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**CELL
BIOLOGY**

By: Gargi Bhardwaj, M.Sc.

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QUESTION PAPER

(June - 2019)

(Solved)

CELL BIOLOGY

Time: 2 Hours]

[Maximum Marks: 50

Note: Question no. 1 is compulsory. Attempt any four questions from question no. 2 to 6.

Q. 1. (a) Fill in the blanks with appropriate words :

- (i) The transport of molecules against the concentration gradient with the use of energy is known as _____.
- (ii) Synthesis of glucose from non-carbohydrate precursors is known as _____.
- (iii) _____ is the initiation codon in majority of living organisms.
- (iv) One molecule of NADH Produces _____ ATP.
- (v) _____ is the site of ATP production in mitochondria.

Ans. (i) Active Transport, (ii) Gluconeogenesis, (iii) AUG, (iv) three, (v) Inner membrane.

(b) Match the terms given under Column I with those given under Column II:

- | Column I | Column II |
|---|----------------------------------|
| (i) Fluid mosaic model of cell membrane | A. Schleiden and Schwann |
| (ii) Cell theory | B. Chloroplast |
| (iii) Semi-autonomous organelle | C. t-RNA |
| (iv) Enzyme kinetics | D. Singer and Nicolson |
| (v) Clover leaf model | E. Michaelis and Menten Constant |

Ans. (i)-(d), (ii)-(a), (iii)-(b), (iv)-(e), (v)-(c).

Q. 2. Write short notes on the following:

(a) Genetic control of enzymen synthesis

Ans. Enzyme quantity is regulated at genetic level. Enzyme synthesis is switched on and off whenever required. Jacob and Monad proposed operon model for the regulation enzymes synthesis at genetic level.

Also, Ref.: See Chapter-10, Page No. 55, Q. No. 1.

(b) Lysosomes

Ans. Lysosomes are formed by budding off vericles from Golgi complex. These are single membrane bound organelles which involved in intra cellular digestion and contain the enzyme required to divert all types of macro-molecules. In the cell four type of lysosomes have been identified; primary lysosomes, secondary lysosomes, residual bodies and autophagic vacuoles.

Also Ref: See Chapter-3, Page No. 14, Q. No. 1.

(a) Prophase I of meiosis

Ans. Ref.: See Chapter-17, Page No. 95, Q. No. 1 and Page No. 97, Q. No. 1.

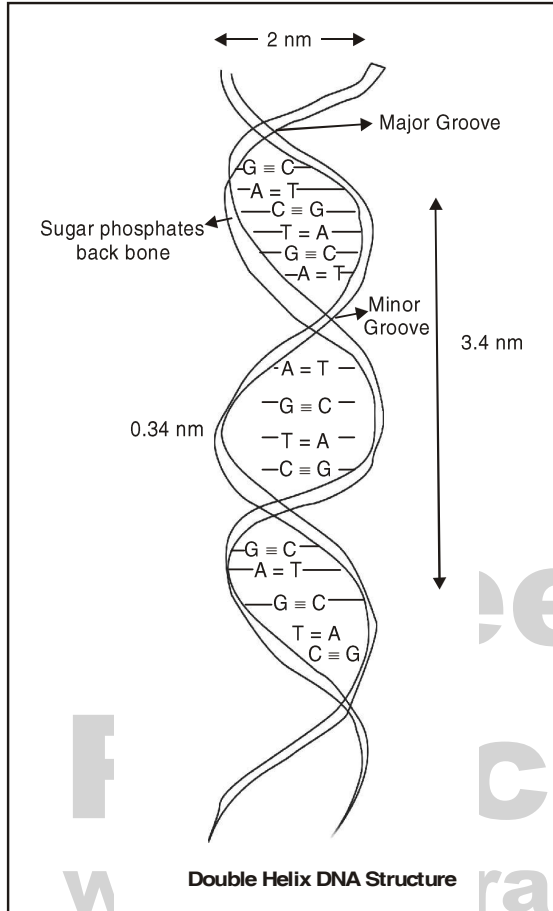
Q. 3. Draw neat and well-labelled diagrams of the following :

(a) Ultrastructure of chloroplast

Ans. Ref.: See Chapter-3, Page No. 15-16, 'Ultrastructure of Chloroplast'.

