

चौधरी PHOTOSTAT

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



"An investment in knowledge pays the best interest."

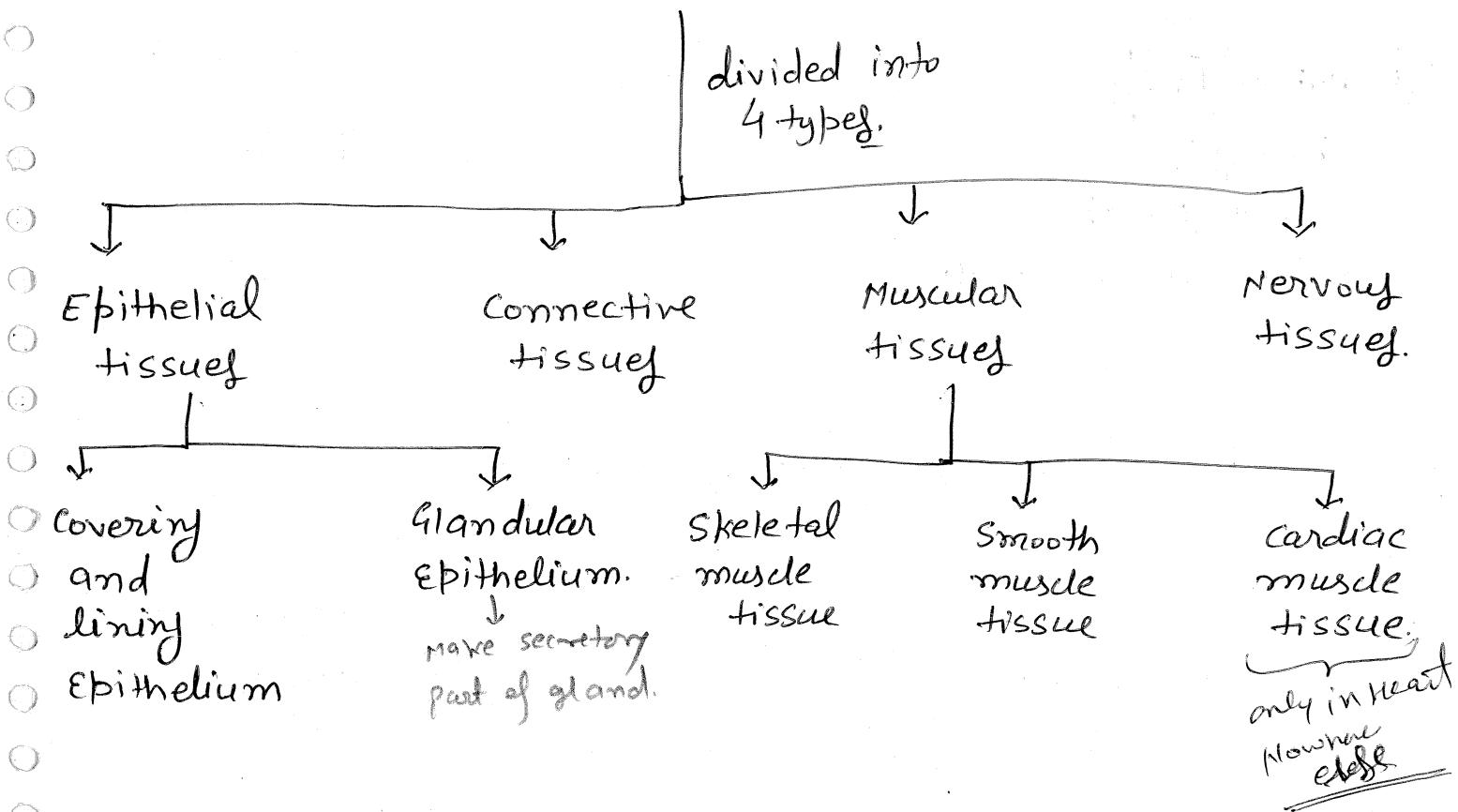
Hi, My Name is

Life Science
for CSIR NET
Pathfinder Academy

Tissue ⇒

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

Tissues



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

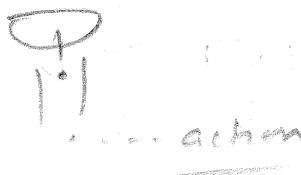
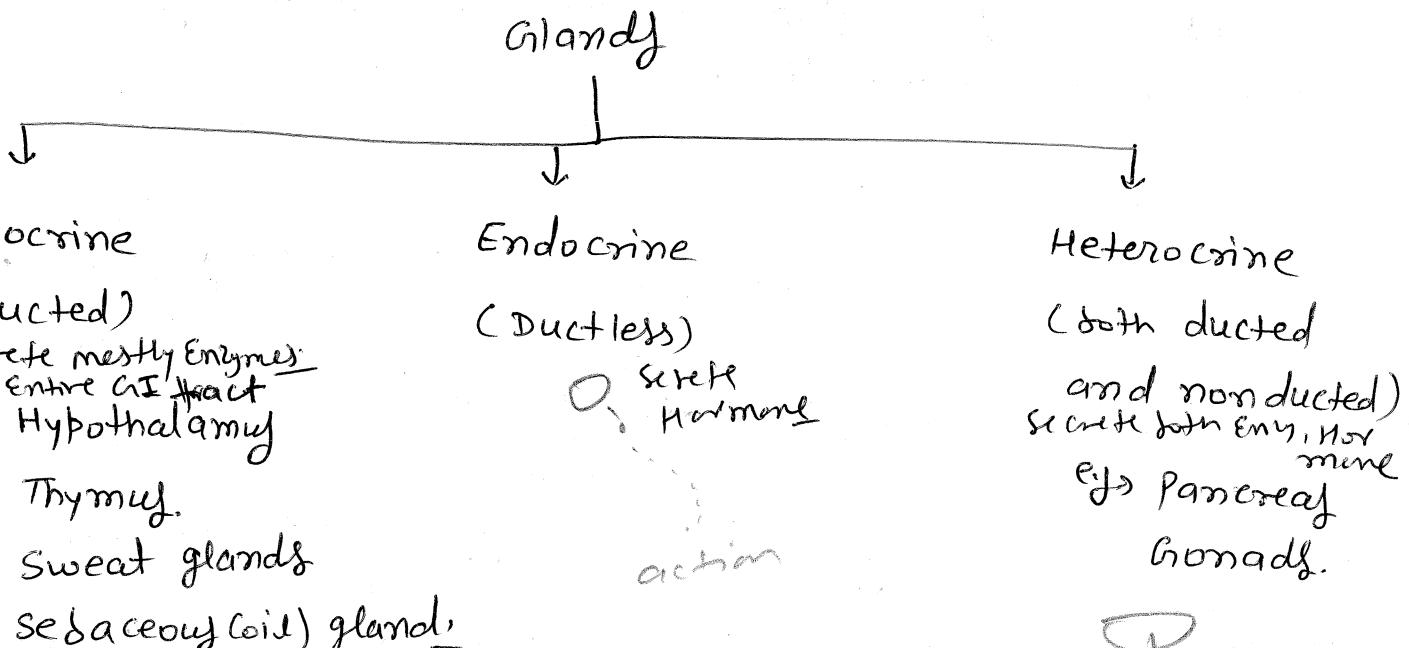
→ These are also divided into two types.

