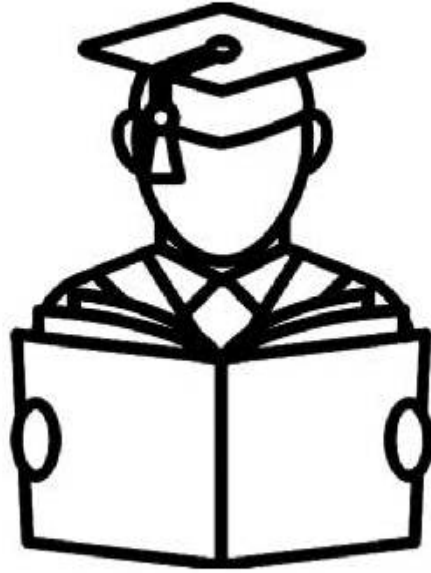


चौधरी PHOTOSTAT

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



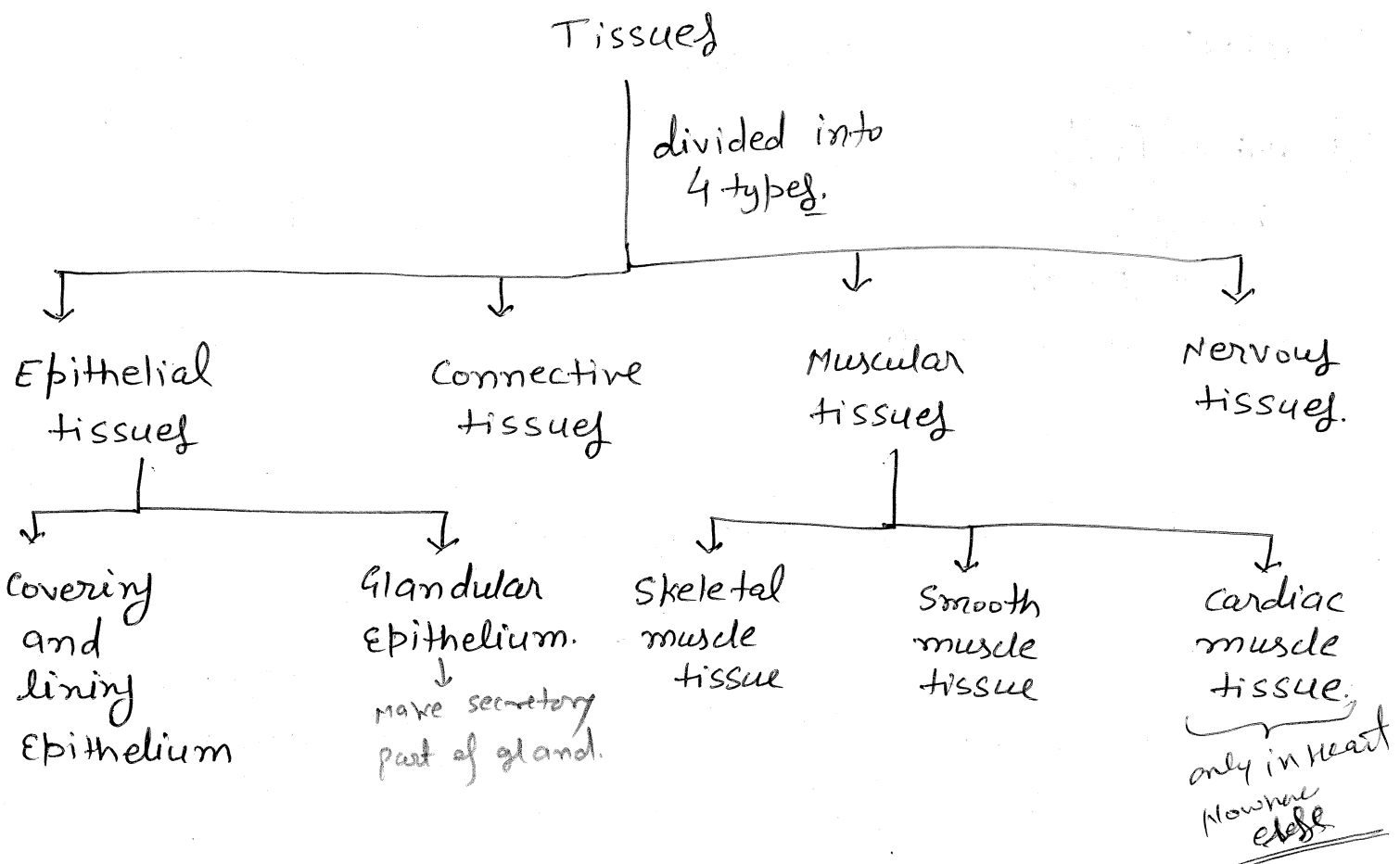
"An investment in knowledge pays the best interest."

Hi, My Name is

Life Science
for CSIR NET
Pathfinder Academy

Tissue ⇒

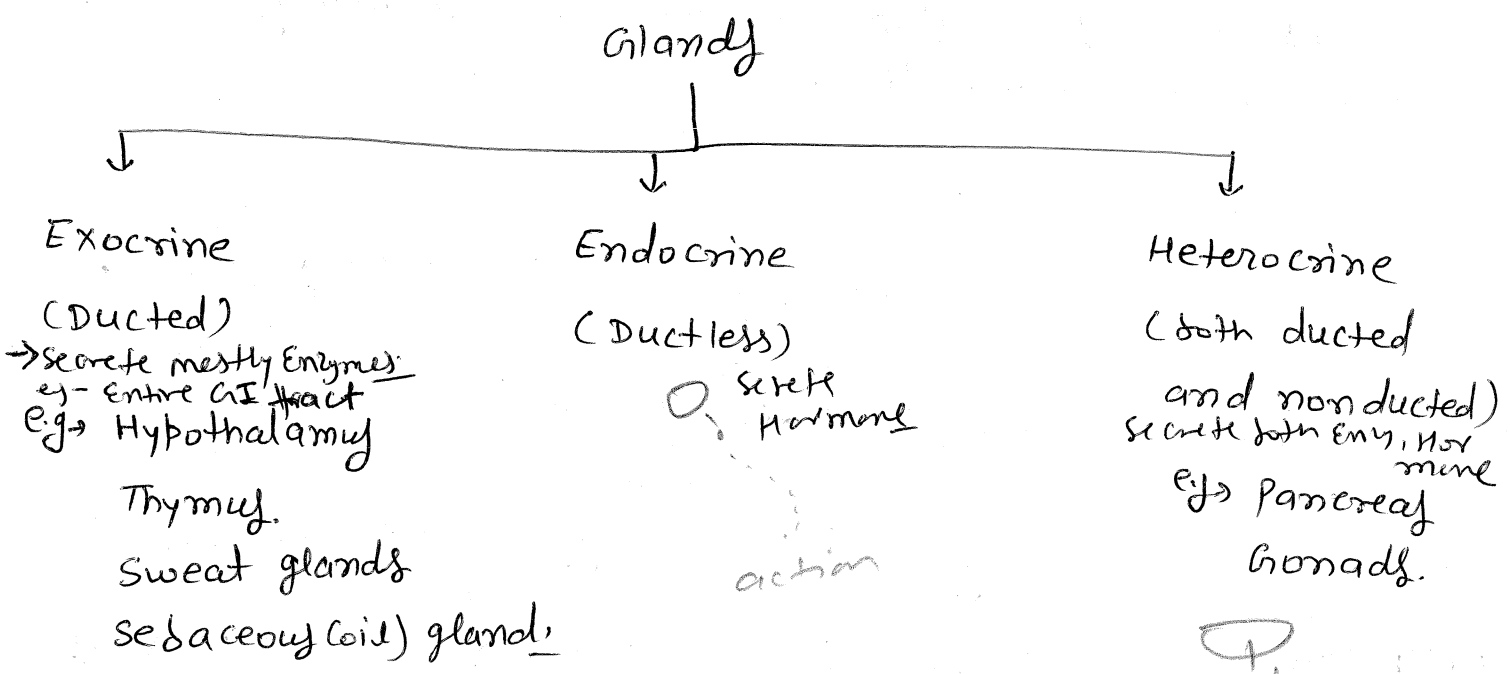
- Group of cells similar in structure and making same function are called tissue.
- >60 % cells are epithelial cells.



① Epithelial tissue ⇒ These tissue consist of cells arranged in continous sheet (may be single or multiple sheet).

- These are also divided into two types.
- Covering and lining epithelium make outer covering of our skin and inner lining of vessels and the interior part of respiratory, digestive, urinary and reproductive system. and function to secretion of mucous and osmosis.
- Glandular epithelium makes secretory part of glands.

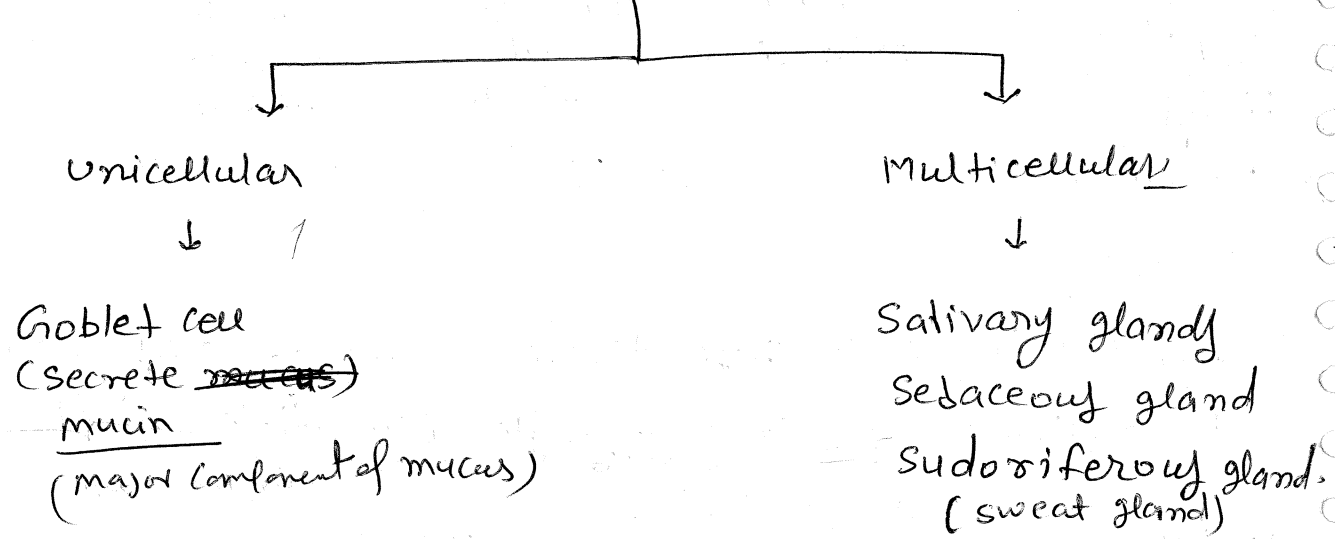
→ Glands are modified epithelial tissues.
→ Liver is largest gland of the body.