(b) Watson and Crick model of DNA

Ans.



Q. 4. Differentiate between the following :

(a) Nucleus and Nucleoid

Ans. The nucleus is the largest and the most important cell organelle in a eukaryotic cell. A nucleus is a membrane-bound organelle that houses the genetic material of eukaryotes in DNA. The nucleus consists of protein fibres or the DNA inside chromatin fibres. Nucleoids contain the genetic material of prokaryotes in the cytoplasm. The nucleoids usually consist of a single chromosome. A nucleus is surrounded by a double layer membrane called nuclear membrane which separates the nucleus from other cell organelles, whereas nucleoid is poorly organised and lacks a protective membrane.

(b) DNA and RNA

Ans. Ref.: See Chapter-5, Page No. 28, 'Difference between DNA and RNA'.

(c) Phagocytosis and Pinocytosis

Ans. The intake of fluids by formation vesicles is called **pinocytosis** while ingestion of large particles by formation of larger vesicles is known as

Phagocytosis: The process of taking in solid and liquid food by phagocytosis and Pinocytosis is called endocytosis while the export of material by secretion is called exocytosis.

(d) Osteoblast and Osteoclast

Ans. Osteoblast and Osteoclast are two special types of cells that are found only in the bone. Osteoclasts are large cells that dissolve the bone. They come from the bone marrow and are related to white blood cells. They are formed from two or more cells that fuse together, so the osteoclasts usually have more than one nucleus. Osteoblasts are the cells that form new bone. They also come from the bone marrow and are related to structural cells. They have only one nucleus.

(e) Tight junctions and Gap junctions

Ans. Ref.: See Chapter-18, Page No. 100, Q. No. 2 (Terminal Question).

(f) Tracheids and Tracheae in plants

Ans. Tracheid is a dead, elongated, tubular cell that functions primarily in the conduction of water and mineral salts.

The trachea is essentially an air-conducting tube (windpipe) that connects larynx to the rest of our respiratory system. It is an integral part of the body's airway and has the vital function of providing air flow to and from the lungs for respiration.

Q. 5. (a) Name the major macro-molecules present in a cell. Describe any one method of separating macro-molecules from a mixture based on molecular size or molecular affinity.

Ans. The major macro-molecules are protein, nucleic acid lipid and carbohydrate that are present in the cell.

Sample Preview of The Chapter

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CELL BIOLOGY

Introduction to the Cell Biology

1

Introduction to the Cell

INTRODUCTION

All organisms are made up of cells which are rather minute in size and so can be seen only with the help of microscope. First evidence about the cell's nature was provided by **Robert Hooke in 1665** in his book **Micrognatha**. Robert Hooke observed a slice of cork which was made up of numerous minute chamber named as cells. In 1683, Leeuwenhoek was first to observe free cells like Bacteria, Protozoa, Red Blood Cells and Spermatozoa etc. In 1831 Robert Brown described the nucleus. Microscopes and various physico-chemical methods used to analyze the cell. Such as X-ray diffraction and cell fractionation. After a long study **Schleiden** and **Schwann** propounded cell theory in 1839. The cell theory states that cell is the structural and functional unit of all living organisms. Cell theory did not explain as to how the new cells are formed? In 1855, **Rudolf Virchow** was the first to explain that all living cells arise from pre-existing cell *i.e.* '**Omnis Cellula-e-cellula.**' study which deals with the cell, is known as Cytology.

Flemming described somatic division and gave term 'Mitosis' to this process. Cell is the basic unit of life so cytology is interconnected with other branches of biology *i.e.*, Biochemistry, Genetics, Evolution, Cytology, Taxonomy, Anatomy etc.

On the prebiotic earth, the evolution of the cell can be divided in two steps:

- Chemical evolution
- Biological evolution

In chemical evolution we study about the evolution of polymer on prebiotic earth, Ammonia, Hydro-

carbons, water were present at the prebiotic earth, which reacted together under the influence of ultra-violet radiation. Electric discharge and solar radiation, resulted into formation of organic monomer *i.e.* Amino acid, Nucleotide etc. Polymers (*i.e.* Protein, Lipid, Nucleic acid) were the result of polymerization of amino acid.