→ 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 mucus and osmosis.

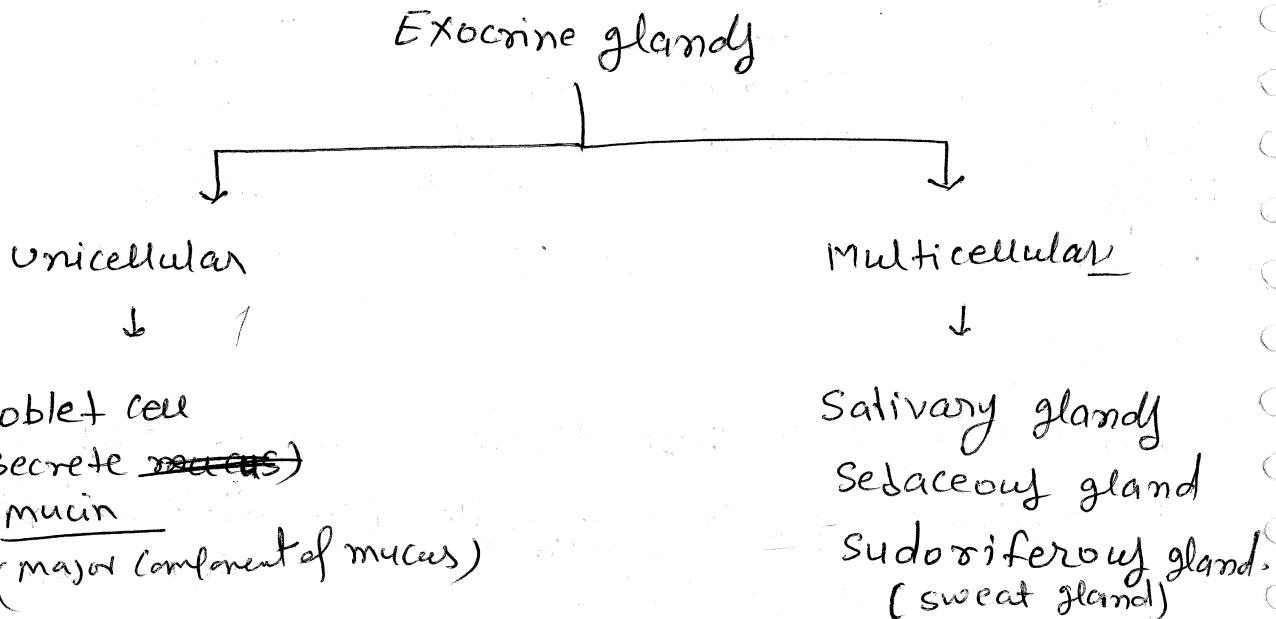
→ Glandular epithelium makes secretory part of gland.

→ Glands are modified epithelial tissues.

→ Liver is largest gland of the body.



action



Kri *Shiv*

② Connective tissue ⇒

collagen
elastin

- consist of two basic elements - cells and ECM.
- ECM is secreted by cells of connective tissues.
- Highly vascular (Have blood supply) except in cartilage.
- Store Fat Energy (Adipose tissue)

(Cartilage)

→ No blood supply.

→ Flexible connective tissue

→ cells are called chondroblast

→ Found in joints of fit, nose, ear, vertebral disc etc

(Cartilage + ligament - tendon)

③ Muscular tissue ⇒ Generate force to body motion.

Muscles

Skeletal

Smooth

cardiac

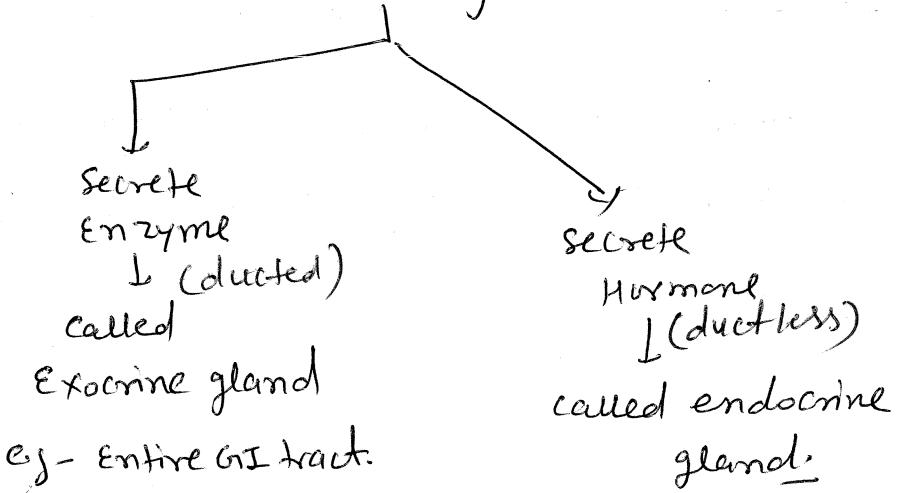
- Multinucleated
- Voluntary motion
- 10 - 100 μm diameter
- length 100 μm - 30 cm
- uninucleated
- Involuntary motion
- 3-8 μm
- 30-200 μm
- uninucleated
- Involuntary pumping
- 10-20 μm
- 50-100 μm

④ Nervous tissue ⇒ consists of neurons and neuroglia.

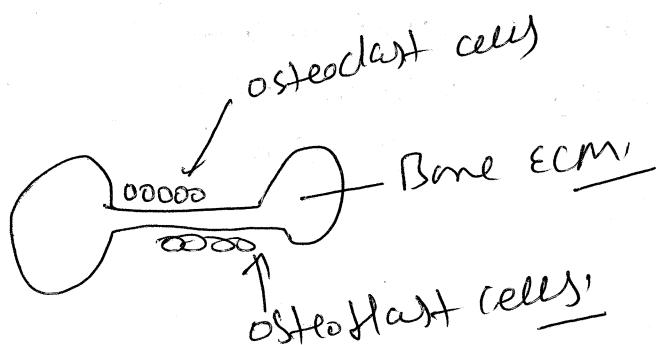
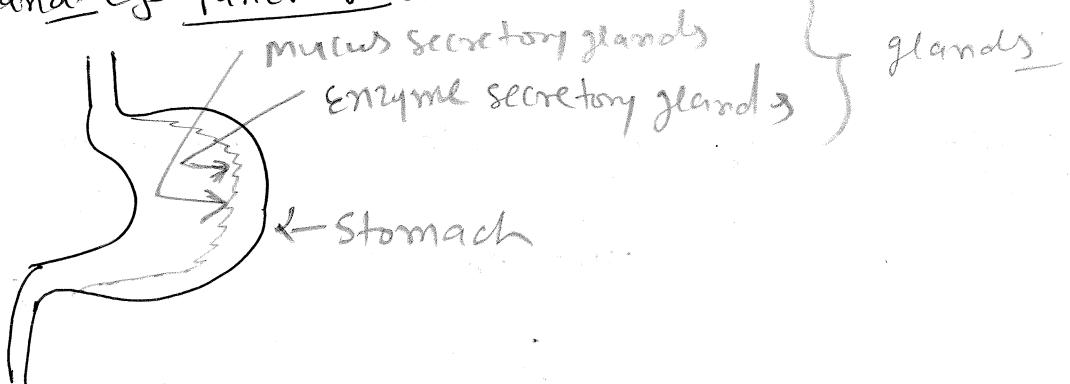
Glands

→ Modified epithelial tissues/cells.

individual cell → Groups of cells that have secretory function.