action

action

Exocrine glands



scribble

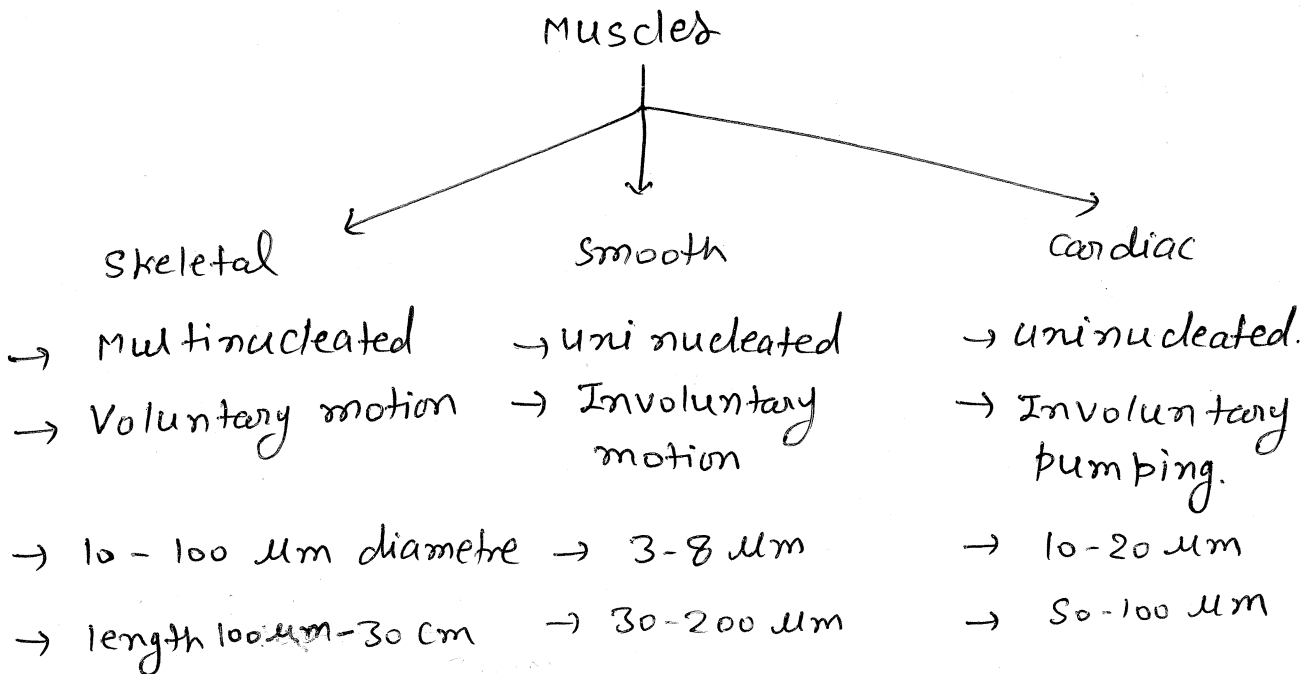
collagen
elastin

② Connective tissue ⇒

- consist of two basic element - cells and ECM.
- ECM is secreted by cells of connective tissue.
- Highly vascular (have blood supply) except in cartilage.
- store Fat Energy (Adipose tissue)

- No blood supply.
- Flexible connective tissue
- cells are called chondroblast
- Found in joints of rib, nose, ear, vertebral disc etc

③ Muscular tissue ⇒ Generate force to body motion.

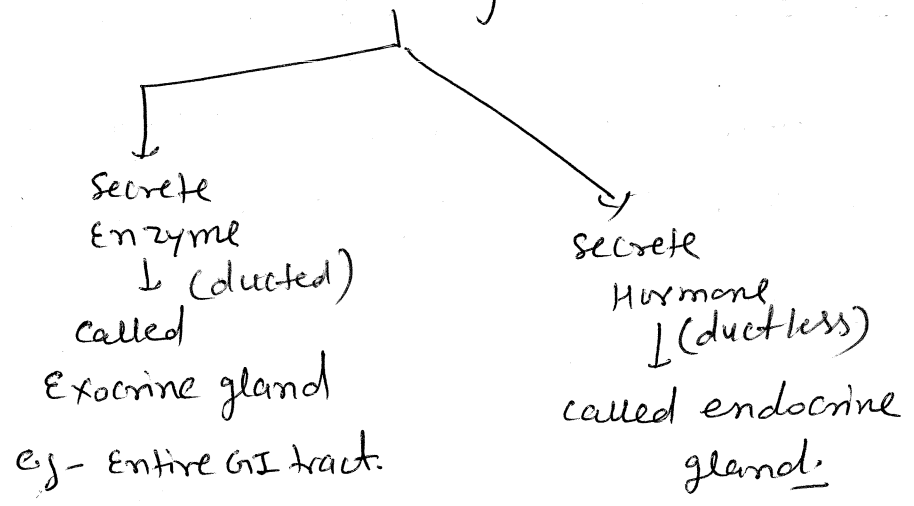


④ Nervous tissue ⇒ consists of neurons and neuroglia.

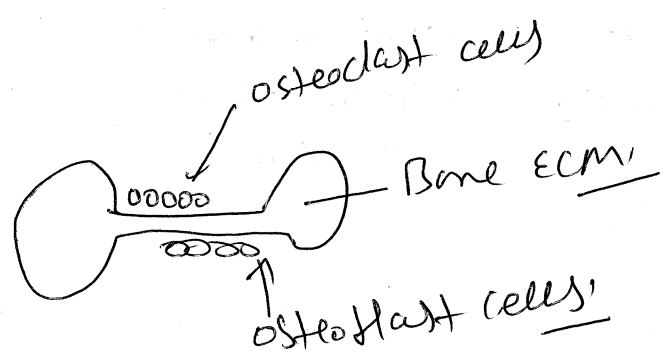
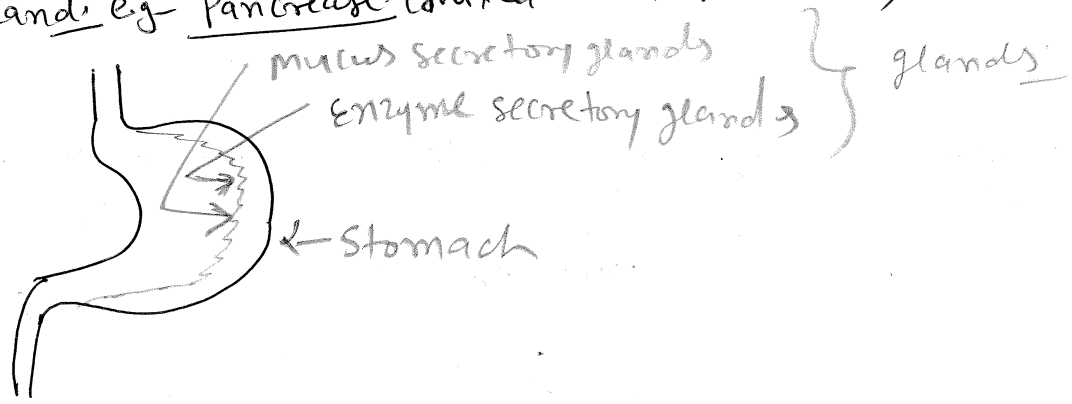
Glands

→ Modified epithelial tissues/cells.

→ ~~individual cell~~ Groups of cells that have secretory function.



→ If a cell/gland can secrete both Enzyme and Hormone is called Heterocrine gland. eg - Pancreas. (Mixed - ducted + ductless)



Carbohydrates

Pramod

→ Mean Hydrates of carbon. $[C_n(CH_2O)_n]$

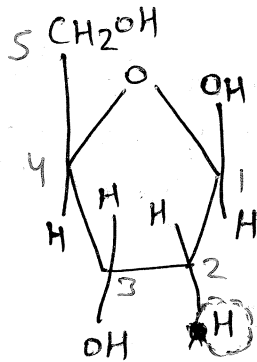
→ But more appropriate to say Polyhydroxy aldehyde or Polyhydroxy ketone. or compounds that can be hydrolysed into them.

→ Major component - C, H, O (Sometimes N, S, P)

→ All carbohydrates are not hydrates of carbon → and some hydrates of carbon are not sugar.

→ $C_2H_4O_2$ (Acetic Acid) } these are hydrates of
 $C_3H_6O_3$ (Lactic acid) } carbon but not carbohydrates
 $[C_n(CH_2O)_n]$ ←

→



β -D-~~Deoxy~~ribose
(lack of O)

$C_5H_{10}O_4$ - Not Hydrate of carbon but sugar

Rhamnose →

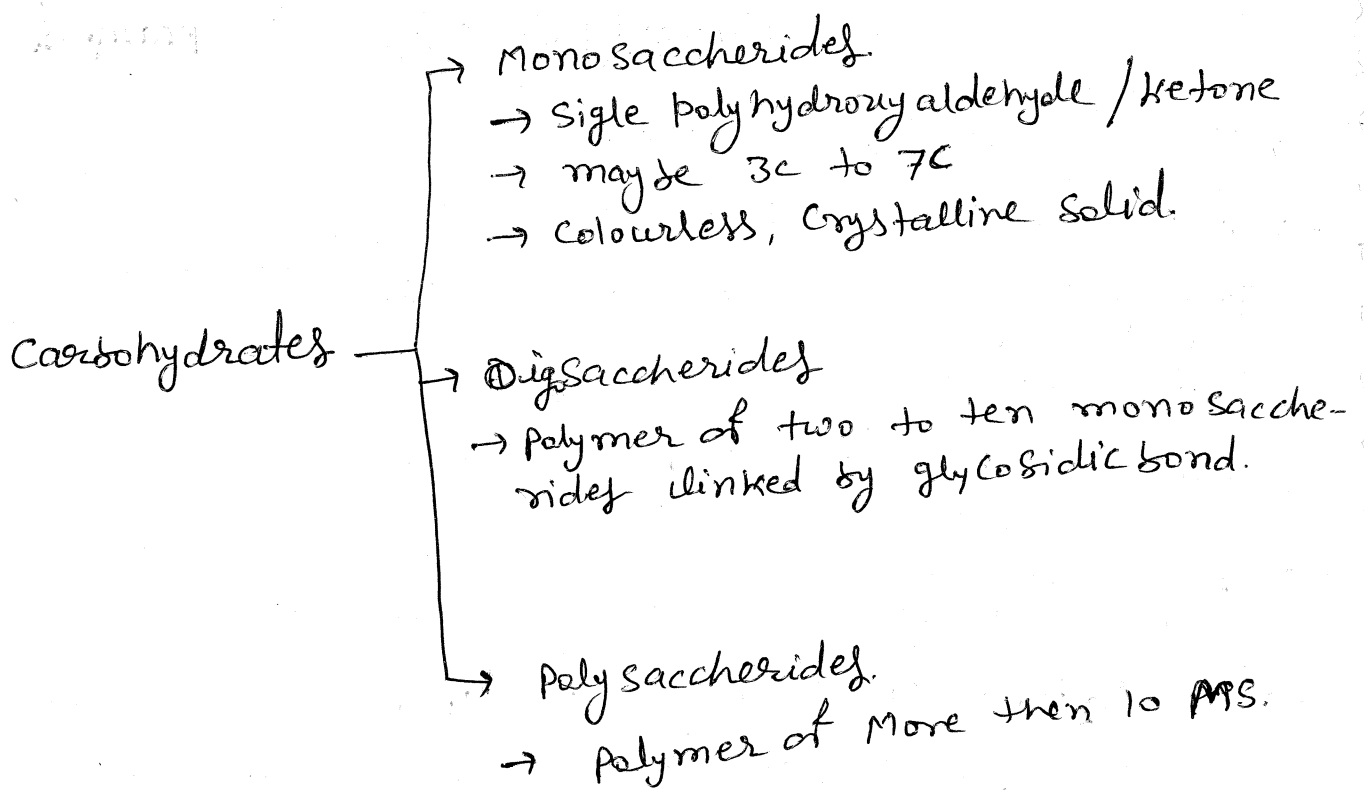
$C_6H_{12}O_5$ not Hydrate of carbon but sugar.

