Cell

Cell

- All living forms are composed of microscopic units called as Cells.
- A cell is the basic structural and functional unit of all living organisms.
- Study of Structure and composition of cell is called as Cytology.
- Cell was first observed by "Robert Hooke" in a dead cork slice in the year 1665. He described about this in his book "Micrographia".
- The word cell was derived from a Greek word "Cellulae" which means small room.
- First living cell was discovered by A.V. Leeuwenhoek.
- The term protoplasm was coined by Purkinje in 1839.
- Protoplasm was discovered by "Felix Dujardin" and named as sarcode.
- Protoplasm consitency differs under different conditions. It exists in sol-gel states.
- Protoplasm is an aggregate of various chemicals such as water, iosn, salts and other organic molecules like proteins, carbohyudrates, fats, nucleic acids, vitamins etc.
- Living beings are divided into two group on the basis of number of cells.
  (i) Unicellular: Living organisms are composed of single cell, e.g. Amoeba, Euglena, Chlamydomonas, Paramoecium.
  (ii) Multicellular: Living organisms are composed of many cell, e'g. Hydra, human, Plants.

Cell Theory

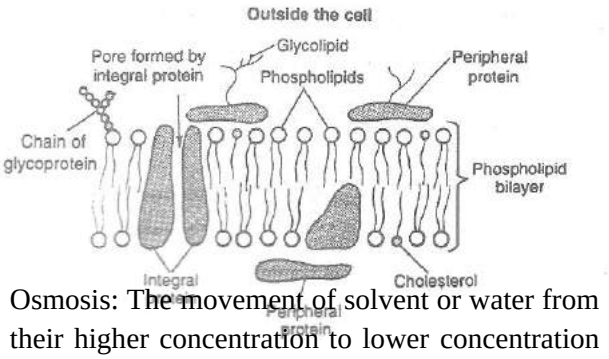
- Two biologist, "Schleiden and Schwann" gave the "Cell theory" which was later on expanded by "Rudolf Virchow"
- Viruses are the exceptions of cell theory.

Cell Size

- Size of Cell is variable depending upon the type of organism. Some are microscopic while some are visible with naked eyes. Their size may vary from 0.2 m to 18cm.
- The largest animal cell is ostrich egg (15 cm. in dia with shell & 8cm. in dia without shell)
- The longes animal cell is nerve cell. (upto 1m. or more)
- Smallest cell sofar known are PPLOs
- E.g. mycoplasma (0.1 m in dia).

Cell Membrane

- Singer and Nicholson gave the fluid mosaic model of plasma membrane according to him it consists of a bilayer of lipid in which proteins are embedded.



- Osmosis: The movement of solvent or water from their higher concentration to lower concentration of solvent through a semipermeable membrane is called as osmosis. Osmosis can also be called as "diffusion of Solvents".
- Endosmosis: Movement of solvent into the cell is called as Endosmosis.
- Exosmosis: Movement of solvent outside the cell is called as Exosmosis.
- Functions: Plasma membrane helps in transportation of molecules inside or outside the cell.

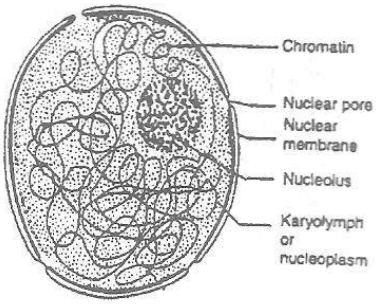
Cell Wall

- It is the outermost covering of the plant cells.
- It is absent in animal cells
- Cell wall is rigitd, strong, thick and non living structure. It is made up of cellulose.
- In fungi it is made up of chitin.
- In bacteria it is made up of peptidoglycan.
- Functions of cell wall:
- It provides definite shape to the cell.
- It is permeable and allows entry of molecules of different sizes.

Nucleus

- Nucleus is the most important cell organelle which directs and controls all its cellular activities.

- It is called as "Headquarter of the cell"/ "Controlling centre of cell".
- In was discovered by "Robert Brown in 1831".
- In eukaryotes a well defined nucleus is present while in prokaryotes a well defined nucleus is absent,
- Prokaryotes contain a primitive nucleus known as nucleoid or genophore.
- It has a double layered covering called as nuclear membrane.
- Nuclear membrane has pores which regulate the movement of materials in & out of the nucleus.
- Nucleus contains chromatin material & nucleoplasm.



