology -

- German scientist heackle gave the term ecology, it was earlier called by riter as oekology.
- odum gave the term ecosystem development
- Dr. Ramdev mishra (B.H.U) is owned 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.