→ In case of Ribose at 2nd no. carbon OH group is at the place of H at C-2.

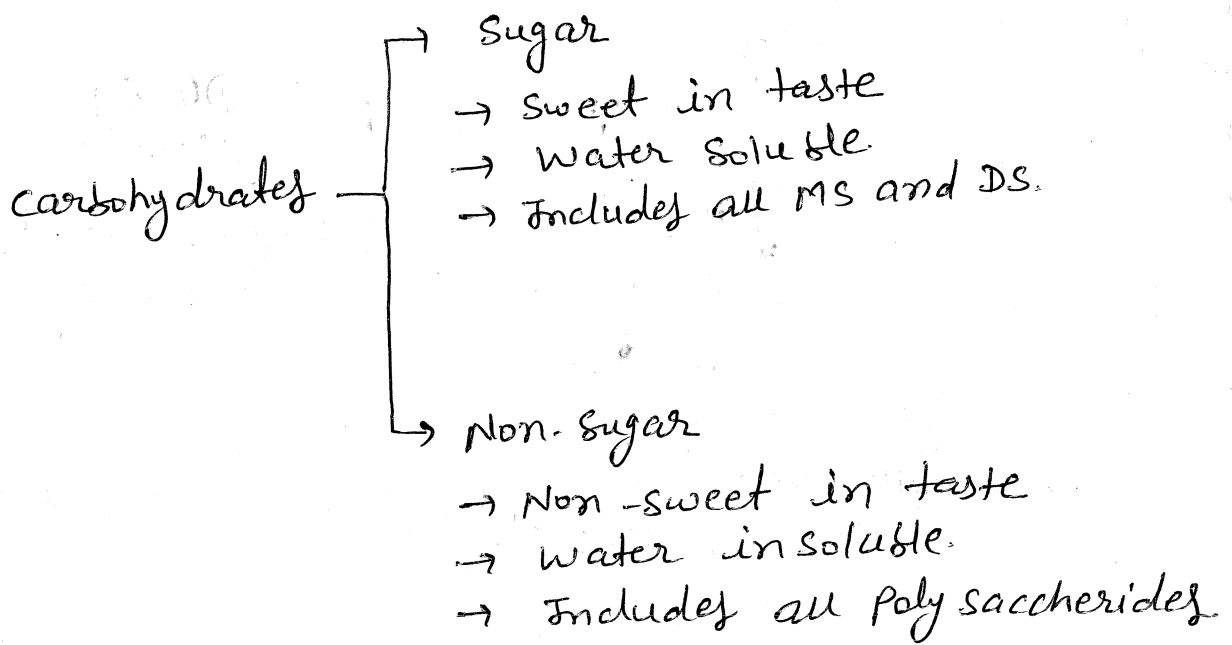
→ These Gives 4 cal/gm.

→ Study of carbohydrates is called Glycobiology.

→ carbohydrates are most abundant biomolecules on earth (mostly cellulose)



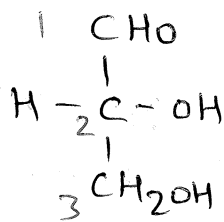
- The most abundant monosaccharide in nature is Glucose
- In oligosaccharides mostly disaccharides are found.



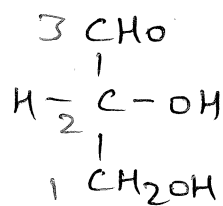
Q. Maize is PS but when we eat sweet corn it gives sweet taste why?

ans By boiling of maize PS are degraded into monosaccharides and gives sweet taste

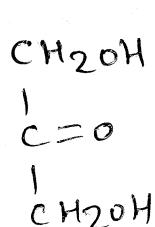
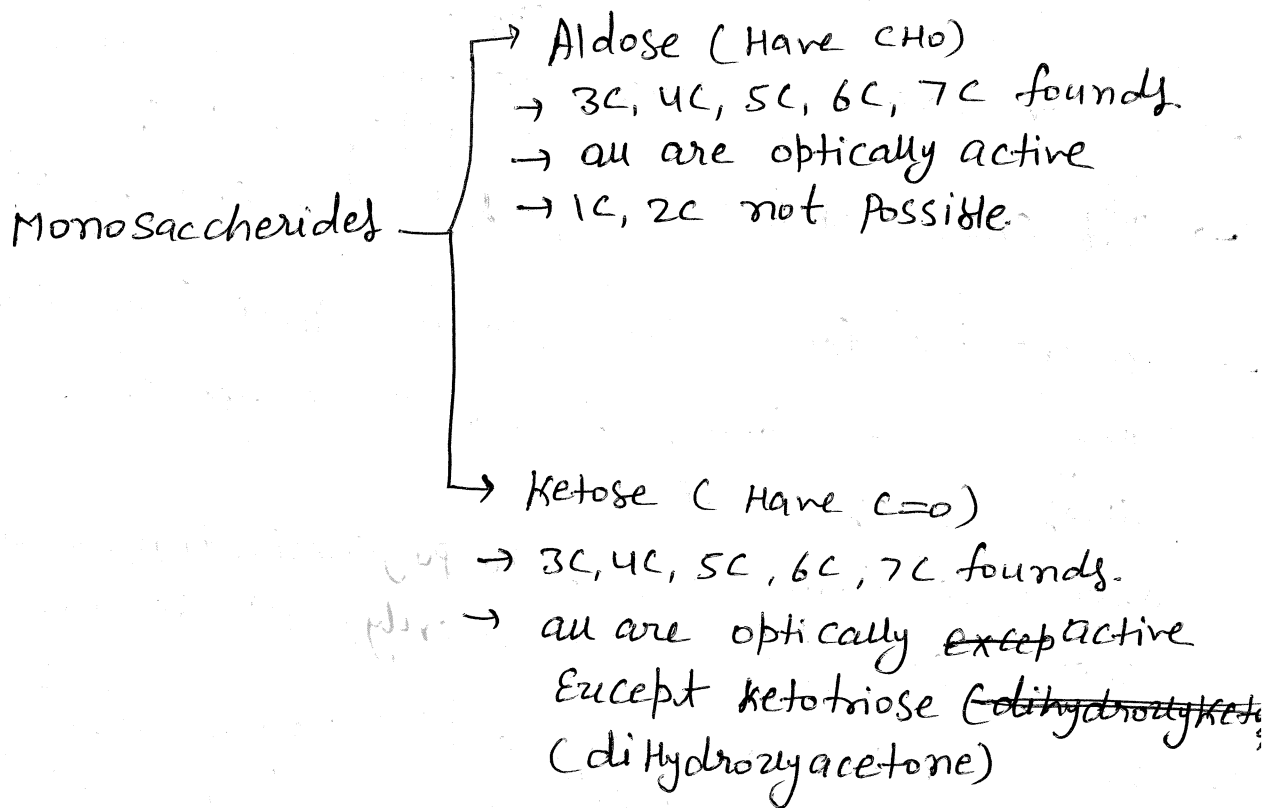
- Aldoses are monosaccharides with an aldehyde group (C=O)
- Ketose are monosaccharides with a ^{ketone} ~~ketose~~ group (C=O)
- All MS and DS have suffix -ose.
- In the numbering of carbon in carbohydrates we give minimum possible no. to ketose group or aldehyde group carbon.



Correct



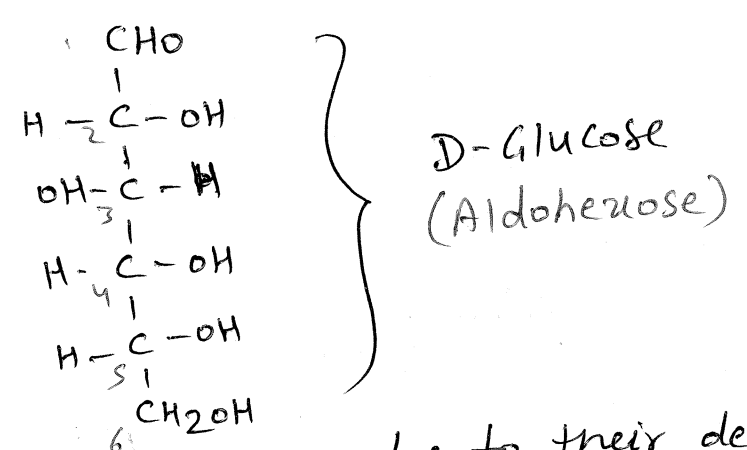
In correct



} Dihydroxy acetone (ketotriose)
 → Not any chiral carbon.

→ Glyceraldehyde (aldotriose) is considered as simplest carbohydrate and taken as reference.

- In optical activity of carbohydrates OH group is taken as reference but in aq. NH_3^+ group is taken as reference.
- If in an structure more than one chiral carbon are present then we take second last carbon (or last chiral carbon) as reference for D & L form detection.



- In lab glucose is called dextrose due to their dextro-rotatory property.
- D, L shows optical activity but d, l shows optical rotation.
- 3C, 4C, 7C forms never form cyclic structure.
- only 5C, 6C forms found in cyclic stru. when gives aqueous medium.
- only cyclic form can go to polymerization. So in polysaccharide or oligosaccharides only 5C, 6C forms are present.
- In 3C ketose not any chiral carbon present but in 3C aldose one chiral carbon is present.
- So always same carbon containing aldose sugar have one more chiral carbon than ketose sugar.