In biological evolution, molecules aggregate and organized and formed the cell organelles (*i.e.* phospholipids and proteins become assemble and forms the plasma membrane) and cell organelles collectively forms cell. The three possible models for protobiont formation are coacervate, protonoid microsphere and lipid bilayer model.

After biological evolution, first organism which evolve is called prokaryotes which have no clear nucleus and membrane bound organelles (*i.e.* Mitochondria, Golgi complex etc). This bacteria utilized H_2S for food synthesis. After some time a more photosynthetic system evolves in which H_2O instead of H_2S was used as an electron donor. It helped in the evolution of autotrophic mode of nutrition and release a free oxygen in atmosphere. Then some bacteria developed which can able to use oxygen for aerobic respiration. Eukaryotes develop from prokaryotes which have clear nucleus and other membrane bound organelles (*i.e.* mitochondria, endoplasmic reticulum, chloroplast and golgi complex). Respiration takes place in Mitochondria and chloroplast is the Site of photosynthesis in Eucaryotes. In prokaryotes DNA is circular and lies freely in cytoplasm while in Eukaryotic cell DNA is packed with histone into chromosome which present in nucleus.

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Plant and animal cell differ in some respect, cellwall and chloroplast is present only in plant cell. Golgi bodies found in plant cell is called dictyosomes.

SELF -ASSESSMENT QUESTIONS

Q. 1. What is the cell theory states?

Ans. Cell theory is given by Schleiden and Schwann in 1839 which states that “the cell is the structural and functional unit of all living organism.”

Q. 2. Which stage of the evolution is characterized by organization of molecular aggregates?

Ans. Biological evolution is characterized by organization of molecular aggregates. In biological evolution molecular aggregates organized and formed in the cell.

Q. 3. Give the name of three protobiont models.

- Ans.** 1. Coacervate model (by *Alexander Oparin*)
 2. Protenoid microsphere model (by *Sidney Fox*)
 3. Lipid bilayer model (by *Richard Goldacre*)

Q. 4. Arrange the following structure and processes in the order in which they are believed to have evolved?

- (a) Aerobic Respiration
- (b) Polymer
- (c) Photosynthesis
- (d) Organic monomer
- (e) Acquisition of intracellular organelles.

Ans. The order in which following structure and processes are believed to have evolved is:

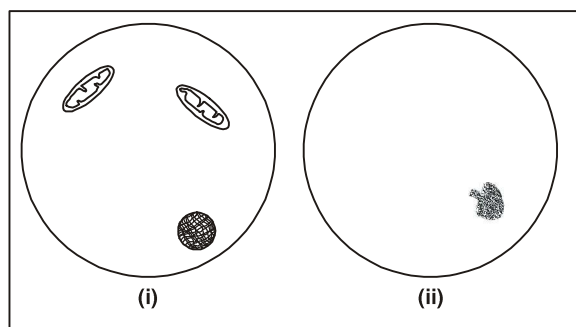
- (d) Organic monomer
- (b) Polymer
- (e) Acquisition of intracellular organelles
- (c) Photosynthesis
- (a) Aerobic Respiration.

- On the prebiotic earth surface, Ammonia, hydrocarbons and water reacted together under the influence of freely available energy resulted into the formation of organic monomer (*i.e.* amino acid, Nucleotides)
- Polymers were the result of the polymerization of organic monomers.
- Intracellular organelles (*i.e.* plasmamembrane) result of polymer aggregation. (Lipid and protein)
- Primitive bacteria utilized H_2S (after some time utilized H_2O) for food synthesis in the presence of light.
- Oxygen generate by photosynthesis and some bacteria soon develop which used the oxygen for the oxidation of food (Aerobic respiration).

Q. 5. Name the organelle common to both prokaryotes and eukaryotes.

Ans. Ribosomes are the only organelle which present in both prokaryotes and eukaryotes.

Q. 6. Two figures are given below, identify the prokaryotic and eukaryotic cell and give one important feature of identification?