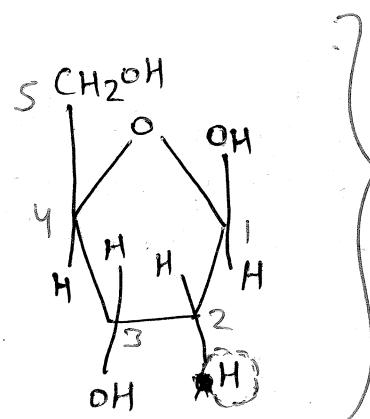
→ If a cell/gland can secrete both Enzyme and Hormone is called Heterocrine gland, e.g. Pancrease (mixed - ducted + ductless)



Carbohydrates

Pramod

- Mean Hydrates of carbon. $[C_n(H_2O)_n]$
- But more appropriate to say Polyhydroxy aldehyde or Polyhydroxy ketone or compound 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 carbon but not carbohydrates
 $C_3H_6O_3$ (Lactic acid) } $[C_n(H_2O)_n] \text{ i.e.}$



β -D-Dekoxy 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)

Carbohydrates

- Mono saccharides
 - single poly hydroxy aldehyde / ketone
 - may be 3C to 7C
 - colourless, crystalline solid.
- Oligosaccharides
 - polymer of two to ten mono saccharides linked by glycosidic bond.
- Polysaccharides
 - polymer of more than 10 PSS.

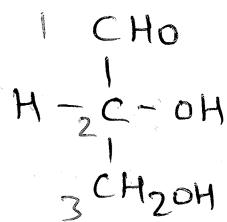
- The most abundant monosaccharide in nature is Glucose.
- In oligosaccharides mostly disaccharides are founds.

carbohydrates

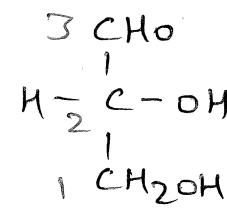
- Sugar
 - sweet in taste
 - water soluble.
 - includes all MS and DS.
- Non-sugar
 - non-sweet in taste
 - water insoluble.
 - includes all polysaccharides.

- Q. Maize is PS but when we eat sweet corn it gives sweet taste why?
- Ans. By boiling of maize PS are degraded into mono saccharides and gives sweet taste.

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



Correct



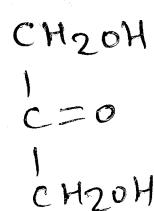
In correct

MonoSaccharides

→ Aldose (Have CHO)
 → 3C, 4C, 5C, 6C, 7C found.
 → all are optically active
 → 1C, 2C not possible.

→ Ketose (Have C=O)

→ 3C, 4C, 5C, 6C, 7C found.
 → all are optically ~~active~~ except active
 Except ketotriose (Dihydroxyketone)
 (Dihydroxyacetone)

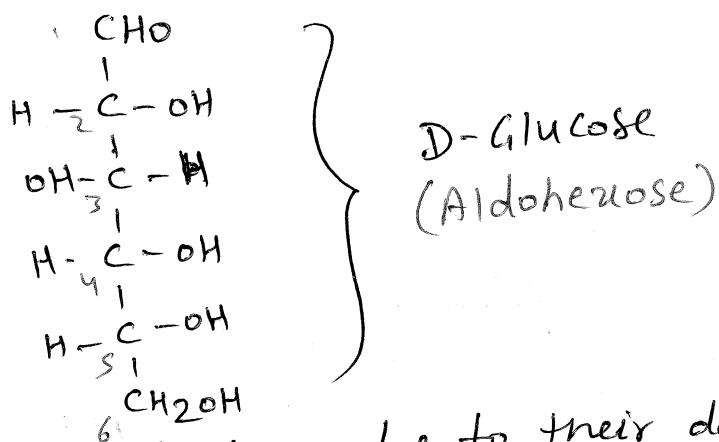


} Dihydroxyacetone (Ketotriose)

→ 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 a 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 aquas medium.
- only cyclic form can goes 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 then 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.

Chiral molecule — derive two form $\begin{cases} \text{If mirror image - stereoisomer} \\ \text{If net mirror image - diasterioisomer} \end{cases}$

Masui

Markert

Masui and Markert Experiment \Rightarrow 1971

\rightarrow To discovery of m-CDK (m-CDK)

\rightarrow Study ~~Meiosis~~ in Female Frog (Xenopus laevis) oocyte maturation (~~in female~~)
 \rightarrow by meiosis?

Normal Process \Rightarrow

$G_1 \rightarrow S \rightarrow G_2 \rightarrow L \rightarrow Z \rightarrow P \rightarrow$ ~~Diploblast~~ $\xrightarrow{*}$ Diploblast $\rightarrow Dk$

activated by
Progesterone

Cycle inhibited

M-I

\downarrow

A-I

\downarrow

T-I

\downarrow

Cycle inhibited

T-II

\downarrow

T-II \leftarrow A-II \leftarrow ~~M-II~~ $\xleftarrow{*}$ P-II

Experiment \Rightarrow

(Step-1)

$G_1 \rightarrow S \rightarrow G_2 \rightarrow L \rightarrow Z \rightarrow P \rightarrow$ ~~Diploblast~~ $\xrightarrow{*}$
Progesterone \rightarrow Extract M-CDK complex
from cell.

