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STUDY MASTER OFFICIAL NOTES

EASY TO UNDERSTAND
ACCORDING TO LATEST SYLLABUS & PATTERN

MUST Read for Sure Success.

NOTES AVAILABLE IN HINDI & ENGLISH MEDIUM

"SLOW PROGRESS IS BETTER THAN NO PROGRESS"

STAY POSITIVE & DON'T GIVE UP.
GOOD LUCK

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1. BIOTECHNOLOGY

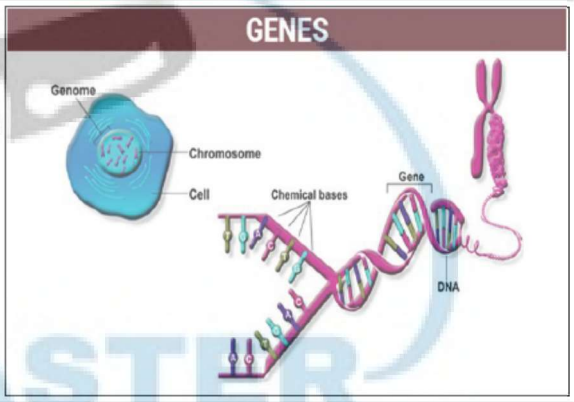
Biotechnology is the use of biological systems found in organisms or the use of the living organisms themselves to make technological advances and adapt those technologies to various fields.

COLOR CLASSIFICATION OF BRANCHES OF BIOTECHNOLOGY:

- **Gold biotechnology or Bioinformatics**: Computational Biology → address biological problems using computational techniques.
- **Red Biotechnology**: Biopharma → relates to medicine and veterinary products.
- **White Biotechnology**: Industrial Biotech → to design more energy efficient, low resource consuming products.
- **Yellow Biotechnology**: Biotech in Food Industry.
- **Grey Biotechnology**: Environmental applications to maintain Biodiversity.
- **Green Biotechnology**: Emphasizes on Agriculture interests.
- **Blue Biotechnology**: based on use of marine resources.
- **Violet Biotechnology**: deals with law, ethical and philosophical issues of biotechnology.
- **Dark Biotechnology**: associated with bioterrorism and biological weapons.

GENE:

- Gene is the basic physical unit of inheritance.
- It is a part of the DNA in a cell that controls the physical development, behaviour, etc. of an individual plant or animal & is passed on from its parents.



GENOME:

- Genome is the complete set of genes or genetic material present in a cell or organisms.
- The human genome is a **complex set of instructions**, like a recipe book, directing organism growth & development.

GENOMIC ORGANIZATION:

- This refers to the linear order of DNA elements and their division into chromosomes.
- Can also refer to the 3D **structure** of chromosomes & the positioning of DNA sequences within the nucleus.

CHROMOSOME:

- These are **thread-like structures** located inside the nucleus of animal & plant cells.
- Each **chromosome** is made of **protein** and a single molecule of Deoxyribose-Nucleic Acid (DNA).
- Chromosomes are a **key part** of the process that **ensures DNA** is **accurately copied** and **distributed in** the vast majority of **cell divisions**.
- **Changes in the number** or structure of chromosomes in **new cells** may lead to serious problems like: Down Syndrome, Turner Syndrome etc.

DEOXYRIBONUCLEIC ACID (DNA):

- DNA is an **organic chemical** that contains genetic information and **instructions for** protein synthesis.
- **DNA** is a **key part of reproduction** in which genetic heredity passed down through **DNA** from parents to offspring.

RIBONUCLEIC ACID (RNA):

- RNA is a nucleic acid principally involved in the **synthesis of proteins**, carrying the messenger (ex: mRNA) **instructions from DNA**, which itself contains the **genetic instructions**.

