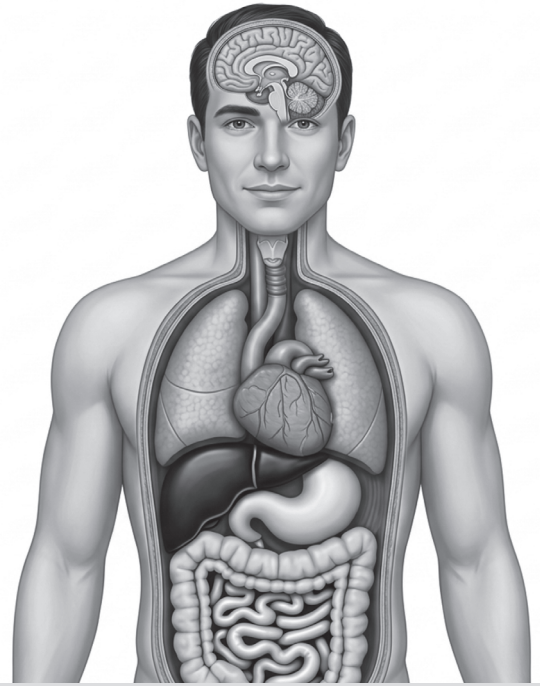


II

APPLIED PHYSIOLOGY



This Subject Deals with

1. General Physiology
2. Respiratory System
3. Digestive System
4. Circulatory and Lymphatic System
5. Blood
6. The Endocrine System
7. Sense Organs
8. Musculoskeletal System
9. Renal System
10. Reproductive System
11. Nervous System

General Physiology

A. MULTIPLE CHOICE QUESTIONS (1 Marks Each)

1. **Cell membranes:**
 - (a) Contain many carbohydrate moles.
 - (b) Contain few protein molecules
 - (c) Are freely permeable to electrolytes but not to proteins.
 - (d) Consist of a double layer of lipid molecules in which proteins are embedded.**
2. **One major function of the cell membrane is:**
 - (a) Protective
 - (b) Digestive
 - (c) Property of selective permeability**
 - (d) Links adjacent cells together to form tissues
3. **For gene, all are true except:**
 - (a) It is made up of chromosomes.**
 - (b) It is a portion of DNA molecule
 - (c) It carries a complete blue print for all the heritable species
 - (d) It is present on chromosomes
4. **The main function of the nucleus is:**
 - (a) To control chemical and physical characteristic of the cell
 - (b) To bring about cellular reproduction and multiplication**
 - (c) To synthesize protein for the cell
 - (d) To help in cellular movement
5. **Protein synthesis takes place in – (SSUHS, 2024)**
 - (a) Mitochondria**
 - (b) Vesicle
 - (c) Golgi apparatus
 - (d) Rough endoplasmic reticulum
6. **The Ion needed for the contraction of muscle is:**
 - (a) Sodium
 - (b) Calcium**
 - (c) Potassium
 - (d) Bicarbonate
7. **Cell Power house is:**
 - (a) Mitochondria**
 - (b) Golgi apparatus
 - (c) Lysosomes
 - (d) Endoplasmic Reticulum
8. **The cell organelle that contains DNA- (RGUHS 2023 JUN)**
 - a) Golgi apparatus
 - b) Mitochondria**
 - c) Smooth endoplasmic reticulum