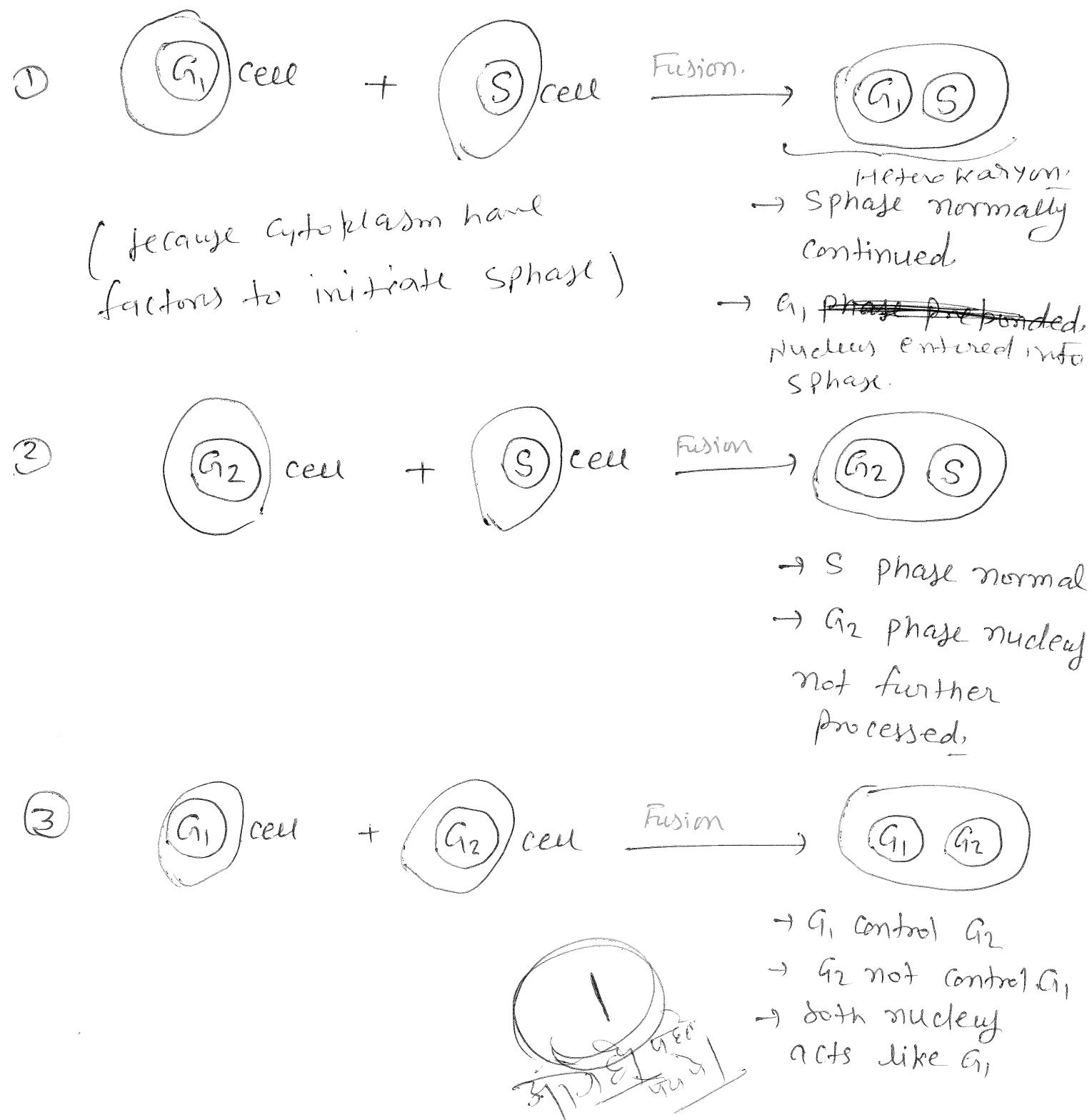
$\boxed{\text{Cell}}$ (contain m-CDK complex)

$G_1 \rightarrow S \rightarrow G_2 \rightarrow L \rightarrow Z \rightarrow P \rightarrow$ ~~Diploblast~~ $\xrightarrow{*}$
(No Progesterone)

Give M-CDK complex by microinjec
and cell goes to normal division.

Cell-fusion Experiment \Rightarrow

- 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

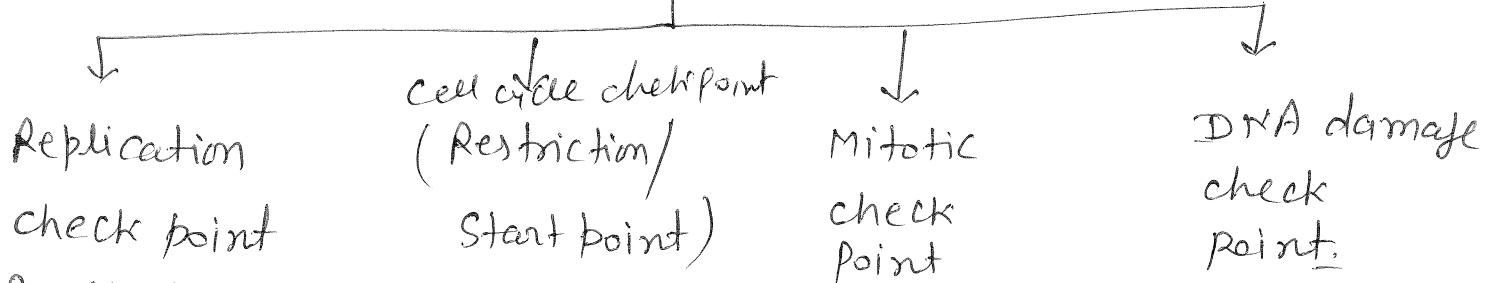


Result \Rightarrow cell cycle is regulated process.

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

\rightarrow Hypothesized by Hartwell and Weinert.

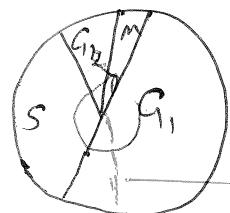
check points.



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

Restriction / start point \Rightarrow

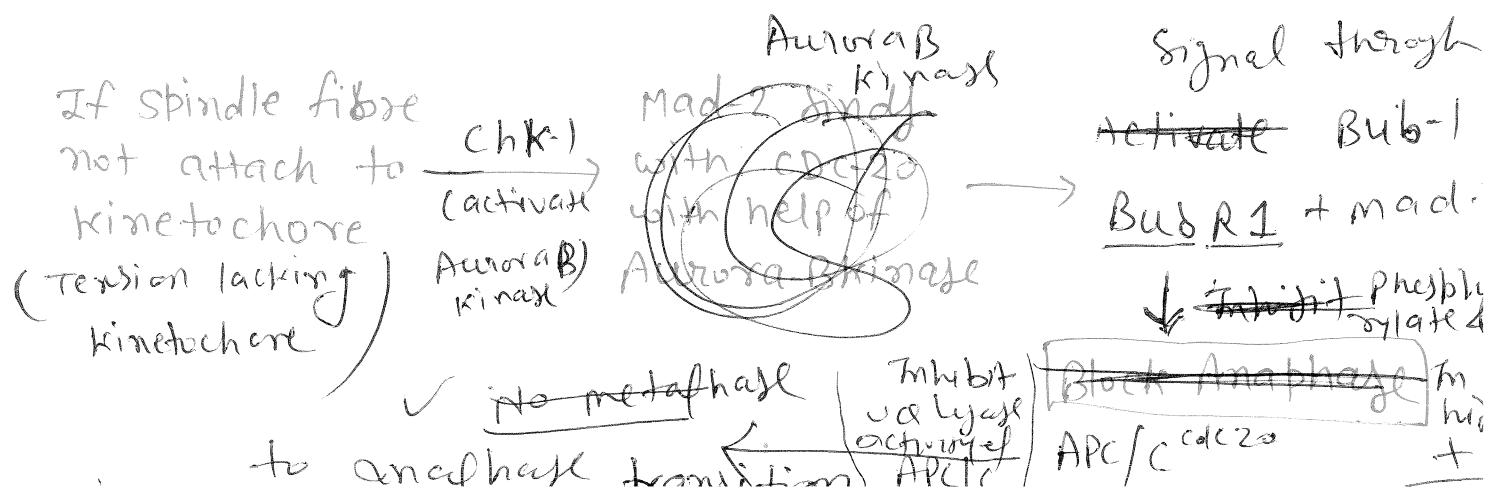
\rightarrow Found in late G₁ phase.