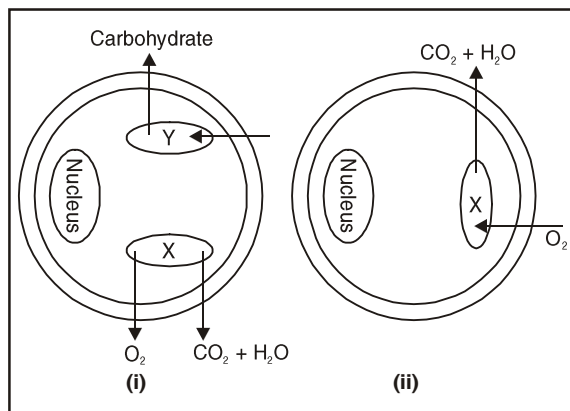
Ans. In figure (i) you can see two mitochondria and one nucleus are present. Mitochondria and nucleus both are membrane bound organelles which are absent in prokaryotic cell; so figure (i) is a eukaryotic cell.

In figure (ii) there are no membrane bound organelles and no clear nucleus. So it is a prokaryotic cell.

Q. 7. State one important difference between eukaryotic and prokaryotic DNA.

Ans. Eucaryotes contain long chain of DNA which is packed with histone protein in chromosome and enclosed inside the nucleus while in prokaryotes, there is a circular molecule of DNA which lies freely in the cytoplasm attached to the cell membrane, that is called nucleoid.

Q. 8. Look at the following figures and answer the questions:



(a) Name the organelles X and Y.

Ans. Organelle X is mitochondria and organelle Y is chloroplast.

(b) Identify the animals and plant cell and give reasons for identification.

Ans. Figure (i) is a plant cell because it contains chloroplast and cell wall which are absent in animal cell.

Figure (ii) is a animal cell because it contains mitochondria but chloroplast and cell wall are absent in it.

(c) Which major process occurs in Organelle X?

Ans. Respiration occurs in organelle X (Mitochondria) because organelle X utilized oxygen and CO₂ and water are released as products and the phenomenon of release of carbon di-oxide, water and energy by oxidation of various organic molecules is known as Respiration.



(d) Which major process occurs in organelle Y?

Ans. Photosynthesis occurs in organelle Y because organelle Y release carbohydrates as a product photosynthesis is a process by which plants synthesis their own food in the presence on light, carbon-di-oxide, water and chlorophyll.



TERMINAL QUESTIONS

Q. 1. How did the primordial cell originate?

Ans. The origin of the primordial cell can be divided into two types of evolution:

1. Chemical evolution
2. Biological evolution.

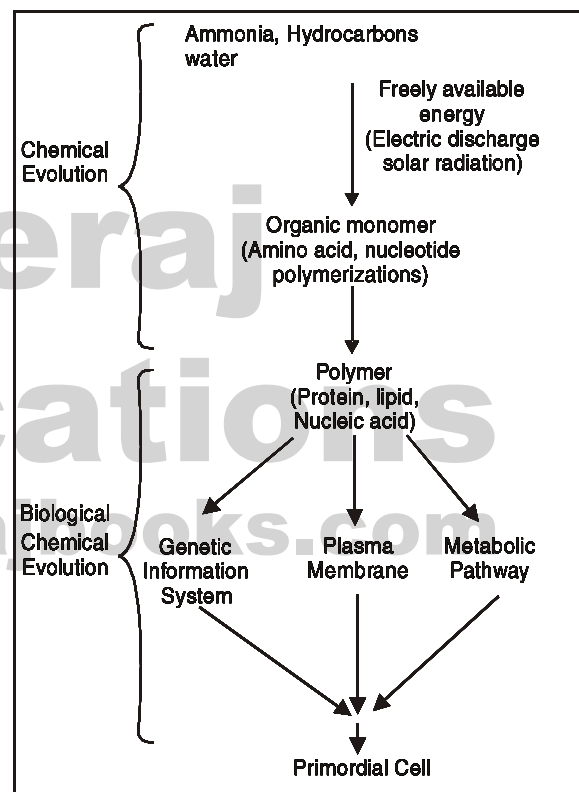
In chemical evolution, ammonia, hydrocarbons and water are reacted together on the prebiotic earth under the influence of freely available energy (electrical discharge, solar energy, UV radiation) resulted in to organic monomer (e.g. amino acid, nucleotide etc.). These organic monomer become polymerized and make polymer (e.g. protein, nucleic acid, lipid).