- d) Rough endoplasmic reticulum
9. The movement of particles from a region of higher concentration to the region of lower concentration is termed as:
- Diffusion
 - Endocytosis
 - Pinocytosis
 - Osmosis
10. Which of the following is the functions of skeletal system:
- Secretion and absorption
 - Contraction
 - Storage and minerals
 - Communication
11. Chief cells secrete:
- Pepsinogen
 - Gastrin
 - Mucus
 - Intrinsic factor
12. A major role for mitochondria is to:
- Transcribe the information in DNA
 - Produce ATP
 - Synthesize proteins from amino acids
 - Use enzymes to lyse molecules
13. What are the primary types of tissue in the body:
- Muscles nervous connective and epithelial
 - Muscles nervous connective osseous and epithelial
 - Muscles nervous connective osseous blood and epithelial**
 - Muscles nervous connective glandular and epithelial
14. Osmotic pressure across the capillary will is exerted:
- Size of the molecule
 - Shape of the molecule**
 - Concentration of the molecule
 - All of the above
15. The intrinsic protein present in the cell membrane mainly function as:
- Enzymes**
 - Carriers
 - Pores
 - Channels
16. Which of the following is a trans parent tissue:
- Fibrous cartilage
 - Tendon
 - Hyaline cartilage**
 - Ligaments
17. Docking markers are mostly closely associated with:
- The nucleus
 - Mitochondria
 - DNA
 - Golgi complex**

B. LONG QUESTIONS AND ANSWERS (1 Marks Each)

1. Describe briefly the structure and function of a generalized cell.

Ans: The fundamental unit of life is cell. The three principle components of a cell are as follows:

- Cell Membranes
- Nucleus and its chromosomes
- Cytoplasm and its organelles

A. Cell Membranes

- Also known as the plasma membrane, is the outermost layer of the cell.
- Thickness 7-10 nanometers
- All membranes consist of a double layer of lipid molecules in which proteins are fixed.
- Some proteins are located in the inner surface of the membrane (intrinsic proteins), some are located in the outer surface of the membrane (Extrinsic surface), while other extend through the membrane (transmembrane proteins).
- The clear area is formed of a bimolecular thickness of lipid molecules (phospholipids, cholesterol and glycolipids). it contains two acid fatty chains facing each other that meet in the water poor interior of the membrane (**Fig. 1**).

Functions:

- Protective: it forms the outermost boundary of the cell organelles.
- Digestive: it takes in food and excretes waste products.

- Property of selective permeability non-polar (water-fearing) uncharged molecules (gases like O₂, CO₂ and N₂, lipids, steroid hormones, alcohol) can dissolve in the membrane and thus move rapidly across the membrane.
- Polar molecules (water-soluble substances: ions, glucose, urea, etc.) have much lower solubility, therefore, penetrate the membrane much more slowly.
- It links neighbouring cells together by junctional complexes to form tissues.

2. Write notes on mitosis.

Ans: Definition: - 'Mitosis is that step in the cell cycle where the newly formed DNA is separated and two new cells are formed with the same number and kind of chromosomes as the parent nucleus.'

Features of Mitosis:

- In each cycle of cell division two daughter cells are formed from the parent cell.
- The cell is also known as equational cell

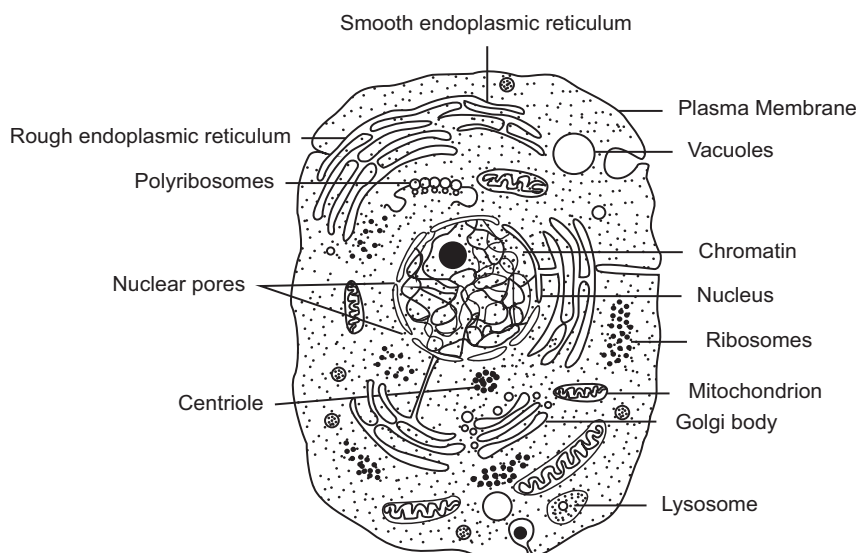


Fig. 1 : Structure of a generalized cell

division because the chromosomes number in the parent cell and daughter cell is the same.