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

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

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



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

→ G₁/S check point

→ Intra S check point

→ G₂/M check point.

→ 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)

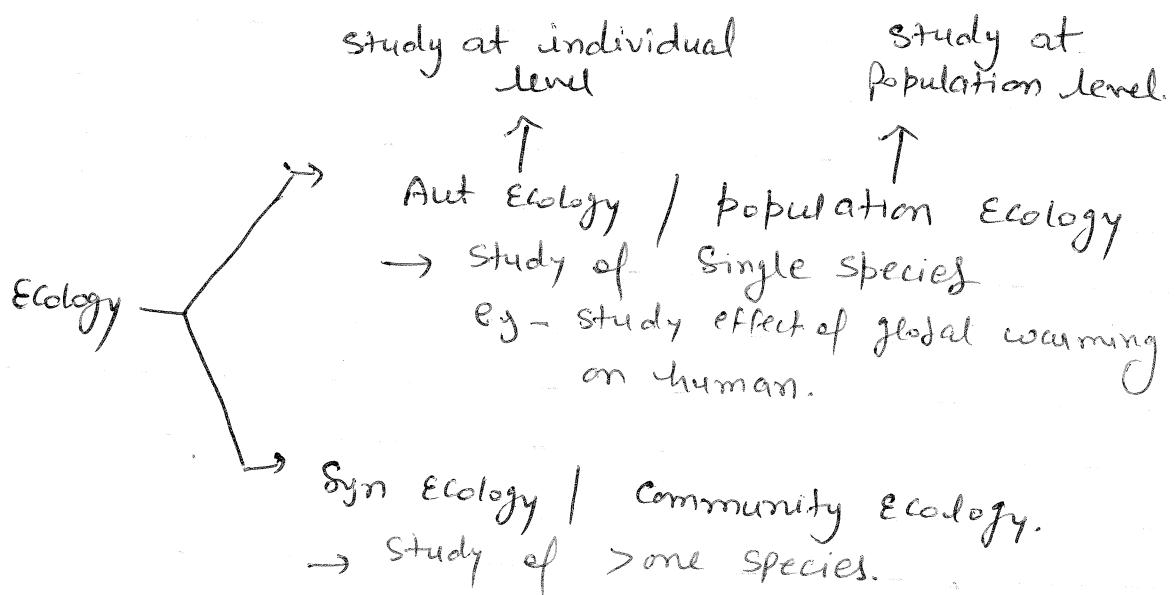
Logy = Logos = Study

Greek words.

→ Study of interactions between organism with their surrounding environment (Home both biotic and abiotic component)

Father of Ecology — Reiter

Father of Indian Ecology — Prof. Ramdeo Mishra. (BHU)



④ Ecological Hierarchy (Level of organization) \Rightarrow

Individual < Population < Community < Ecosystem < Landscape
 < Biome < Biosphere

Individual -

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

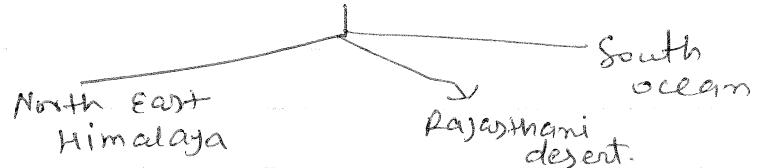
Population - Group of individuals of same species, at particular place, at particular time.

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
 → 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 characters from parents to offspring is called Heredity. | Inheritance³

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

Mendelian genetics \Rightarrow

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

→ In 1900 work of mendal was independently rediscovered by three biologists Hugo de Vries, Carl Correns and Erich Tschermark.

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

Dominant / Recessive

→ seed shape Round / wrinkled.

→ seed colour yellow / green

→ flower colour violet / white

→ pod (cot) shape full / constricted

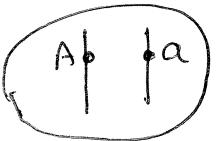
→ pod colour green / yellow

→ stem height tall / dwarf

→ flower position. Axial / terminal



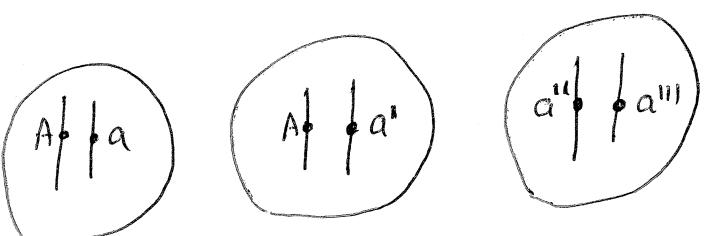
Allele \Rightarrow Alternative forms of a gene present on the same locus are called allele



Multiple Allele \Rightarrow In a diploid cell maximum two allelic forms of a gene can found. But when we study it in large population we found several forms of a gene commonly 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 commonly 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.
- Mendal supposed only two allelic form of gene giving two discrete class of result. This pattern of genes is also called major genes or oligogenes.

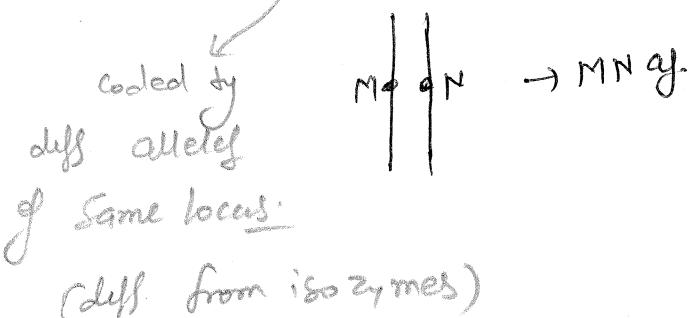
Incomplete dominance / Partial dominance / Semi dominance \Rightarrow

→ When recessive allele is not totally suppressed.

$RR \rightarrow \text{Red}$ } Flower colour of
 $Rr \rightarrow \text{Pink}$ } Mirabilis Jalapa
 $rr \rightarrow \text{White.}$ } and
in dog flower (snapdragon)

Codominance \Rightarrow Both allelic forms are equally dominant.

e.g. Allozymes, MN blood group.