DIFFERENCES BETWEEN DNA AND RNA:

DNA	RNA
It has deoxyribose and phosphate backbone having four distinct bases: Adenine, Cytosine, Guanine & Thymine (ACGT).	It has ribose and phosphate backbone with four bases: Adenine, Cytosine, Guanine& Uracil (ACGU).
Found in cell nucleus and Mitochondria.	Found in Cytoplasm, nucleus and Ribosome.
Has 2-deoxyribose.	Has Ribose.
Double stranded molecule with long chain of nucleotides.	Single stranded molecule with shorter chain of nucleotides.
Self-replicating	Synthesize from DNA when required.

CELL

- A Cell is defined as **smallest, basic unit of life** responsible for all life's processes.
- **Robert Hooke** coined the term **Cell** in 1665.
- Cells provide structure and support to the body of an organism.
- **Cells are of 2 types** namely, Prokaryotes & Eukaryotes.

Prokaryotes	Eukaryotes
Size of cell is generally small	Size of cell is generally large.
Nucleus absent.	Nucleus present.
It contains single chromosome	It contains more than one chromosome
Membrane bound cell organelles are absent.	Cell organelles are present.
Cell division takes place by fission or budding.	Cell division takes place by mitosis and meiosis.

STRUCTURE OF A CELL:

A cell consists of three parts:

1. The cell membrane
2. The nucleus, and, between the two,
3. The cytoplasm.

The Cell membrane	• Every cell in the body is enclosed by a cell (Plasma) membrane. • It maintains the integrity of a cell and controls passage of materials into and out of the cell. • All materials within a cell must have access to the cell membrane for the needed exchange.
The Nucleus & nucleolus	• The nucleus determines how the cell will function, as well as the basic structure of that cell. • Threads of chromatin in the nucleus contain Deoxyribonucleic Acid (DNA), the genetic material of the cell. • The nucleolus is a dense region of ribonucleic acid (RNA) in the nucleus and is the site of ribosome formation.
The cytoplasm	• Cytoplasm is a thick solution that fills each cell and is enclosed by the cell membrane. • Within the cytoplasm lie intricate arrangements of fine fibres and hundreds or even thousands of miniscule but distinct structures called organelles.

	• Each type of organelle has a definite structure and a specific role in the function of the cell.

ORGANELLE AND ITS FUNCTION

Organelle	Function
Nucleus	DNA Storage
Mitochondrion (Power house)	Energy production
Smooth Endoplasmic Reticulum(SER)	Lipid Production; Detoxification
Rough Endoplasmic Reticulum(RER)	Protein production
Golgi apparatus (Cell's Post office)	Made of tubes, vesicles & vacuoles. Protein Modification and material transfer, also involved in the synthesis of Cell wall, Plasma membrane & Lysosomes
Peroxisome	Lipid Destruction; contains oxidative enzymes
Lysosome (cell's suicide bags)	Protein Destruction
Chromosomes	Determine the sex of an individual
Ribosome	Protein synthesis
Chloroplast (Kitchen of the plant cell)	It contains the pigment Chlorophyll–take part in Photosynthesis
Vacuole	It helps in Osmoregulation. It stores toxic metabolic waste.

NOTE: Organelles are found **only in plant cells**.

PLASTID:

- Plastid is a **double membrane-bound organelle** involved in the **synthesis and storage of food**.
- Commonly found within the **cells of photosynthetic plants**.
- **It is of 3 types**: Chloroplasts, Chromoplast & Leucoplast.
- **Chloroplasts**: These are green pigments found in green plant involve in photosynthesis.
- Chromoplast provides various colors to the plant like flower, fruit etc. For example, Carotene provide orange color for Carrot & Lycopene in tomato provide red color.
- **Leucoplast is colorless**. It stores the food in the form of starch, fat & protein.

NOTE: Plastids were discovered and named by **Ernst Haeckel**, but A. F. W. Schimper was the first to provide a clear definition.

CELL WALL:

- A cell wall is an outer layer surrounding certain cells that is outside of the cell membrane.
- All cells have cell membranes, **but** generally **only** plants, fungi, algae, most bacteria, and archaea **have cells with cell walls**.
- The cell wall provides strength and structural support to the cell.

NOTE: **Chitin** a polysaccharide that is a main component of **fungal cell walls** and also of the exoskeletons of certain animals like insects.