Stages of Mitosis: - Right before prophase the cell spends most of its life in the interphase where preparations are made before the beginning of mitosis. How even since the actual process involved in the division of the nucleus the prophase is technically the first stage of this process.

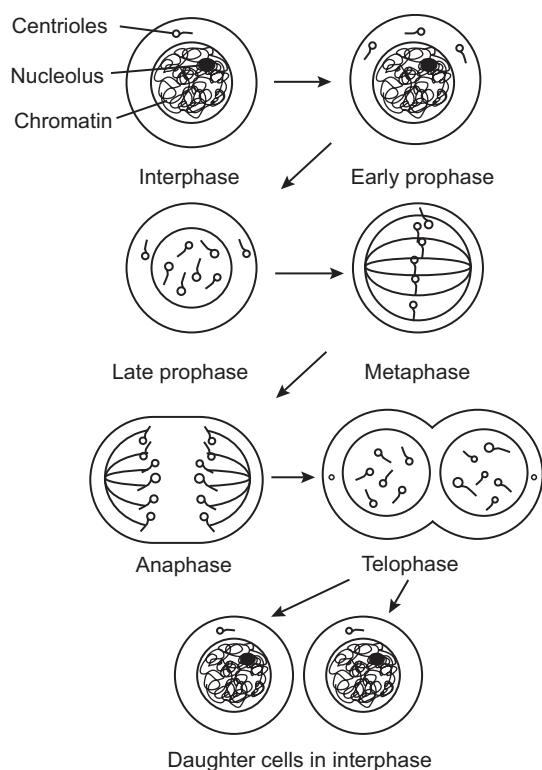


Fig. 1.2 : Stages of mitosis

Different Stages: -

1. Interphase.
2. Prophase.
3. Prometaphase.
4. Metaphase.
5. Anaphase.
6. Telophase.

1. Interphase: - Before entering mitosis a cell spends a period of its growth under inter phase. It undergoes the following phases when in interphase.

- **G1 Phase:** - This is the period before the synthesis of DNA.
- **S. Phase:** - This is the phase during which DNA synthesis takes place.
- **G2 Phase:** - This is the phase between the end of DNA synthesis and the beginning of the prophase.

2. Prophase: - Prophase immediately follows the S and G2 phase of the cycle and is marked by condensation of the genetic material to form compact mitotic chromosomes composed of two chromatids attached at the centomere.

The completion of prophase is characterised by the initiation of the assembly of the mitotic spindle. The micro tubules and the proteinaceous. Components of the cytoplasm that help in the process. The nuclear envelope starts disintegrating.

3. Prometaphase: - In the prometa phase the nuclear envelop disintegrates now the micro-tubules are allowed to extend from the centomere to the chromosomes. The microtu-bules attach to the kinetochores which allow the cell to move the chromosome around.

4. Metaphase: - At this stage, the microtubules start pulling the chromosomes with equal force, and the chromosome ends up in the middle of the cell. This region is known as the metaphase plate. Thus, each cell gets an entire functioning genome.

5. Anaphase: - The spitting of the sister chromatids marks the onset of anaphase. These sister chromatids become the chromosomes of the daughter nuclei. The

chromosomes are then pulled towards the pole by the fibres attached to the kinetochores of each chromosome. The centromere of each chromosome lies at the edge, while the arms trail behind it.

6. **Telophase:** - The chromosomes that cluster at the two poles start coalescing in to undifferentiated mass as the nuclear envelope starts forming around it. The nucleus, Golgi bodies and Endoplasmic reticular complex which had disappeared after prophase start reappear. The telophase is followed by cytokinesis which denotes the division of the cytoplasm to form two daughter cells thus it marks the completion of cell division.