Overdominance \Rightarrow When due to both allele (Heterozygous) the character is over expressed

$R//R \rightarrow \text{Red}$

$R//r \rightarrow \text{dark Red}$

Immunology \Rightarrow

1

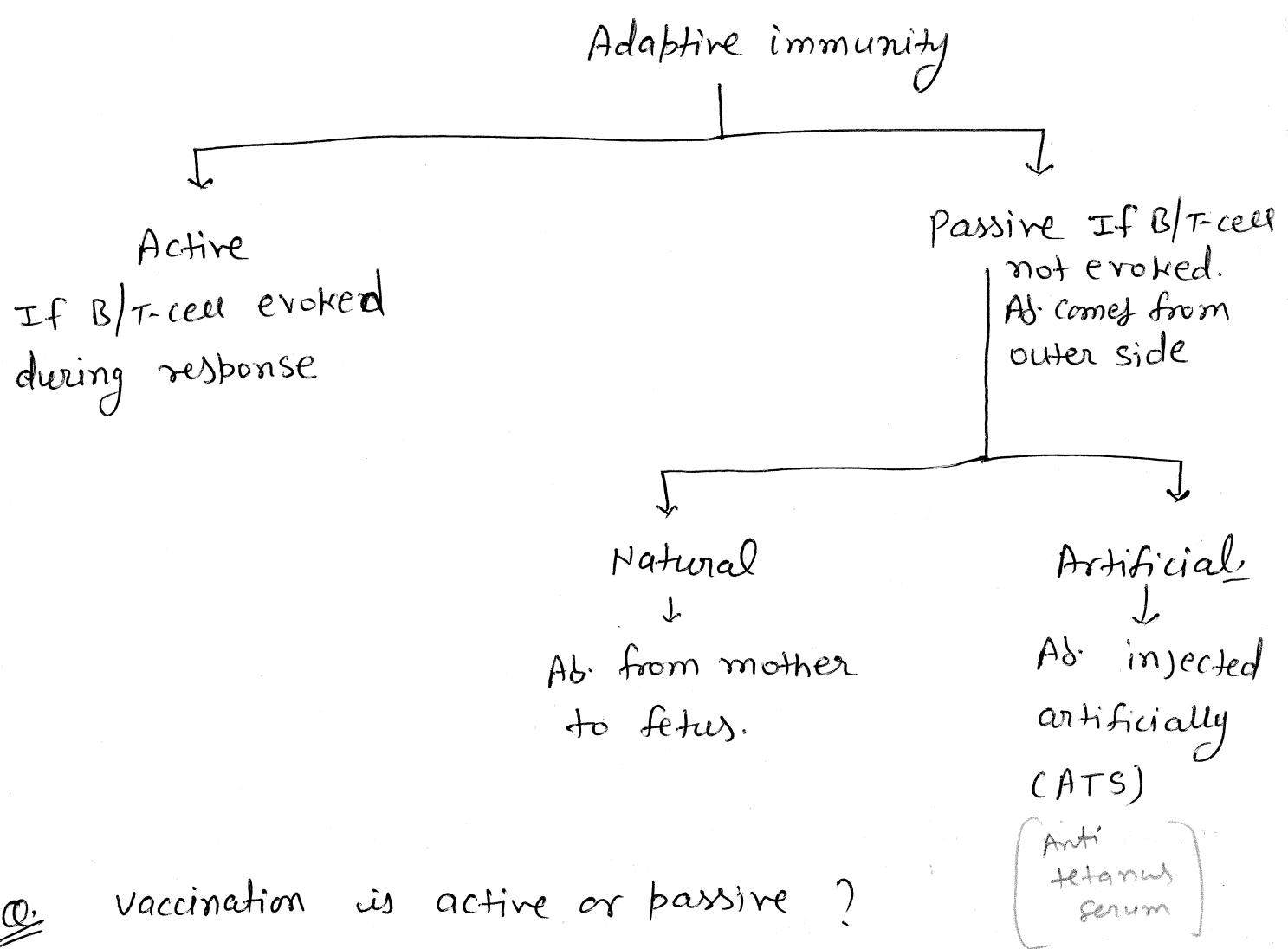
- Immunology is study of immune response towards pathogen and foreign challenges. is called Immunology.
- 'Immunology' is derived from Latin word 'immunis' means exempt (state of protection between pathogens)
- System work in two step recognition and response
- Response is of two types effector and memory response
- derived for
- 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 | Acquired / Adaptive immunity. |
| → Develops before the birth | → develops after the birth. |
| → In both vertebrate / Invertebrate | → only in vertebrate. |
| → First line of defense | → Second line of defence. |
| → Non specific for ag. | → Specific for ag. |
| → Fast response | → Slow response |
| → Less diverse | → Highly diverse. |
| → No immunological memory | → Immunological memory found. |
| → can't find self / non self | → Have self/non self recognition |

→ If B-cell (Ab-forming) or T-cell (TCR-forming) are involve
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 apply for all disease.

Historical Experiments ⇒

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 at opening of nose

Outer surface

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 become resistant to both disease.

Louis Pasteur ⇒

Domestic bird / cock.

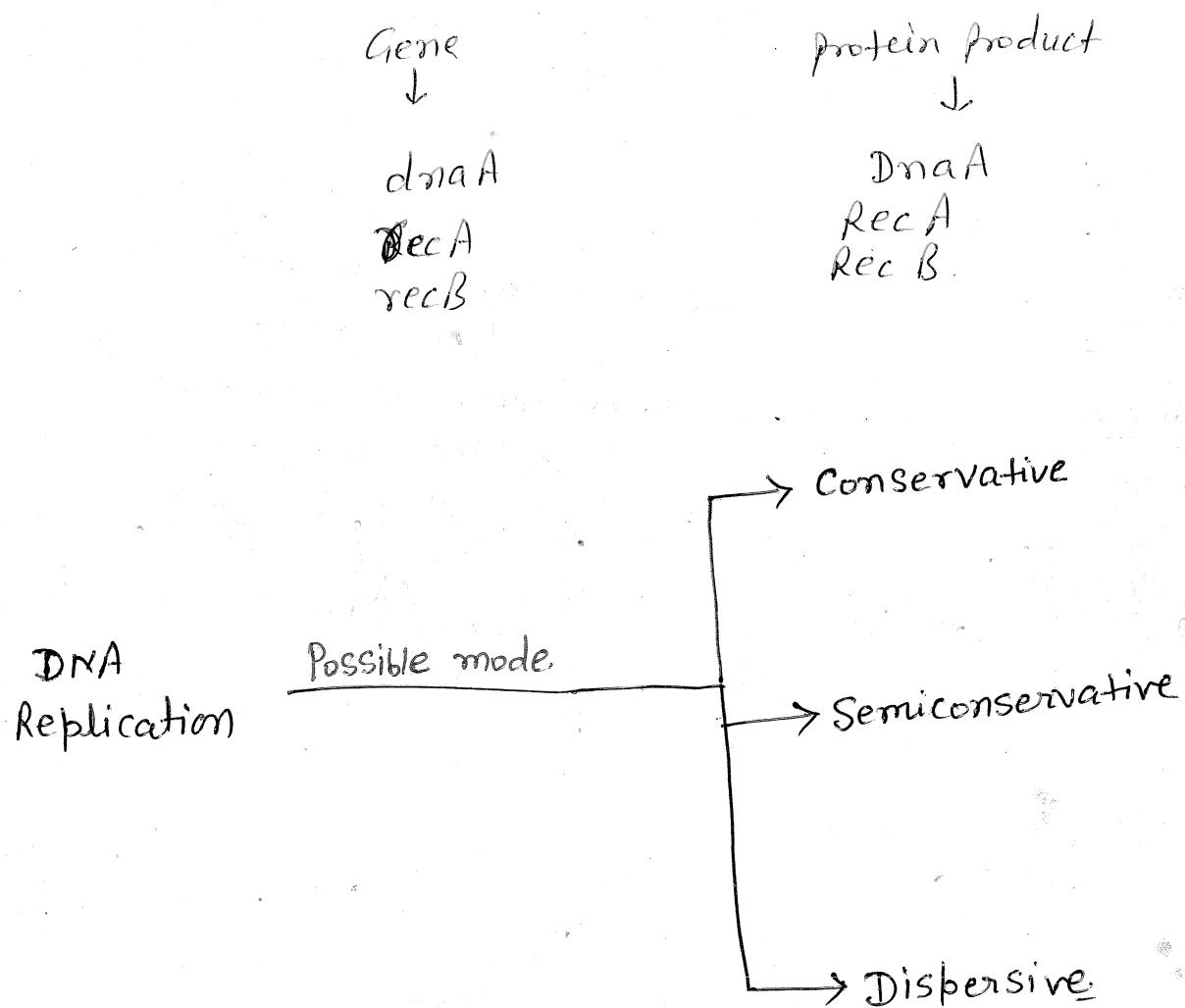
- Take culture of fowl cholera.
- give to chickens they got infected.
- But when same culture after 10 days given to another group of chickens they not get infection.
- He told that aging done weakened of virulence of ag. and it used as vaccine.
- In 1881 He make first vaccine by heat attenuated *Bacillus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