- It was first observed by Fontana.
- It is without a limiting membrane.
- It is the structure in which ribosomes are formed.

Functions of the nucleus:

- It controls all the metabolic activities of the cell and regulates the cell cycle.
- It helps in transmission of hereditary characters from parents to offsprings.

Cytoplasm

- Cytoplasm was discovered by Kolliker in 1862.
- It is the site of both biosynthetic and catabolic pathways.
- It can be divided into two parts:

(i) **Cytosol:** Aqueous soluble part contains various fibrous proteins forming cytoskeleton.

(ii) Cell Organelles: Living part of the cell having definite shape, structure & function bounded by membrane.

Endoplasmic Reticulum

- It was discovered by porter, Claude and Fullam.
- These are present in all cells except prokaryotes and mammalian erythrocytes.
- They are made up of three components:

(i) Cistemae (ii) Vesicles (iii) Tubules

- Endoplasmic reticulum of striated muscles are called as sarcoplasmic reticulum.

(a) Types:

Endoplasmic reticulum is of two types

Smooth ER	**Rough ER**
○ Made of tubules mainly.	○ Made of cistemae
○ Helps in steroid, lipids and.	& vesicles.
○ Polysaccharide synthesis.	○ Helps in protein
○ Ribosomes are absent.	Synthesis.
○ Helps in membrane biogenesis.	○ Contains ribosomes on its surface.

(b) Functions of ER:

(i) It forms endoskeleton of cell.

(ii) It helps in synthesis of fats, steroids, cholesterol etc.

(iii) It helps in transportation of molecules.

(iv) SER plays a crucial role in detoxification of drugs and poisonous by-products.

Golgi apparatus

- Golgi apparatus consists of a system of membrane bounded vesicles arranged parallel to each other in stacks called cisternae along with some large and spherical vacuoles.
- It was discovered by Camilo golgi.
- In plants golgi body is called as Dictyosomes.
- It is absent in prokaryotes, mammalian RBC's& sieve cells.

(a) Functions:

(i) It helps in formation of middle lamellae

(ii) It is secretary in nature.

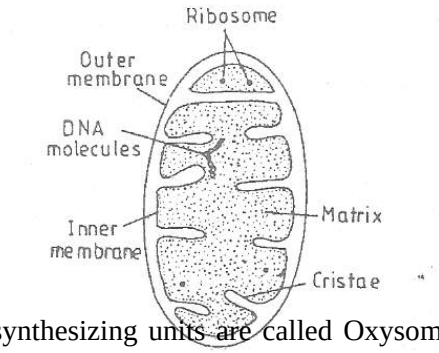
(iii) It helps in melanin synthesis

(iv) Lipids and proteins synthesized in endoplasmic reticulum are packed at golgi complex. They provide the site for assembly of new membrane material.

Mitochondria

- These are also absent in prokaryotes.
- It was first seen by Kolliker in striated muscle of insect.

- It is also called as "Power House of the Cell" or the "Storage Battery"
- It is double membranous structure where outer membrane has specific proteins while inner membrane is folded inside to form chambers called Cristae. "Cristae" are the infoldings of inner mitochondrial membrane.
- Matrix possess enzymes for respiratory cycle like kreb Cycle.



Internal Structure of mitochondria

- ATP synthesizing units are called Oxysomes or F_1 Particles.
- Space between inner and outer mitochondrial membranes is called as perimitochondrial space. The fluid present in mitochoniria is called as matrix.
- **Functions:**

(i) Its main function is to produce and store the energy in the form of ATP.
(ii) It is the site of Kreb cycle of respiration.
(iii) Oxysome contains enzymes for ATP production.

Ribosomes

- Ribosomes are the sites of protein synthesis.
- Ribosomes are made up of ribonucleoprotein & naked.
- Ribosomes are smallest cell organelle.
- Rebosome are two types
  (i) 70 S in prokaryotic cell. (ii) 80 S in eukaryotic cell.
  (S = Svedberg units)
- **Functions:** Ribosomes help in protein synthesis.