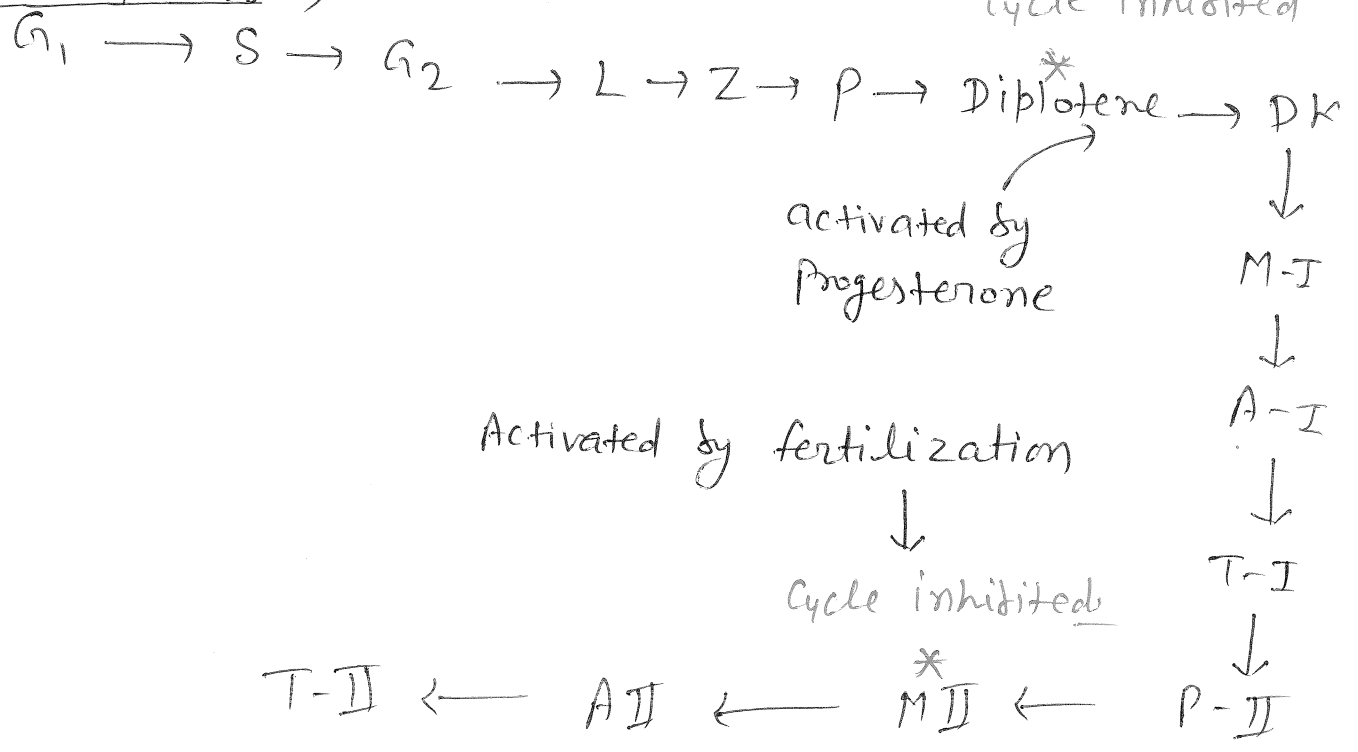
chiral / asymmetric carbon \Rightarrow carbon atom have tendency to attach with max 4 atoms and when all four attached atoms are different it is called chiral carbon or groups.

chiral molecule \rightarrow develop two form $\left\{ \begin{array}{l} \text{If mirror image - enantiomers} \\ \text{If not mirror image - diastereoisomers} \end{array} \right.$

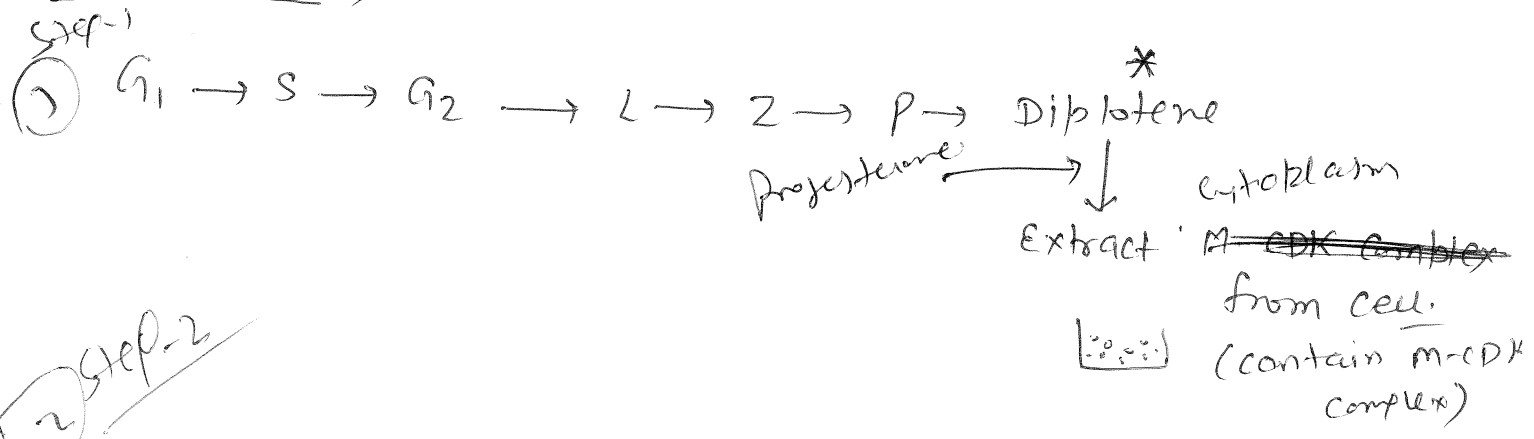
masui ^{markert}
~~Masui~~ and ~~Markert~~ Experiment \Rightarrow 1971

- \rightarrow To discovery of MPF (m-CDK)
- \rightarrow Study ~~Meiosis~~ in Female Frog (Xenopus laevis)
 oocyte maturation (~~by meiosis~~)
 \rightarrow by meiosis