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

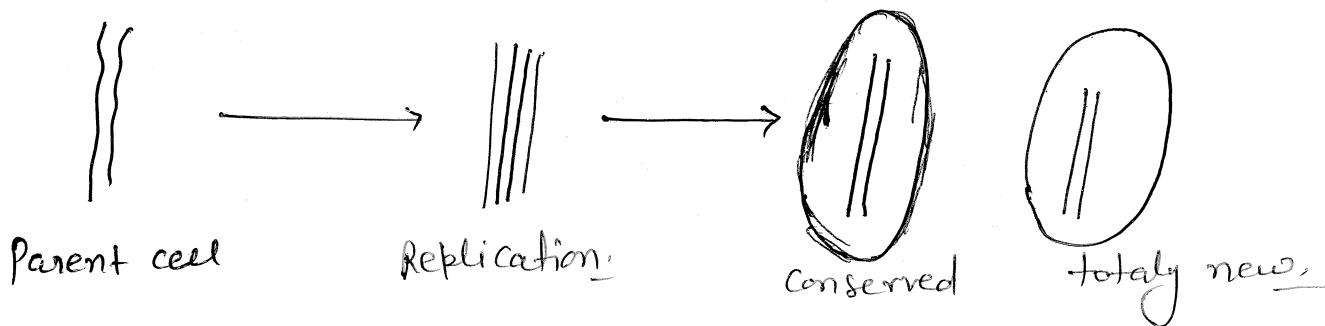
Ans due to lack of tissue culture technique.

DNA REPLICATION

- In E.coli ~60 genes are involved in DNA replication and repair which encodes various proteins essential for replication.
- Whole E.coli genome is mapped and divided in ~100 minutes in which 1 minute corresponds to ~40,000 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.



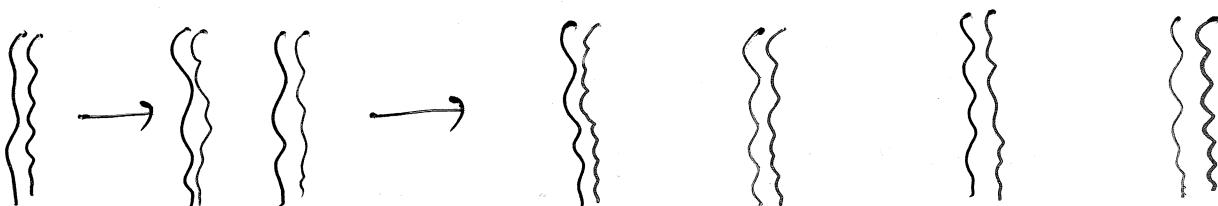
dispersive \Rightarrow In this some part of chromosome become conservative and some part become non-conservative.

+ In this case size of chromosome ~~size~~ may increase.



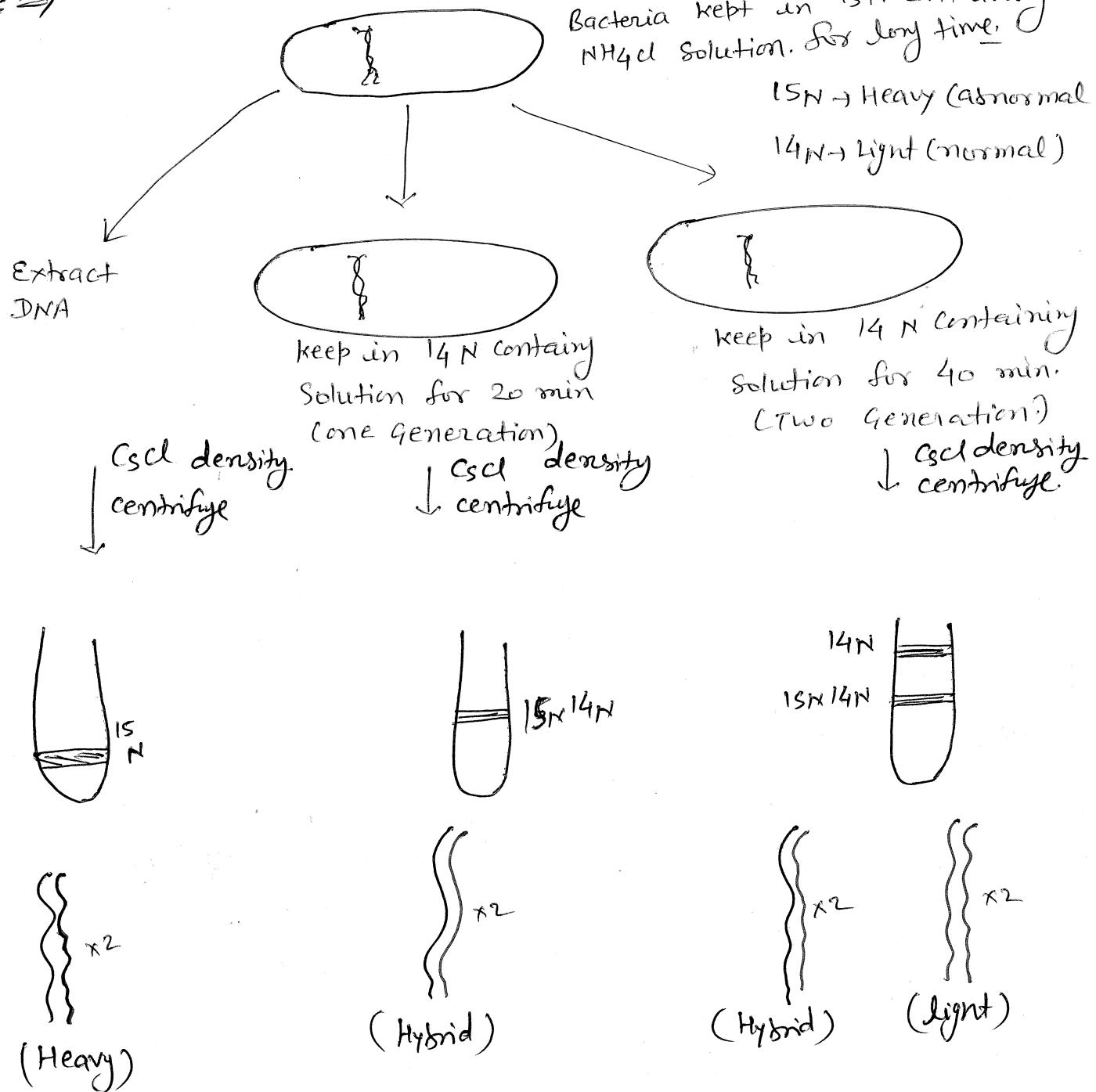
- \rightarrow In this DNA first fragmented then goes to replication by conservative or semiconservative method and then reassembled.
- \rightarrow The resulting chrom have some place with both strand conservative, some strand non conservative and some fragment of Hybrid also.