Plastid

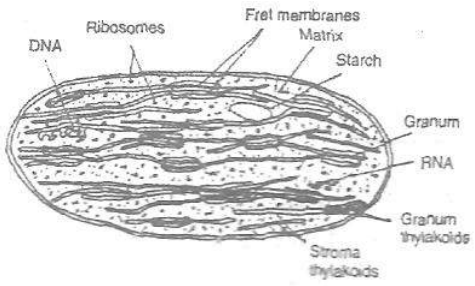
- It is a double membranous discoidal structure, found only in plant cells.
- Term plastid was given by Haeckel.
- Chloroplast was discovered by A.V. Leeuwenhoek and named by Schimper.
- Plastids are three types
- Leucoplast: Storage of food.
- Chromoplast: contain colourful pigments.
- Chloroplast: contain green pigments & site of photosynthesis.

(a) Chloroplast have Following Two Parts:

(i) Grana: It Constitutes the lamellar system. These are found layered on top of each other, these stacks are called as Grana. Each granum of the chloroplast is formed by super imposed closed compartments called Thylakoids.

- **Functions:** They are the sites of light reaction of photosynthesis as they contain photosynthetic pigment chlorophyll. In each thylakoid Quantasomes are present which are called as photosynthetic units. Each quantasome possesses 230 chlorophll molecules.

(ii) **Stroma:** It is a granular transparent substance also called as matrix. Grana are embedded in it. Besides grana they also contain lipid droplets, grains, ribosomes etc.



Internal Structure of chloroplast

- **Function:** This is the site of dark reaction of photosynthesis. Also helps in protein synthesis due to present of ribosomes.

Vacuoles

- These are membrane bounded regiouns in the cytoplasm containing water and other substances.
- They are bounded by a single membrane called Tonoplast.
- In animal cells vacuoles are smaller in size and numerous while in plant cells a single large vacuole is found which occupies about 90% of the volume of cell.

(a) Functions:

- It helps in maintaining osmoregulation in a cell.
- It stores toxic metabolic products of plant cell.

- It contains various coloured pigments like anthocyanins.

Lysosomes

(Discovery: Christian de Duve) (Lyso= digestive, soma=body)

- These are tiny sac like structure containing enzymes of intracellular digestion.
- They are bonded by a single membrane.
- They occur in animal cells and a few in plant cells.
- They contain hydrolyzing enzymes called acid hydrolases.

(a) Functions:

- They are kind of waste disposal system.
- They help in digesting foreign materials and wom out cells. So they are also called as "Suicidal Bags".

Peroxisomes

- These structures were first described from liver and kidney cells by Rodhin (1954)
- In plant cells, they were first observed in germinating seeds by Tolbert (1969)
- In green leaves of C3 plants, peroxisomes carry out photorespiration.
- In animal cells they carry out lipid metabolism.

Glyoxysomes

- Beavers (1961) was the first person to discover these organelles and were described later by R.W. Briedenbach (1967).
- They are found in plant cells, particularly, in germinating fatty seeds e.g. Ricinus (castor) and groundnut where fat is being converted into carbohydrates by a process called glyoxylate cycle. **Differences between a plant cell& an animal cell**

Plant Cell	Animal Cell
Cell wall is present	Cell wall is absent
Plastids are found	Plastids are absent
One large vacuole	Numerous tiny vacuoles are found
Centriole is absent	Centriole is present

Cytoskeleton

Three principal types of protein filaments are microfilaments, microtubules, and intermediate filaments, constitue the cytoskeleton.

- Microfilaments are made up of actin-like protein. They
  (i) Help in maintaining cell shape
  (ii) Are involved along with microfilaments in cell movements.
  (iii)Participate in intracellular transport.
  (iv)Play an important role in movement of organelles.
- The intermediate filaments have 8-10 nm diameter. In most animal cells, they form a basket around the nucleus and are present in cell-cell junction.
- On the basis of type of organization, cells are of Two Types:
  (i) Prokaryotic cells: These are primitive and incomplete cells. They have less developed nucleus without nuclear membrane and nucleolus, e.g. Bacteria.
  (ii) Eukaryotic Cells: These are well developed cells. They have advanced nucleus with nuclear membrane and nucleolus. E.g. Plants & animals.