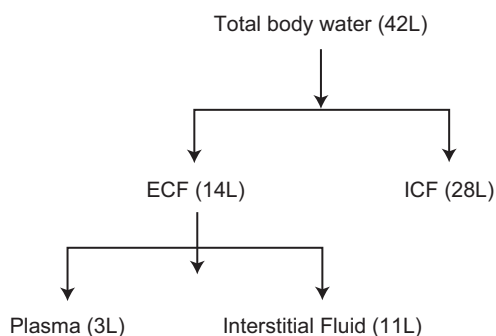
3. **Give the normal Value of total body water. Classify various compartments by giving the normal value. Explain the methods of measurement of various compartments.**

Ans: Total body water (TBW) is around 60% of the body weight i.e. 42 L in a 70kg male adult. It is about 10% less in normal adult female.

Various compartments is:

Body fluids are divided into two compartments

1. Intracellular Fluid
2. Extracellular fluid



Flow Chart - 1

INTRACELLULAR:

Intracellular fluid is the total amount of fluid present inside all the cells of our body. The normal volume of ICF is 28 L (two-thirds of the total body fluids).

EXTRACELLULAR FLUID:

Extracellular fluid is the fluid present outside the cells. The normal volume of ECF is 14 L (one-third of the total body fluids).

It has two parts: (i) interstitial fluid (11 L) and (ii) plasma (3 L).

Interstitial fluid surrounds the cells. It is the fluid occupying the interstitial spaces between the tissues. Plasma is the non-cellular part of blood. It communicates continuously with interstitial fluid through the pores of capillaries. Therefore, plasma and interstitial fluid have almost similar compositions.

TRANSCELLULAR FLUID:

Transcellular fluid is a special type of ECF. It includes synovial, peritoneal, pericardial, intraocular, and cerebrospinal fluid. Transcellular fluid in total constitutes 1-2 L.

Table - 1 : Composition of Body Fluids

	ECF (mOsm/LH ₂ O)	ICF (mOsm/LH ₂ O)
Na	142	14
K	4.2	140
Ca	1.3	0
Mg	0.8	20
Cl	108	4
Protein	1.2	4

MEASUREMENT OF BODY FLUIDS:**Total Body Water**

Total body water (TBW) is measured by using radioactive water, heavy water (D_2O), and antipyrine. These substances mix well with body water within a few hours after the injection. Total body water is calculated by estimating the degree of dilution of these substances:

Amount of substance injected

TBW = _____

Concentration of the substance after the dilution

Extracellular Fluid

Extracellular fluid is measured by using substances that disperse in ECF and plasma but do not enter the cell. Substances used are radioactive sodium, sucrose, thiosulfate ion, and inulin.

Plasma Volume

Substances that remain in the vascular system but do not readily penetrate the capillary membranes are used to measure the plasma volume, e.g., serum albumin labelled with radioactive iodine and Evans blue (a dye) by the dilution technique.

Intracellular Fluid

Intracellular fluid is the fluid present within the cells. It cannot be measured directly. It is calculated indirectly using the following formula:

$$ICF = TBW - ECF$$

C. SHORT ESSAYS**1. What are the types of RNA? Add a note on their functions.**

Ans: There are three types of RNAs:

1. mRNA (messenger RNA)
2. tRNA (transfer RNA)
3. rRNA (ribosomal RNA)

mRNA

mRNA carries the genetic code from the nucleus to cytoplasm for controlling protein synthesis. It is composed of several hundred to several thousand nucleotides in a single unpaired strand. It enters the cytoplasm and arranges itself on the ribosomes.

Functions:

- mRNA provides the necessary information for arranging the amino acids in proper order.

tRNA

tRNA contains about 80 nucleotides. It is folded to form a clover leaf. It transports amino acids to protein molecules as the protein is being synthesized. tRNA combines with amino acids that are to be incorporated into proteins.