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



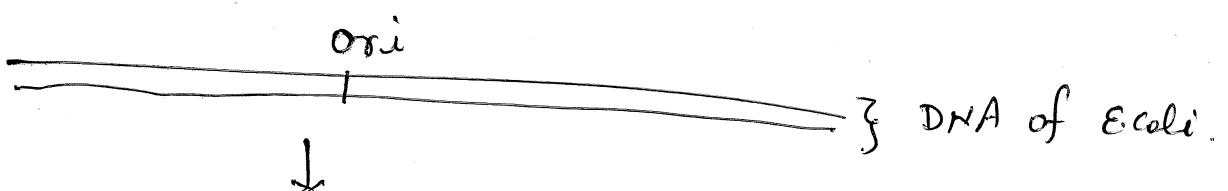
→ Watson and Crick proposed Hypothesis of Semiconservative DNA replication in 1953 which experimentally proved by Meselson and Stahl in 1957.

Exp ⇒

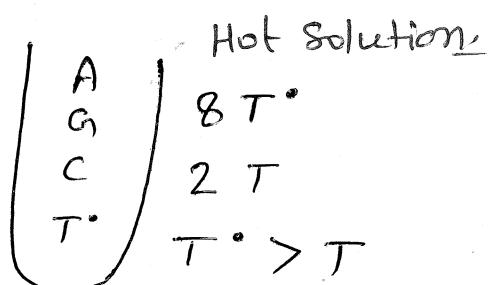


- Here they use N with diff. density (not with radioactivity)
- The DNA with heavy N have only more density compare to DNA with light Nitrogen.

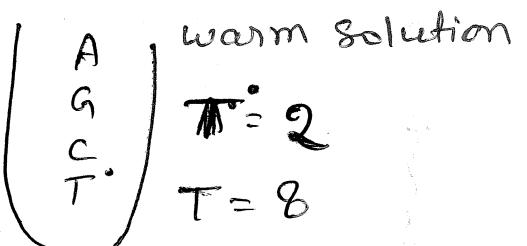
- John Cairns first make experiment that proved that nature of replication is bidirectional (mostly). called pulse labelling exp.
- He use autoradiography and make radioactive DNA by using Thymidine that are radiolabeled with tritium (^3H)
- He use thymidine because its present only in DNA not in RNA.



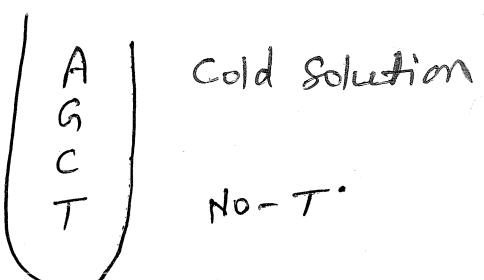
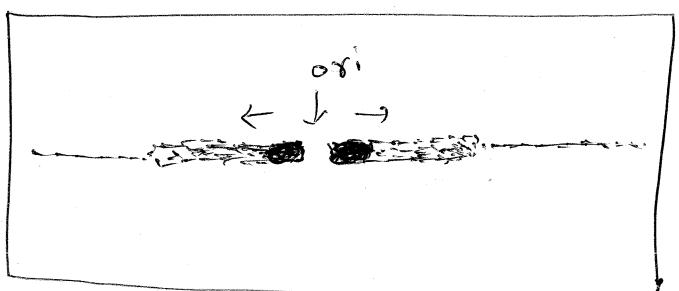
Transfer E. coli cells in Hot medium for first 10 minutes.



After 10 minutes transfer to warm / cold solution



do autoradiography



Silver halide containing photographic plate.

(Pulse labelling exp.)

RDT / Genetic engineering

alteration of natural gene sequence

- Recombinant DNA means ~~presence of foreign gene sequence~~
- First recombinant DNA was ~~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 $E. coli$ genome and other side Stanley Cohen developed method to remove plasmid from bacterial cell and transfer it to other cell.
- Then Herbert Boyer and Stanley Cohen made other recombinant by adding antibiotic resistⁿ gene ~~and~~ with help of enzyme S. typhi plasmid in 1973 & DNA ligase

- Biotechnology deals with techniques that use living organism or their product ~~in human~~ and environmental welfare.
e.g. bread, wine, curd to ~~transgenic~~ 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 firm used only for GMOs or related works like In vitro fertilization (first test tube baby), Gene therapy, transgenic etc

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

10^5 = one lakh

10^6 = 10 lakh = one million

10^9 = one ~~billion~~ billion

10^{12} = one trillion

10^{15} = quadrillion

10^{18} = quintillion

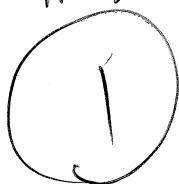
cloning - making multiple identical copies of any template

DNA

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

Bioreactor \Rightarrow

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



- Finger prints ~~of two individ.~~ are developed due to touchy of fingers by mother & tract during embryo development. So they are ~~not~~ identical & random.
- So no chance to be same even in twins. So for crime detection (twins) finger printing is used.

1

① stirred tank bioreactor —

- Have curved base to facilitate mixing.
- stirrer facilitates O₂ availability throughout bioreactor.
-