Differences between prokaryotic and Eukaryotic cell

Characters	Prokaryotic cells	Eukaryotic cells
Nuclear body	Incipient nucleus, No Nuclear membrane Nucleolus absent DNA Single closed loop, (histones absent)	True nucleus, Nuclear membrane present Nucleolus present Multiple Chromosomes, (histones present in chromosome)
Mitosis	No Mitosis	Mitosis found
Respiratory System	In plasma membrane, (mitochondria absent)	In mitochondria
Photosynthetic Apparatus	In internal membranes, (mitochondria absent)	In chloroplasts
Golgi bodies,		

Chloroplast, Endoplasmic reticulum. Mitochondria, Lysosomes	Absent	Present
Ribosomes	70S types	80S type
Cell wall	Generally present.	Present in plant cell.
Vacuoles	Absent	Present
Capsule	May be present	Always absent

Some Important Points

(i) Centrosome:

- It is found only in animal cell.
- It consists of two centrioles.
- It is membraneless structure.
- It is made up of microtubules.
- It helps in cell division and spindle formation.

(ii) Cilia and flagella: These are thread like appendages used for locomotion and emerge from basal body.

(iii) Chromosomes: These are thread like structures containing hereditary information in form of genes.

(iv) There are four different types of membranes on the basis of permeability:

(A) Permeable: They allow diffusion of both solvent and solute molecules or ions through them, e.g. Cell wall of plant cell.

(B) Impermeable: They prohibit the diffusion of both solvent and solute particles through them e.g. Cutinized cell wall, Lignified cell wall.

(C) Semipermeable: Allows diffusion of solvent molecules but do not allow the passage of solute molecules, e.g. parchment paper, Kidney membrane.

(D) Differentially permeable: It allows some solutes to pass through them along with the solvent molecules. E.g. plasmalemma, Tonoplast.

- Connections through which cells communicate chemically with each other through their thick walls are called as "Plasmodesmata".
- Protoplasm was called as "Physical Basis of Life" by Huxley.
- Euglena is the connecting link between plants and animals as it lacks cell wall but has plastids.
- Mesosomes in bacteria are analogous to mitochondria as they both help in cellular respiration.
- Centre for cellular and molecular biology is situated at Hyderabad.
- In animal cell the 'Cell Coat' is present instead of cell wall which provides them protection. It is made up of glycocalyx.
- ATP (Adenosine Triphosphate) is the energy currency of the cell i.e. energy in cell is stored in form of ATP molecules.
- DNA is called as "Chemical Basis of Life".
- DNA- structure explained by double helix model which was proposed by Watson and crick.
- Mitochondria, Plastid and centrioles have their own DNA molecules so they are calledas "Semiautonomous Cell Organelles".
- RNA (Bibose Nucleic acid): RNA responsible for protein synthesis in a living. RNA are of three type: mRNA, tRNA, rRNA.

Cell Division

Cell division was first observed by Nageli in Plant cell (1842) and it was first studied by Prevost and Dumas in the fertilized egg of frog.

(a) Cell Cycle:

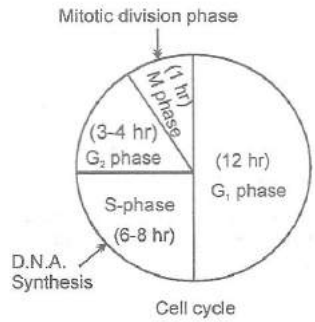
It is a series of programmed cyclic changes by which the cell. Duplicates its contents and divides into two parts. Cell cycle was discovered by Howard and Pelc. It is divided into two phases:

(i) Long non dividing (I- Phase) or interphase.

(ii) Short dividing M-phase or mitotic phase

(i) Long non dividing (I- phase) or interphase: Interphase divided in the following steps.

- G_1 (First growth phase),
- S (Synthesis phase),
- G_2 (Second growth phase)



(ii) Short dividing M- Phase: It is the phase of cell division. It consists of Karyokinesis (nuclear division) and cytokinesis (cytoplasmic division). It is of two types:

(b) Mitosis:

- Term mitosis was given by Flemming.
- It is also called as somatic division as it occurs during formation of body cells.
- It is an equational division in which a parent cell divides into two identical daughter cells, each of them contains the same number of chromosomes as are present in parent cell.
- It occurs in two steps:

(i) Karyokinesis: Division of nuclear. It is divided in four steps:

(A) Prophase:

(B) Metaphse: Chromosomes are arranged at the equator & forming a metaphase plate. Chromosomes are shortest and thickest in this stage. This phase is most suitable for study of chromosomes.

(C) Anaphse: Shortest phase of cell division. Chromosomes are appeared in different shapes.