Biological evolution involve acquisition of three major features:

- Assemble of phospholipid and proteins into a cell membrane forms the boundary of the cell.
- Development of protein-directed metabolic pathways to utilize the organic molecules for energy needs, and
- Formation of nucleic acid molecules that are not only capable of self-replication but also capable of storing genetic information for the synthesis of proteins.

After the biological evolution, the primordial cell originate which is caused by plasma membrane and its genetic information stored in nucleic acid molecules.

We can show the origin of primordial cell by this flow chart:



Q. 2. List two changes in the environment that resulted from evolution of water splitting photosynthesis.

Ans. The photosynthesis which takes place by utilizing water resulted following two major changes in the environment:

- It helped in the evolution of autotrophic mode of nutrition.
- Release of free oxygen in the atmosphere by which some bacteria developed a metabolic sys-

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tem in which oxygen was used for respiration it is called Aerobic respiration. In Aerobic respiration more energy release from organic molecules.

Q. 3. Name the organelle(s) responsible for the following function in a eukaryotic cell:

- (a) Production of ATP by the oxidation of food
- (b) Protein synthesis
- (c) Secretion
- (d) Synthesis of food in the presence of sunlight.

Ans. (a) Production of ATP by the oxidation of food take place in mitochondria.

In eukaryotic cell, mitochondria are the site of aerobic respiration. In Aerobic respiration more energy release in the form of NADPH_2 and FADH_2 . In **mitochondrial cristae**'s F_1 particle, these NADPH_2 and FADH_2 convert into ATP by electron transport system. So ATP produce in Mitochondria and it is the reason why Mitochondria is called "power house of the cell."

(b) Protein synthesis take place in Ribosome. Protein synthesis complete in two steps:

- (i) Transcription
- (ii) Translation.

In transcription DNA convert into *mRNA* and in translation process, amino acid carried by *tRNA* come at the ribosome and bind to codons of *mRNA* and latter join to each other to produce a polypeptide chain (protein).

(c) Secretion take place in Golgi complex.

Golgi complex plays an important part in the synthesis and storage of secretory products like mucopolysaccharides and glycoproteins.

(d) Synthesis of food in the presence of sunlight take place in chloroplast.

In chloroplast, chlorophyll is present and plants synthesise their food by the reaction of carbon dioxide and water in the presence of chlorophyll and sunlight. In green plants chloroplast is the site of photosynthesis.

Q. 4. A symbiotic relationship of mitochondria with prokaryotic cells helped in tracing the evolution of eukaryotic cells. Explain it.

Ans. In some eukaryotes (like *pleomyxa palustris*) mitochondria are absent. In *pleomyxa palustris* an aerobic bacteria help it in respiration at the place of mitochondria. The association of bacteria with the organism shows a kind of symbiotic relationship. In this relationship, bacteria help the organism in

respiration and in turn bacteria living in the organism permanently.

According to above para we can say that mitochondria are aerobic bacteria which entered the eukaryotic cell as endosymbionts.

OTHER IMPORTANT QUESTIONS

Q. 1. Distinguish between prokaryotic and eukaryotic cells?

Ans. Prokaryotic Cells

1. Lack of organized nucleus the genetic material present in the form of nucleoid.
2. Nuclear membrane present
3. DNA not complexed with histones.
4. DNA in a circular form; not packed into chromosomes.
5. Membrane bound organelles absent.
6. Cell wall made up of murein.
7. Flagella simple, made up of flagellin and 9 + 2 organisation is absent.
8. Ribosomes only of 70 type
9. Pili present.

Eukaryotic Cells

1. Nucleus well organized.
2. Nucleus membrane absent.
3. DNA complexed with histones to constitute chromatin.
4. Linear DNA packed into well defined chromosome.
5. Membrane-bound organelles like ER, Golgi, Lysosome etc. present.
6. Cell wall absent in animal cell. In plant cell it is made up of cellulose, hemicellulose, lignin and pectin.
7. Flagella specialized and show 9+2 organisation.
8. Ribosomes of 80s type (in cytoplasm) 70s (in plant cell). 80s and 55s in animal cell.
9. Pili present.

Q. 2. Give the difference between Gram Positive and Gram Negative Bacteria.

Ans. Gram Positive Bacteria

1. The bacteria remain coloured blue or purple with Gram staining even after washing with alcohol.