DIFFERENCE BETWEEN PLANT AND ANIMAL CELL:

Plant Cell	Animal Cell
Cell are larger in size	Generally smaller
Cell wall – Present. Made up of Cellulose & Chitin	Cell wall - Absent
Plastid present	Plastid absent

Centrosome absent	Centrosome present
Vacuole are larger in size	Vacuole are smaller in size

STEM CELLS

- The smallest functional unit of life is called the Cell.
- These cells develop to form tissues which in turn develop to form organs.
- Stem cells are basically undifferentiated, primitive cells which have the potential to develop into many different types of cells like those in muscles, kidney, liver etc.
- Stem cell therapy has shown potential to cure many severe ailments. It is touted as future of medical treatments.
- They have proved effective in the treatment of blood disorders, immune disorders, metabolic problems, & other organ degenerated diseases.

Growing Human Organs in Animal Body

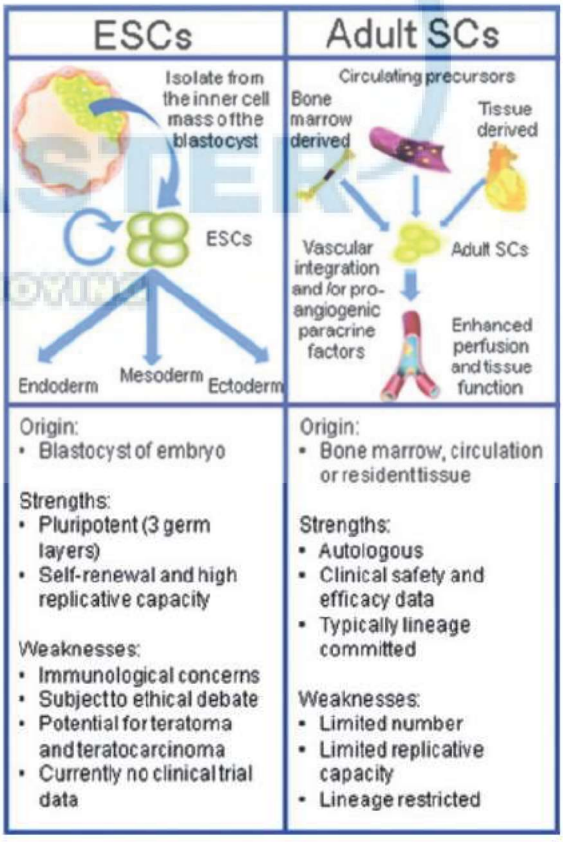
Recently Japanese researchers have successfully developed functional mouse kidneys inside rats using stem cells. This could be replicated in Humans.

Source of Stem Cells:

- Bone marrow, Umbilical cord blood, Adipose tissue, Allografts, Amniotic fluid etc.
- Types of stem Cells, Based on Source:
  1. Embryonic Stem Cells (ESCs)
  2. Adult/Somatic stem cells

Adult stem cells include:

- Hematopoietic Stem cells (HSCs), Mesenchymal Stem Cells, Neural stem cells, Epithelial Stem cells, Skin stem cells, Induced pluripotent stem cells.
- **Induced pluripotent stem cells (iPS):** Scientists **create these in a lab**, using skin cells and other tissue-specific cells. These cells behave in a similar way to embryonic stem cells, so they could be useful for developing a range of therapies.
- These cells derived from the patient themselves, so less likely to be rejected.



Cell Potency:

- Refers to the varying ability of stem cells to differentiate into specialized cell types.
- Cells with greatest potency can generate more cells types than lower potency cell.

Hierarchy of Cell Potency:

- **Totipotent Stem Cells**: Stem cells can give rise to any of 220 cell types found in embryo as well as extra-embryonic cells(placenta).
- **Pluripotent Stem Cells**: can give rise to all cell types of body (but not the placenta).
- **Multipotent Stem Cells**: can develop limited number of cell types in a particular lineage.
- **Unipotent Stem Cells**: give rise to cells of their own type along a single lineage.