- V – Shaped (Metacentric)
- L - Shaped (Submetacentric)
- J - Shaped (Acrocentric)
- I – Shaped (Telocentric)

(D) Telophase:

(ii) Cytokinesis: It is referred to the division of cytoplasm. In animals it occurs by formations of cleavage furrow in the middle by constriction in plasma membrane. In plants it occurs by cell plate formation.

- **Note:** Colchicine is a mitotic poison. It blocks the completion of metaphase.

(c) Meiosis:

- It occurs only once in the life cycle of organism.
- It is a double division in which a diploid cell divides twice to form haploid cells.
- It can be studied in anthers of unopened flowers in plants and in testis of grasshopper in animals.

It consists of two phases:

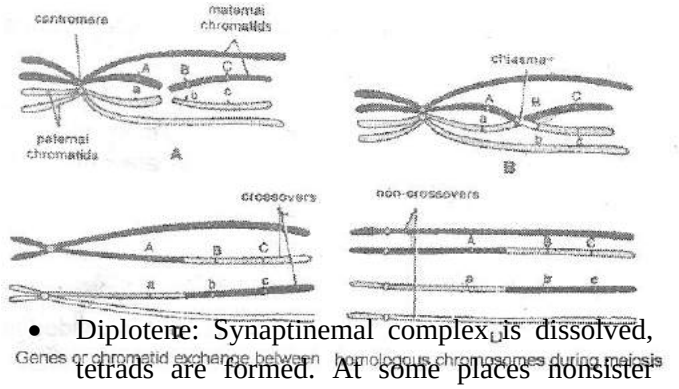
(i) Interphase: Size of nucleus increases to three times. It also involves G,-S-G_2 phase.

(ii) M- phase: It occurs in two steps.

(A) Meiosis –I, (B) Meiosis-II

(A) Meiosis-I: Also called as reduction division. Diploid stage changes to haploid stage. It Occurs in four steps.

- Prophase –I: It is the longest phase of meiosis. It has following stages:
- Leptotene
- Zygotene
- Pachytene: The exchange of segments between non sister chromatids of chromosome is called as crossing over.



- Diplotene: Synaptinemal complex is dissolved, tetrads are formed. At some places nonsister chromatids of two homologous chromosomes remain attached to form a chiasmata.

a. Diakinesis b. Metaphase-I

b. Anaphase-I c. Telophase-I

(B) Meiosis –II: It is also called as equational division and maintains the haploid number of chromosome. No replication of DNA occurs in this stage.

a. Prophase –II b. Metaphase-II

b. Anaphase- II c. Telophase-II

Difference between mitotic and meiotic cell division

Mitosts	Meiosis
It occurs in all somatic cells.	It occurs in reproductive cells (germ cells)
In the resultant daughter cells, the number of chromosomes remains the same (i.e., diploid), hence, called equational division.	In resultant daughter cells, the number of chromosomes reduces to half (i.e., haploid), hence, called reductional division.
By mitosis two daughter cells are produced	By meiosis four daughter cells are produced.
During mitosis no	During meiosis crossing

crossing over takes place	over takes place.
Daughter cells have identical chromosomes which are also identical to that of parent cell (i.e. remains constant)	Chromosomes of the daughter cells are with combined components (genes) of both parents (i.e. genetic variability occurs)

(d) Amitosis:

It was discovered by Remak. In this division cells are divided in to two into cells without any particular pattern. E.g. prokaryotic cells.

- Significance of mitosis: It is essential for growth, repair, differentiation, maintenance of chromosome number etc.
- Significance of meiosis: It produces variations and essential for sexual reproduction. It maintains the chromosome number in each generation of living organisms.

EXERCISE

1. The red colour of the tomato is due to
(A) Ieucoplast (B) Chromoplast
(C) Chloroplast (D) none of these

2. The cellular structure concerned with intra cellular digestion is
(A) Mitochondria (B) chloroplast
(C) ribosome (D) Iysosome

3. Power house of the cell is
(A)Mitochondria (B) Ribosome
(C) Lysosome (D) Golgi body

4. 'Physical basis of life's is the used for
(A) cytoplasm (B) Protoplasm
(C) Nucleoplasm (D) Sarcoplasm

5. Cell was discovered by
(A)Robert Brown (B) Robert Hooke
(C) Leewenhoek (D) Whittaker

6. Prokaryotic cell is
(A) Bacterial Cell (B) Amoeba
(C) nerve cell (D) Human bone cell

7. Centrioles and centrosomes occur in the cell of
(A)Green plants
(B) animals
(C) bacteria and Cyanobacteria
(D) Both B and C