Functions:

- it acts as a carrier to transport these amino acids to the ribosomes where protein is formed.

rRNA

rRNA is synthesized in the nucleus. It constitutes about 60% of the ribosomes. The remainder of the ribosomes are proteins.

Functions:

- rRNA functions in association with tRNA and mRNA.

3. Functions of the Thyroid Gland.

Ans: The thyroid gland is a vital hormone gland. It plays a major role in the metabolism growth and development of the human body. It helps to regulate many body functions by constantly releasing a steady amount of thyroid hormones into the blood stream.

Functions: -

- Gastrointestinal function.

- Reproduction function.
- General metabolism.
- Lipid metabolism & protein metabolism.
- Growth and development.
- Nervous system.
- Hormonal function:- Respiration.
- Gastrointestinal Function: - Increase secretion of digestive juices and motility. Increase appetite and food intake thyroid hormones are decreased carotenemia result.
- Reproduction: - Essential for normal menstrual cycles and fertility increase milk secretion in lactating women.
- General Metabolism: - Increase the metabolic rate and oxygen consumption of most of tissues of the body testes, uterus, lymph nodes pituitary gland. Increase the size number & activity of mitochondria. Increase the size number synthesis and activity of many intracellular enzymes eg Na K ATP.
- Lipid & Protein Metabolism: - Thyroid hormone accelerates the oxidation of fatty acids by the cells lower level of cholesterol phospholipid & triglyceride in the blood. Normal levels of thyroid hormones stimulate protein synthesis & growth (anabolic) Excess thyroid hormone causes protein catabolism
- Growth and Development: - Essential for normal growth of soft tissue and skeleton. Required for production & action of growth hormone and IGF.
- Nervous System: - Promotes growth and development of the brain (Fetal life & for the first few years)
- Hormonal Function: - The Thyroid gland secretes T3, T4 & Calcitonin hormones.

- Respiration: - Increased respiration due to increased rate. Dissociation of oxygen from hemoglobin by increasing the amount of RBC.

4. Functions of neuroglia and Neuron.

Ans: Functions of neuroglia:

- It offers essential nutrients it includes oxygen to neurons.
- It also helps create the myelin sheath the sheath is important in the functioning of the nervous system it promotes and speeds up the electrical impulse conduction. It does so by wrapping around the axons.
- It also helps to maintain homeostasis within the neurons.
- Homeostasis is how a cell maintains a stable internal environment despite disturbances.
- It also destroys pathogens. It helps protect the neurons.
- It also provides structural stability. It forms a support structure that the neurons can inhabit.
- This barrier protects the brain it blocks any undesirable substances from entering via the vasculature.

Functions of neuron:

Some of the most important functions of nerve cells are as follow

- Conduction of nerve impulses.
- Ion Gradients across the membrane.
- Initiation of the action potential.
- Conduction of the Action potential.
- Synaptic transmission.

5. Write briefly on Mitochondria and its functions.

Ans: Structure:

- (i) It is filamentous or globular in shape; it occurs, in varying numbers, from a few hundred to few thousands in different cells.
- (ii) It is made up of an outer membrane and an inner membrane. The inner membrane is folded to form cristae (shelves) which project into the interior of the mitochondrion.
- (iii) The interior (matrix) of the mitochondrion contains a large number of enzymes to burn glucose in oxygen. The ultimate result is the production of CO₂, water and synthesis of ATP.

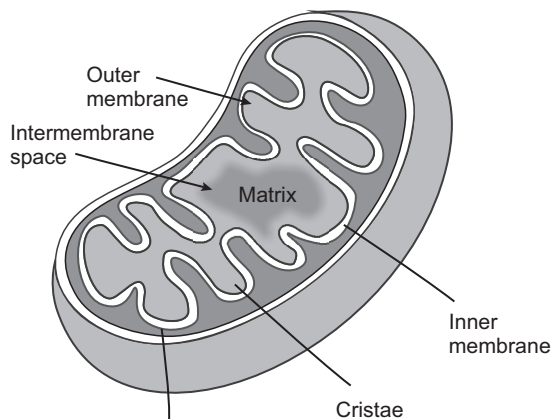


Fig. 3 : Mitochondria

Functions:

- (i) Mitochondria are power-generating units of the cells and are plentiful and best developed in parts of cells where energy-requiring processes take place, e.g., rapidly contracting skeletal muscles.
- (ii) Mitochondria contain DNA and can synthesize proteins.