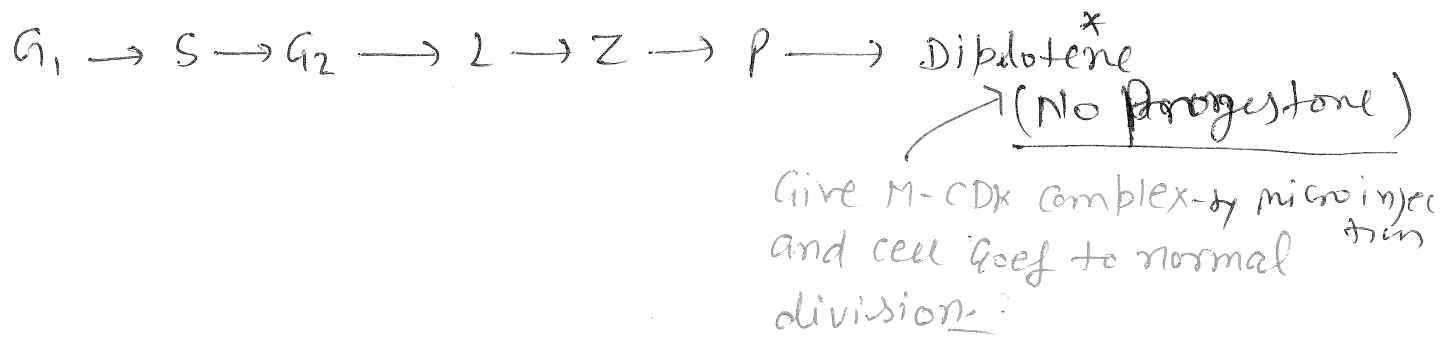
Normal Process \Rightarrow



Experiment \Rightarrow

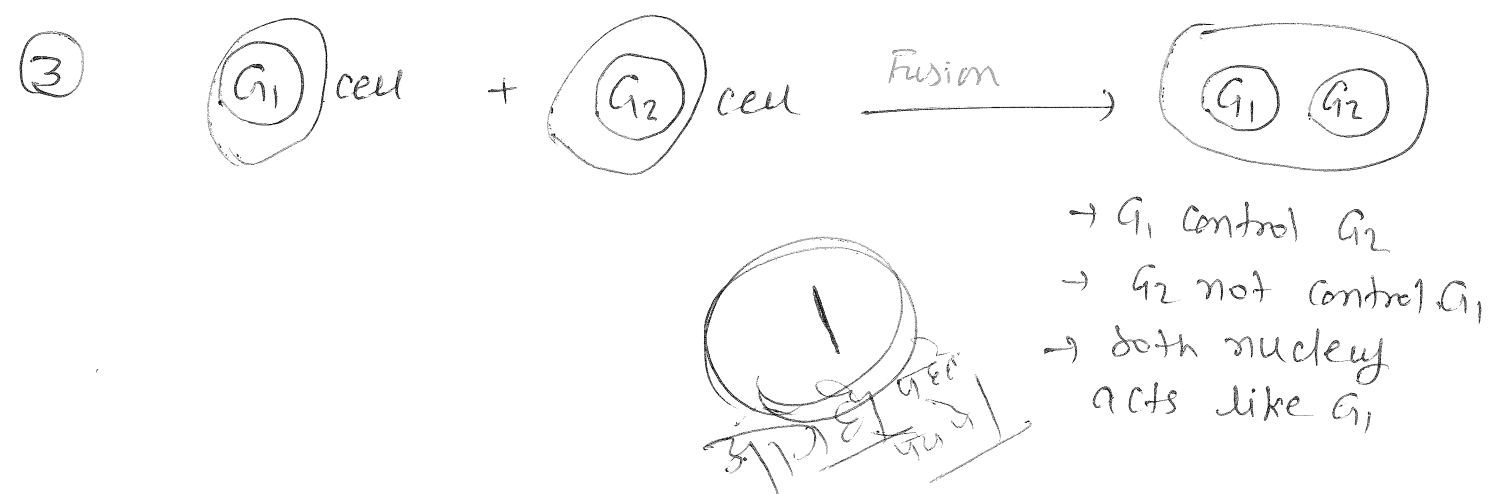
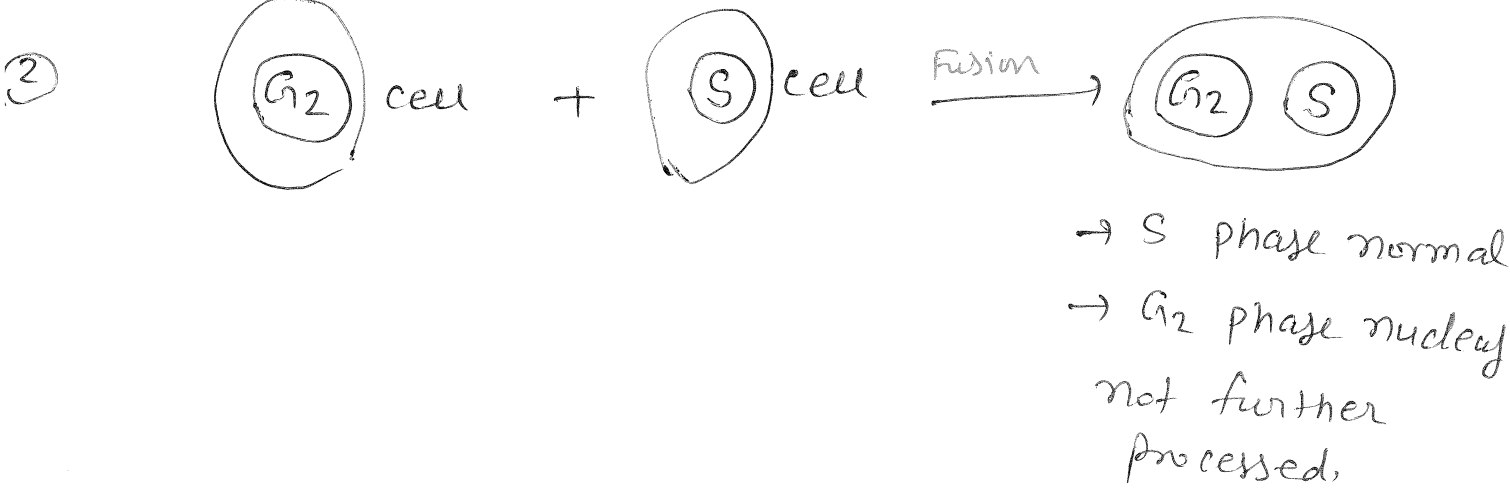
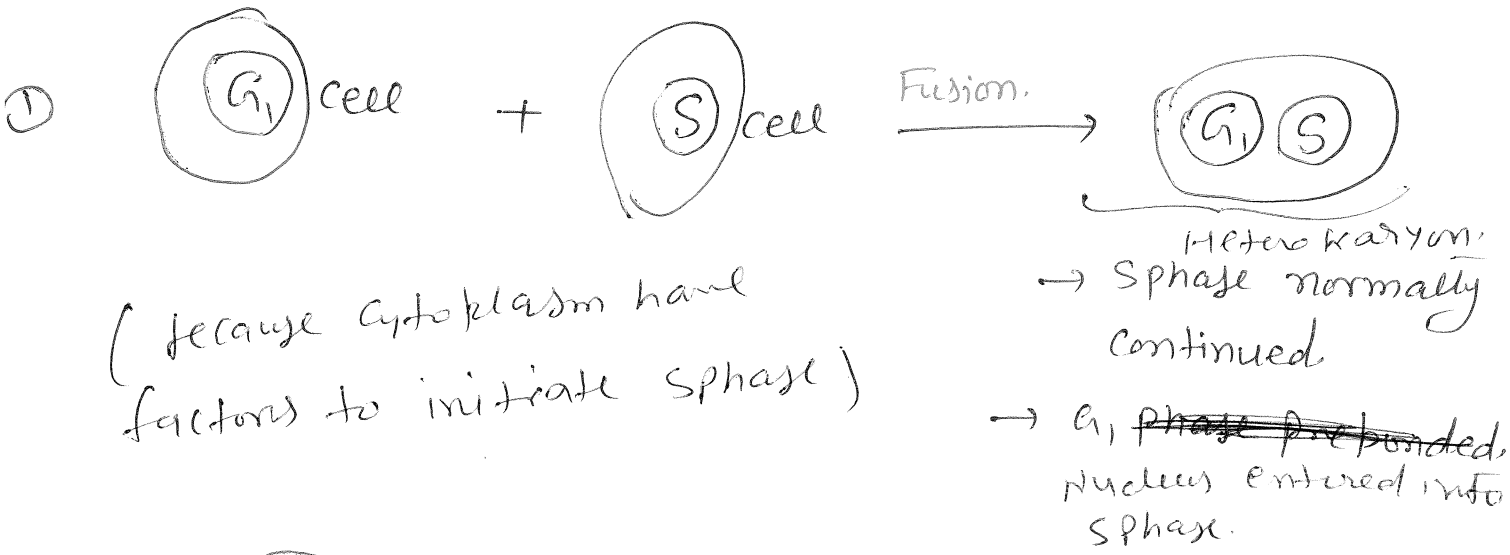


Step-2



Cell-fusion Experiment ⇒

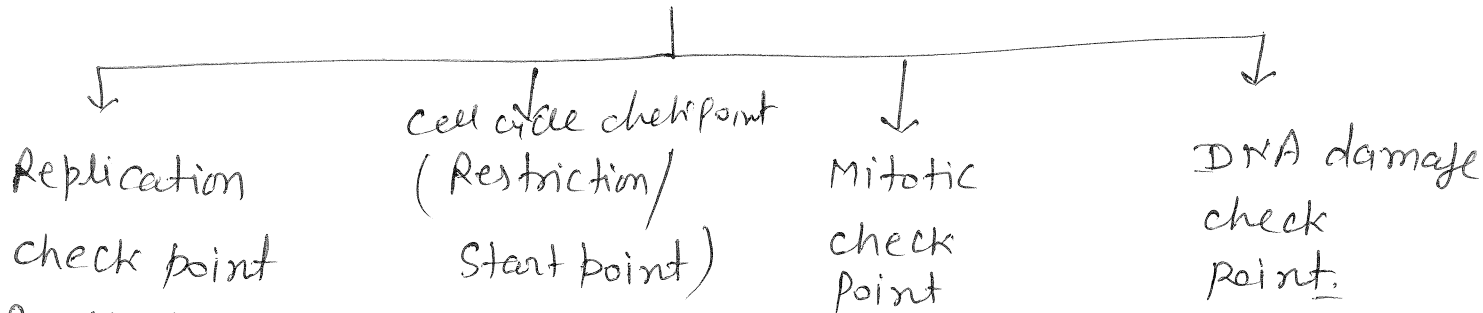
- Done by Roh and Johnson in 1970
- used inactivated Sendai virus to fusion of ~~two~~ cell results one cell with one nucleus from each cell and cytoplasm from both. resultant is called Heterokaryon



Result ⇒ cell cycle is regulated process.

check points \Rightarrow Found between cell cycle to ~~check~~ ensure that complete and proper DNA is transferred into daughter cells.

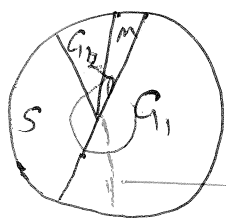
\rightarrow Hypothesized by Hartwell and Weinert.
check points.



Replication check point \Rightarrow Confirm that replication process is completed normally.

Restriction / start point \Rightarrow

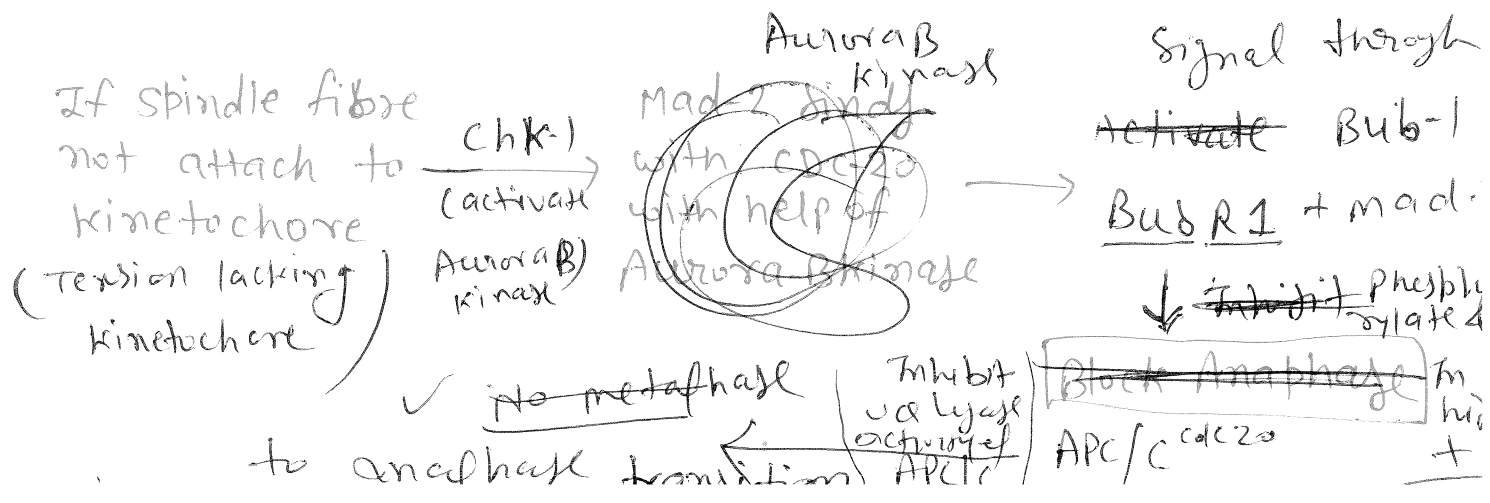
\rightarrow Found in late G_1 phase.



Restriction point \rightarrow In vertebrates
Start point \rightarrow In yeast

Mitotic check point \Rightarrow (spindle assembling check point.)

\rightarrow In this it is checked that spindle fibres formed and attached to chromosome.



DNA damage check point \Rightarrow check DNA damage in all phase. check point are at: -

\rightarrow G₁/S check point

\rightarrow Intra S check point

\rightarrow G₂/M check point.

\rightarrow If DNA damage is found it first tried to repair. If repaired then cell cycle further proceeds if not then cell induces for apoptosis.