8. Semi autonomous organelle is
(A)Endoplasmic reticulum
(B) Iysosome
(C) Peroxisoem (D) Chloroplast

9. Lysosome are store house of –
(A) Proteins (B) hydrolytic enzymes
(C) ATP (D) Sugar

10. Who proposed the cell theory?
(A) Schleiden (B) Schwann
(C) A and B both (D) None of the above

11. Enzymes are absent in
(A) Algae (B) plants
(C) viruses (D) bacteria

12. Iodine test is used to detect
(A) Fats (B) Carbohydrates
(C) protein (D) Vitamin

13. Cellulose is a polymer of
(A) α - Glucose (B) β - Glucose
(C) α - Fructose (D) β - Fructose

14. In which of the following nucleoid is present?
(A) Plant Cell (B) Animal cell
(C) Green algae cell (D) Bacterial cell.

15. Cell organelle surrounded by a single unit membrane is
(A) mitochondria (B) chloroplsat
(C) Isysosome (D) nucleus

16. Protein Formation is related to
(A) mitochondria (B) ribosomes
(C) Iysosomes (D) nucleus

17. Smallest cell so far known is
(A) Bacteria (B) cyanobacteria
(C) PPLO (D) Virus

18. The bacterial cell wall made up of
(A) Polypeptide (B) cellulose
(C) mucopolypeptide (D) lipid & protein

19. Protein packaging is done by
(A) nucleus (B) nucleolus
(C) golgi apparatus (D) E.R.

20. Dictyosomes are
(A) Class of ribosomes (B) respiratory particles
(C) pigment storing granules (D) Golgi bodies

21. In humans the number of chromosomes in a haploid cell is
(A) 23 (B) 46
(C) 44 (D) 30

22. In metacentric chromosomes. Position of centromere is-
(A) terminal (B) middle
(C) subterminal (D) none of these

23. In plant cells, cytokinesis occurs by-
(A) Cell plate (B) invagnation
(C) furrowing (D) all of these are correct

24. Chromosomes are distinctly visible in-
(A) anaphase (B) metaphase
(C) prophase (D) Telophase

25. In electron microscope, the source of light used is-
(A) ordinary daylight (B) ultraviolet
(C) infrared (D) beam of electrons

26. Which nitrogen base is present only in RNA? **(NTSE Stage-I/Raj./2007)**
(A) Adenine (B) Guanine
(C) Thymine (D) Uracil

27. If a nucleus is removed from a living cell, the remaining part will be- **(NTSE Stage-I/Raj./2007)**
(A) Nucleoplasm (B) Protoplasm
(C) Cytoplasm (D) Cell Sap

28. True statement is – **(NTSE Stage-I/Raj./2007)**
(A) Plant cell has cell membrane.
(B) Number of Ribosome is constant.
(C) Protein synthesis is done in plastids.
(D) The shape of animal cells is spherical

29. Synthesis of protien in cell occurs at- **(NTSE Stage-I/Raj./2008)**
(A) Nucleus (B) Chloroplasts
(C) Cell membrane (D) Ribosomes

30. Suicidal bags of cell are- **(NTSE Stage-I/Raj./2008)**
(A) Lysosomes (B) Ribosomes
(C) Centrosomes (D) Nucleosomes

31. Genetic Characters of a living being are transmitted to the offsprings by- **(NTSE Stage-I/Raj./2008)**
(A) Ribosomes (B) Chromosomes
(C) Plasma (D) Lysosomes

32. Elephants eat grass and both have cells. Read the following statements regarding cells. Identify the correct ones. **(NTSE Stage-II/Raj./2008)**
(A) Elephant cells are bigger that than grass cells.
(B) Elephant cells have plastids and small Vacuoles.
(C) Grass cells have cell walls and vacuoles.
(D) Grass cells have cilia and chloroplasts.
(E) Elephants cells have cell membrane and mitochondria.

Which one of the following alternatives is correct?
(A) A and C (B) B and C
(C) C and E (D) D

ANSWER KEY

CELL

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.	B	D	A	B	B	A	B	D	B	C	C	B	B	D	C
Q.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A.	B	C	C	C	D	A	B	A	B	D	D	C	A	D	A
Q.	31	32													
A.	B	C													