D. VERY SHORT ANSWERS

1. Define Synapse.

Ans: Synapse is a small gap between two neurons (nerve cells) that allows them to communicate with each other. It is a specialized junction where chemical signals, called neurotransmitters, are released by one neuron (the presynaptic neuron) and received by another neuron (the postsynaptic neuron).

2. Define Osmosis.

Ans: Osmosis is the passive flow of the solvent, e.g. water across a selectively permeable membrane, into a region where there is a higher concentration of a solute to which the membrane is impermeable.

3. Any two functions of cell membrane.

Ans: The two functions of cell membrane are:

- f) Protective: it forms the outermost boundary of the cell organelles.
- g) Digestive: it takes in food and excretes waste products.

4. Active transport. (AUG 2019 MGR)

Ans: Active transport is the movement of molecules or ions across a cell membrane from an area of lower concentration to an area of higher concentration, against the concentration gradient, requiring energy (usually in the form of ATP).

5. Define Glands. (Mar 2021, MGR)

Ans: A gland is a secretory organ, which may exist as a separate organ such as liver, pancreas and spleen, or it may be simply a layer of cells as the simple tubular glands in the GIT.

6. Types of membrane. (Dec 2021 MGR)

Ans: There are 3 types of membrane.

- a) Mucous membrane
- b) Synovial membrane
- c) Serous membrane

7. Name different types of muscle tissue (MGR Jun2022)

Ans: There are three types of Muscle tissue:

- a) Cardiac muscle tissue
- b) Smooth muscle tissue
- c) Skeletal muscle tissue

8. List any two physiological properties of skeletal muscle.

Ans: Two physiological properties of skeletal muscle are excitability (the ability to respond to a stimulus) and contractility (the ability to contract when stimulated).

9. Write a different between osmosis and diffusion.

Ans:

Table - 2

Diffusion	Osmosis
Diffusion can occur in any medium whether it is liquid, solid and gas.	Osmosis can occur only in solid Medium.
Diffusion does not require a semipermeable membrane	Diffusion require a semipermeable membrane

10. Define Muscle tone.

Ans: The term “muscle tone” describes the constant, partial contraction of muscles, even during rest. This condition is characterized by mild, continuous muscle tension that supports movement, maintains posture, and controls the body’s total muscle activity.

11. What is surfactant? (MGR 2022 Dec)

Ans: It is kind of molecule that lowers the

surface tension between two liquids or between a liquid and a solid is called a surfactant (surface-active agent).

12. List any two contractile proteins present in the skeletal muscle (MGR Aug 2024)

Ans: Here are two contractile proteins present in skeletal muscle:

- a. **Actin:** Also known as F-actin, it is a thin filament protein that interacts with myosin to produce muscle contraction.
- b. **Myosin:** It is a thick filament protein that interacts with actin to produce muscle contraction. Myosin heads bind to actin and use ATP energy to produce muscle contraction.

13. List the types of connective tissue (RGUHS 2023 JUN)

Ans. Two primary categories can be used to classify the many forms of connective tissue:

a) Connective tissue proper.

- Loose Connective Tissue
- Dense Connective Tissue
- Fibrous Connective Tissue

b) Specialized connective tissue

- Cartilage
- Bone
- Blood
- Adipose Tissue
- Lymphoid Tissue

14. Define Fracture. (RGUHS 2024 JUN)

Ans: A fracture is a break or crack in a bone. It occurs when the bone is subjected to more force or stress than it can withstand, causing it to split or shatter. Fractures can range from small, hairline cracks to complete breaks, and can occur in any bone in the body.