Ecology ⇒

→ Termed by Ernst Haeckel (mean- Life at Home)

Eco = oikos = Home (Habitat)

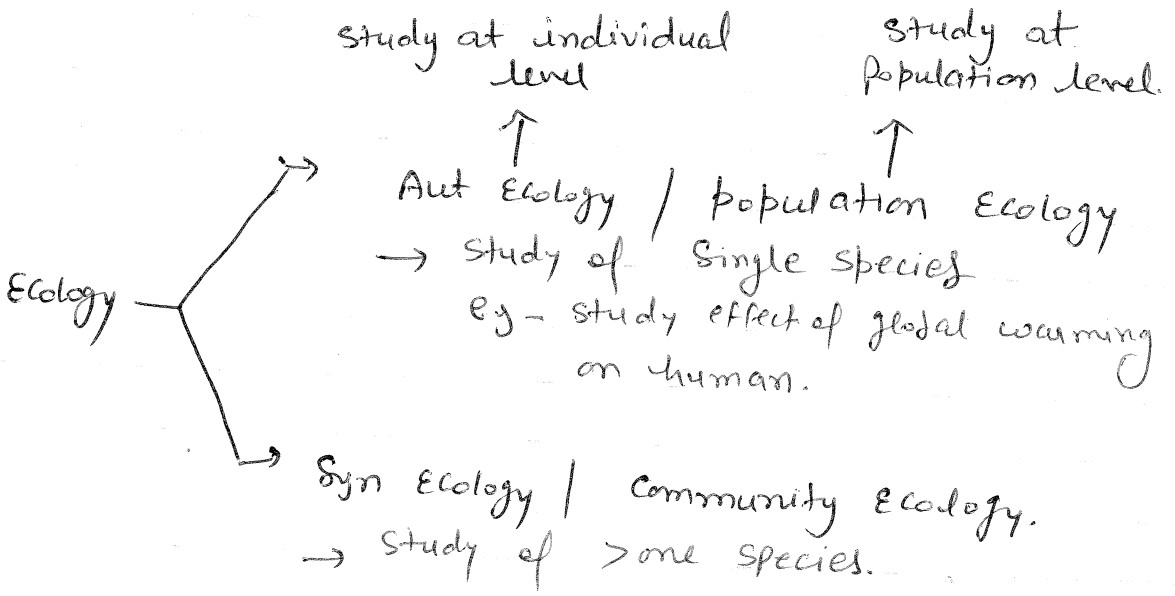
logy = Logos = Study

~
Greek words.

→ Study of Interactions between organism with their surrounding Environment (Have both biotic and abiotic component)

Father of Ecology — Reiter

Father of indian Ecology — Prof. Ram deo Mishra. (BHU)



① Ecological Hierarchy (Level of organization) \Rightarrow

Individual \leftarrow Population \leftarrow Community \leftarrow Ecosystem \leftarrow Landscape
 \leftarrow Biome \leftarrow Biosphere

Individual -

- \rightarrow Minimum level of organization
- \rightarrow Represent a single organism (plant/animal/bacteria)

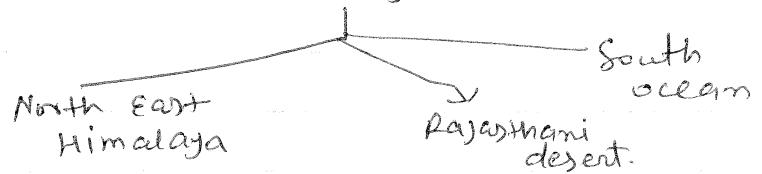
Population - Group of individuals of same species, at particular place, at particular time.

Community - Group of interacting individuals of all species in a specified geographical area.

Ecosystem - Have more than one community (biotic factor) interacting with abiotic environment
 \rightarrow structural and functional unit of Ecology.

Landscape -

- Group of different Ecosystems surrounded by a natural boundary.
- e.g. - India with diff. Ecosystems.



Biome - Large Group of plants and animals living together in a large climate zone called biome.
e.g. - Forest, Grassland, Coniferous forest

Heredity \Rightarrow Mechanism of transmission of characters³ from parents to offspring is called Heredity / Inheritance

Genetics \Rightarrow Scientific Study of heredity is called Genetics.
 \rightarrow Termed by Bateson.

Mendelian genetics \Rightarrow

\rightarrow Mendal is known as father of genetics. In 1856 he published their hybridization experiment results those were ignored by scientists.

\rightarrow In 1900 work of mendal was independently rediscovered by three biologists Hugo de vries, car Correns and Erich Tschermak.

\rightarrow Mendal did experiment on Garden pea (*Pisum sativum*) which is a bisexual plant. He study 7 characters.

	<u>Dominant</u>	<u>Recessive</u>
\rightarrow seed shape	Round	wrinkled.
\rightarrow seed colour	Yellow	Green
\rightarrow Flower colour	violet	white
\rightarrow Pod (荚) shape	Full	Constricted
\rightarrow Pod colour	Green	yellow
\rightarrow stem height	Tall	dwarf

\rightarrow Flower position.

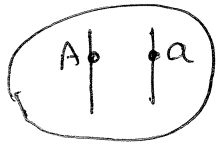
Axial



| Terminal



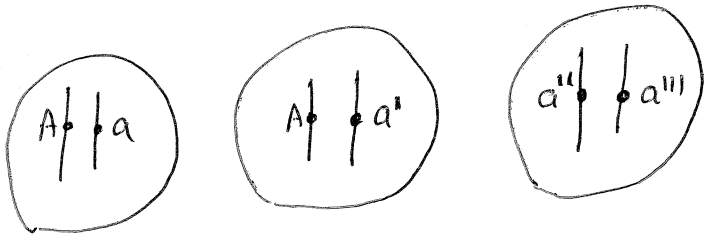
Allele \Rightarrow Alternative forms of a gene present on the same locus are called allele.



Multiple Allele \Rightarrow In a diploid cell maximum two allelic forms of a gene can be found. But when we study it in large population we found several forms of a gene combinedly called multiple alleles.

e.g. \rightarrow ~~ABO blood group~~,

\rightarrow The set of multiple alleles in population is called allelic series.



allelic series \rightarrow A, a, a', a'', a'''

Multiple genes \Rightarrow When same proteins are coded by diff. genes (on diff. locus) are combinedly called multiple genes.
like - Isozyme coding genes.

Phosphoglucomutase \rightarrow In *Helianthus debilis*



coded by 2 Nuclear & 2 chloroplast gene

Wild Type and Mutant type ⇒

- Alleles common in population is called wild type.
- Alleles uncommon in population are called mutant type.

Dominant and recessive allele ⇒

- That allele which suppress the function of another is called dominant allele.
- And that allele who is suppressed by dominant is called recessive allele.

Complete dominance ⇒

- When in cell dominant gene is completely expressed and recessive gene is completely suppressed.
- Mendel supposed only two allelic form of gene giving two discrete class of result. This pattern of genes is also called major genes or oligogenes.

Incomplete dominance / partial dominance / semi dominance \Rightarrow

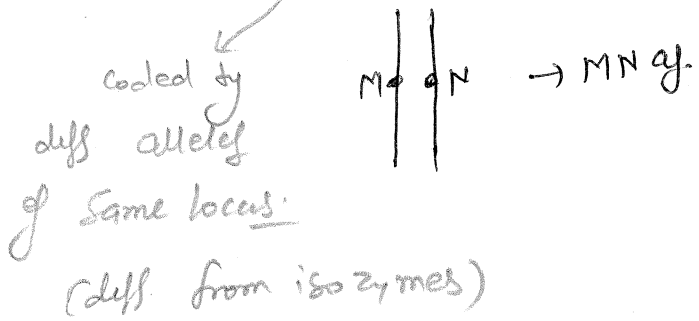
\rightarrow When recessive allele is not totally suppressed.

$RR \rightarrow$ Red
 $Rr \rightarrow$ Pink
 $rr \rightarrow$ white.

} Flower colour of
Mirabilis Jalapa
and
in dog flower (Snapdragon)

Codominance \Rightarrow Both allelic forms are equally dominant.

eg \rightarrow Allozymes, MN blood group.



overdominance \Rightarrow when due to both allele (heterozygous) the character is over expressed.

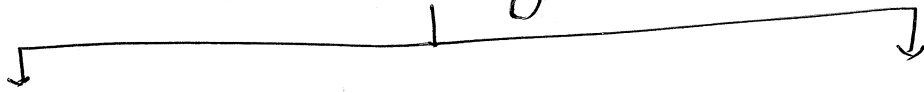
$R \parallel R \rightarrow$ Red

$R \parallel r \rightarrow$ dark Red

Immunology ⇒

- Immunology is study of immune response towards pathogens and foreign challenges. ~~is called Immunology~~
- 'Immunology' is derived from latin word 'immunis' means exempt (state of protection between pathogens)
- System work in two step recognition and response.
- Response is of two types effector and memory response
- derived from
- Response given first time to ag. is called primary or effector response and next time to same ag. response is called memory response.

Immunity



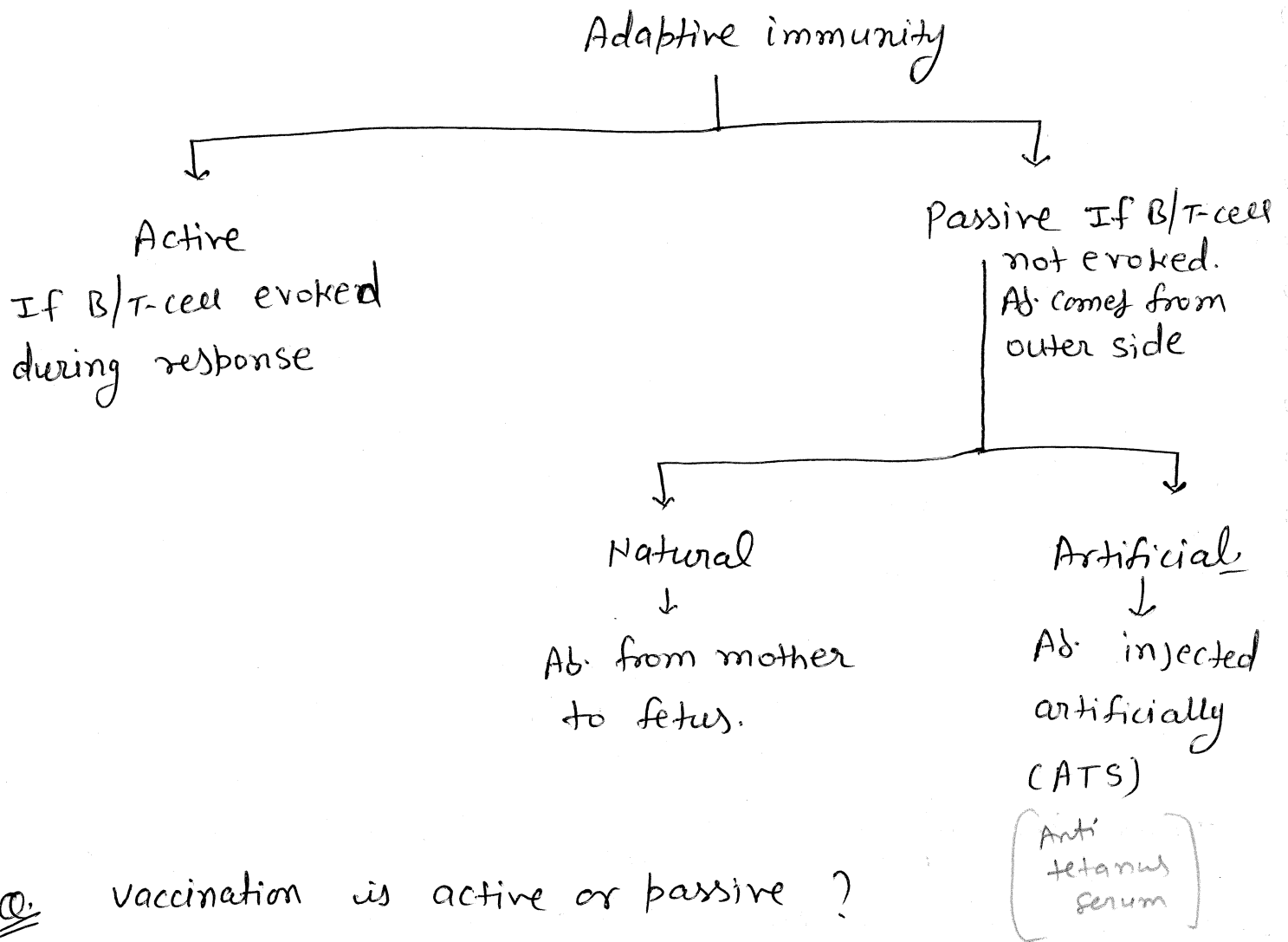
Innate immunity / native / natural

- Develops before the birth
- In both vertebrate / Invertebrate
- First line of defense
- Non specific for ag.
- Fast response
- Less diverse
- No immunological memory
- can't find self / Nonself

Acquired / Adaptive immunity

- develop after the birth.
- only in vertebrate.
- Second line of defence.
- specific for ag.
- slow response
- Highly diverse.
- Immunological memory found.
- Have self / non self recognition

→ If B-cell (Ab. forming) or T-cell (TCR-forming) are involve² then response is Adaptive otherwise Innate.



Q. Vaccination is active or passive ?

ans → Active immunity.

Herd immunity ⇒ In this a part of population (called herd) is immunized by vaccination so in remaining also infection chance will be decreased. This does not applied for all disease.

Historical Experiments ⇒

3

Thucydides (430 BC) ⇒ Told that only those people which recovered after infection of plague can nurse patients of plague. because they can't infected second time.

chinese and Turks ⇒

→ Induce immunity by variolation (Insert dry crusts of smallpox) postulated in nostrils or insert in cut of skin. outer surface
opening of NOSE

Edward Jenner (1798)

- Reported that milkmaid contacted with cowpox also become resistant to smallpox.
- Jenner take serum from milkmaid and inject into 8 yr. old boy and he became resistant to both disease.

Louis Pasteur → ^{using} domestic bird / cock.

4

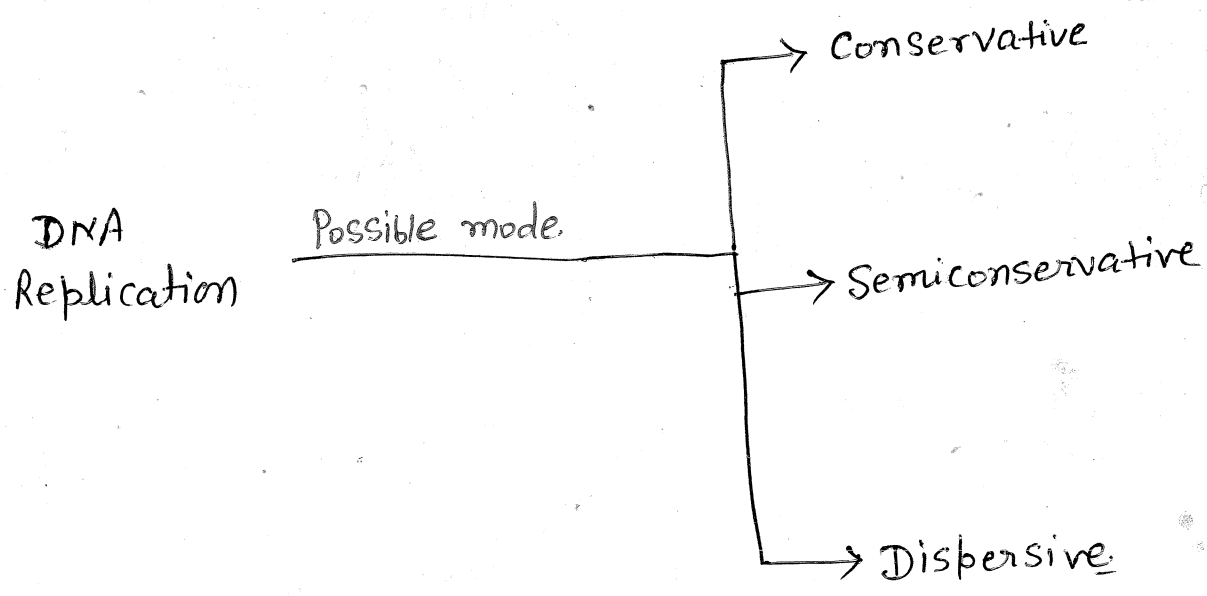
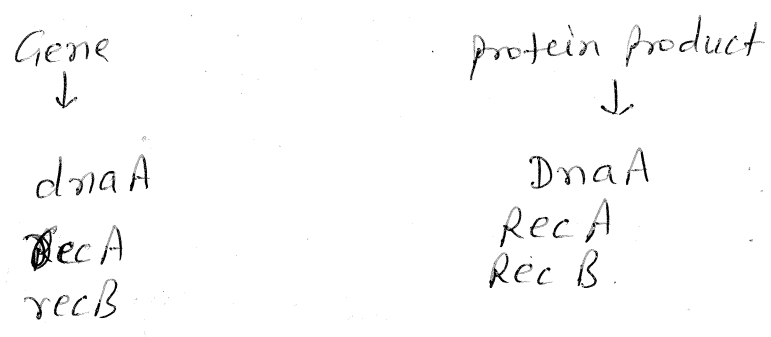
- Take culture of fowl cholera.
- give to chickens they got infected.
- But when same culture after 10 days given to another group of chickens they not get infection.
- He told that aging done weakened of virulence of it and it used as vaccine.
- In 1881 He make first vaccine by heat attenuated Bacillus anthracis for sheeps.
- The first human vaccine was also developed by Pasteur for Rabies.

Q. cellular immunity discovered earlier but not developed on that time, why?

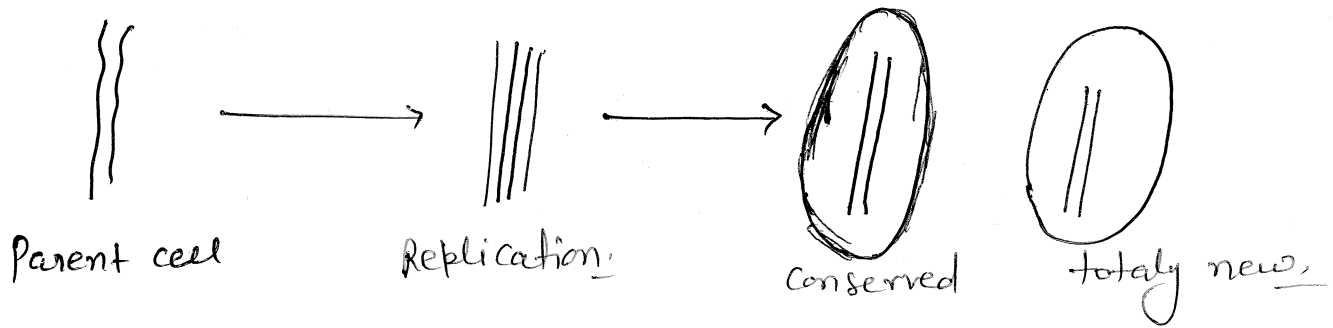
ans) due to lack of tissue culture technique.

DNA-REPLICATION ⇒

- In E. coli 160 genes are involved in DNA replication and repair which encode various proteins essential for replication.
- Whole E. coli genome is mapped and divided in 100 minutes in which 1 minute corresponds to 140,000 bp.
- Genes are mostly shown by lowercase (small) italic letters like dna, rec, uvr.
- In dnaA, dnaB, dnaC like naming of gene sequence reflect the order of discovery (not reaction sequence).
- Protein products are shown by making first letter in uppercase (capital) like RecA, DnaA, DnaB protein.



Conservative \Rightarrow In this both strand of chromosome acts as template for other copy and by which one chromosome remain same in progeny and another totally new synthesized. This type of replication called conservative.



Dispersive \Rightarrow In this some part of chromosome become conservative and some part become non-conservative.

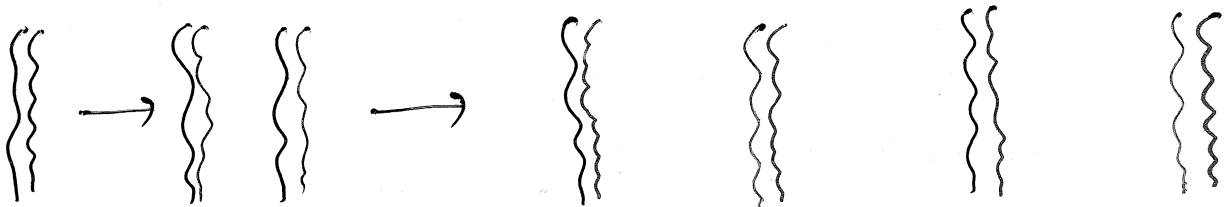
\rightarrow In this case size of chromosome ~~is~~ may ~~be~~ increase.



\rightarrow In this DNA first fragmented then goes to replication by conservative or semiconservative method and then reassembled.

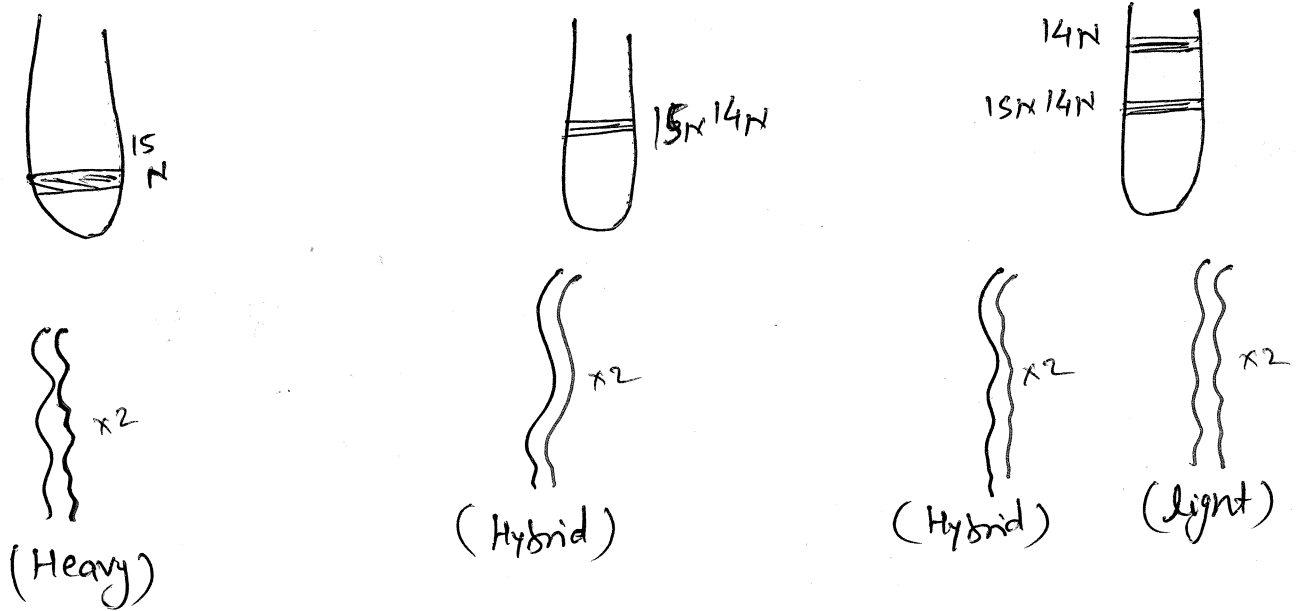
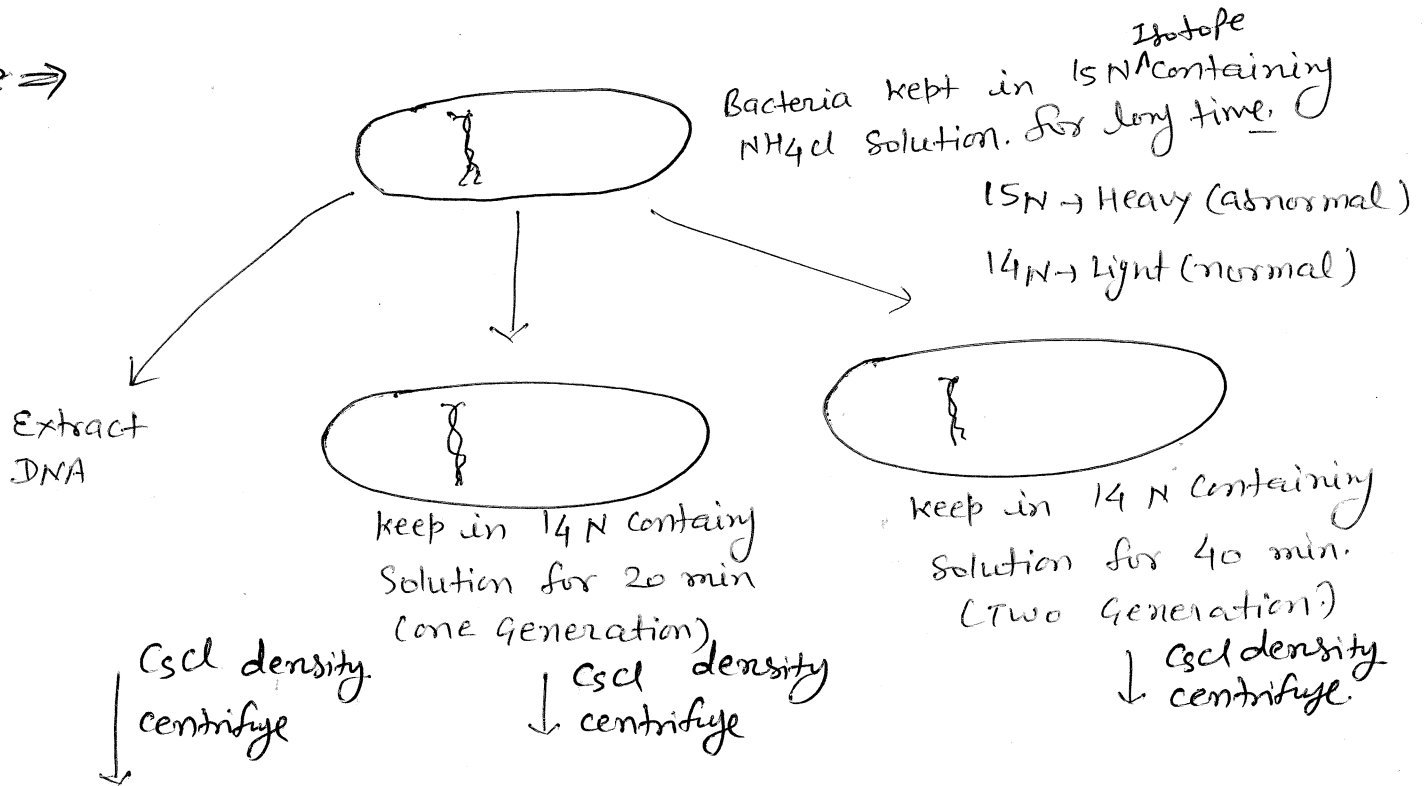
\rightarrow The resulting chrom have some place with both strand conservative, both strand non conservative and some fragment of Hybrid also.

Semiconservative \Rightarrow In this in daughter cell one strand of chromosome is parental and second is newly synthesized.



→ Watson and Crick proposed Hypothesis of semiconservative DNA replication in 1953 which experimentally proved by Meselson and Stahl in 1957.

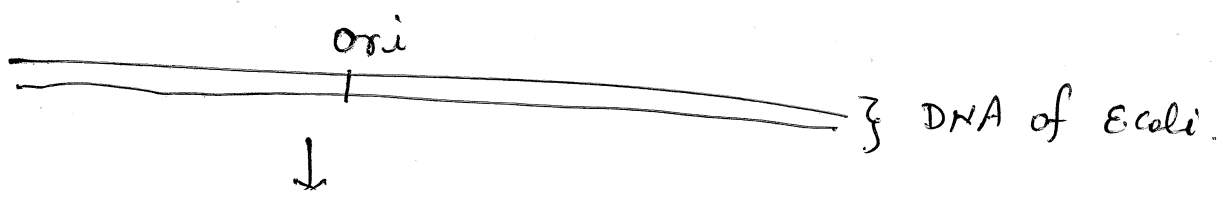
Exp ⇒



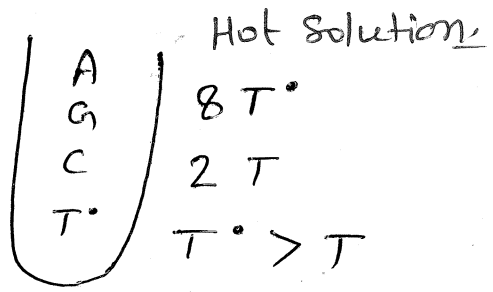
→ Here they use N with diff. density (not with radioactivity)

→ The ~~dec~~ DNA with heavy N have ~1% more density compare to DNA with light Nitrogen.

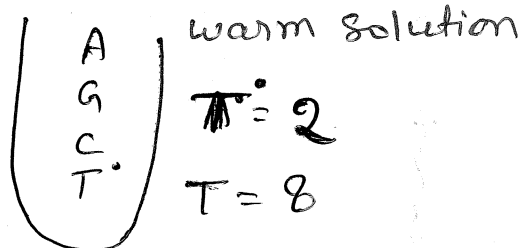
- John Cairns first make experiment that proved that nature of replication is bidirectional (mostly). called pulse labelling exp.
- He use autoradiography and make radioactive DNA by using Thymidine that are radiolabeled with tritium (3H)
- He use thymidine because its present only in DNA not in RNA.



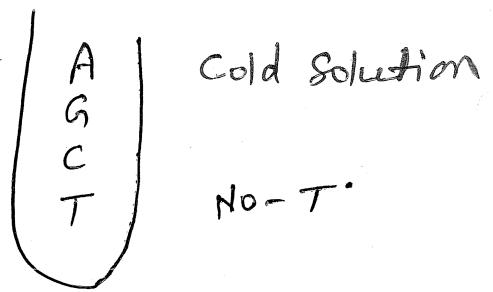
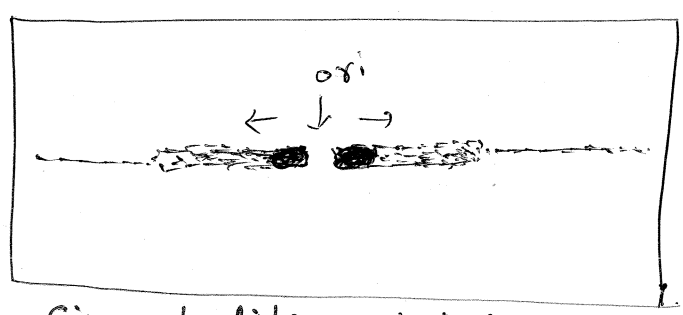
Transfer E. coli cell in Hot medium for first 10 minutes.



After 10 minutes transfer to warm/cold solution



do autoradiography



Silver halide containing photographic plate.
(Pulse labelling exp.)

RDT / Genetic engineering

→ Recombinant DNA means ~~for presence of foreign gene~~ alteration of natural gene sequence

→ First recombinant DNA was ~~made~~ developed by Paul Berg (Father of RDT) ^{using} λ -Phage (ds-linear) and SV-40 (ds-circular) without using restriction Enzymes in 1972.

→ Later Herbert Boyer discovered restriction Enzymes in E-coli and other side Stanley Cohen developed method to remove plasmid from bacterial cell and transfer in other cell (1969) @ genome

→ Then Herbert Boyer and Stanley Cohen made other recombinant by adding antibiotic resistⁿ gene and S. typhi plasmid into in 1973 with help of no enzyme & DNA ligase

→ Biotechnology deals with techniques that use living organism or their product in human and environmental welfare. ex. bread, wire, cord to transistors, traditional breeding ①

→ When we done Hybridization for crop improvement we found that some undesired gene also pass to progeny with desired genes. RDT can overcome this problem.

① But now biotech is used only for GMOs or related works like In vitro fertilization (test tube baby), gene therapy, transgenic etc.

Biotech as per EFB (European federation of biotechnology) — The integrati^on of natural science and organisms, cells, parts thereof and molecular analogues for products and services.

10^5 — one lakh

10^6 — 10 lakhs — one million

10^9 — one ~~hundred~~ billion

10^{12} — one trillion

10^{15} — quadrillion

10^{18} — quintillion

cloning - making multiple identical copies of any template
DN/A.

→ For large scale production mostly continuous culture is done
(adding media ~~contin~~ in time to time)

Bioreactor ⇒

- also called large volume flask (100-1000 Ltrs)
- used to large scale production
- Have pH, temp, pressure, air controlling system
- use agitator/stirrer to ↑ surface area, ~~for~~
- Some have Gas bubble system to ↑ O₂ transfer area
- most commonly used are of stirring type.



- Finger Prints ~~of two~~ individuals are developed due to touching of fingers by mother @ tract during embryonic development. So they are ~~never identical~~ & random.
- So no chance to be same even in twins. So for crime detection the twins finger printing is useful.

1

①

stirred tank bioreactor

- Have curved base to facilitate mixing.
- stirrer facilitate O_2 availability

throughout bioreactor.

→