

BSc in Laboratory Medicine Part-I

Edited by-

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B.Sc in Health Technology (Laboratory Medicine)

1st Batch

Institute of Health Technology

Mohakhali, Dhaka.

Recommended for further reading-

1. **Practical Pathology and Microbiology**
- Prof. Kazi Khaleque, Prof. Kazi Mamun
2. **Human Anatomy and Physiology**
- Kent M. Van de Graaff, R. Ward Rhees, Sidney Palmer
3. **Pocket Atlas of human anatomy**
- W. Dauber
4. **Essentials of Human Anatomy and Physiology**
- Valerie C. Scanlon, Tina Sanders
5. **Cliff's quick review of Human Anatomy and Physiology**
-Phillip E. Pack
6. **Human Physiology**
-Sandra Roberts
7. **Principles of General Anatomy**
- A K Datta
8. **Essentials of Human Anatomy (Thorax and abdomen)**
- A K Datta
9. **Anatomy and Physiology for Nurses**
- Evelyn Pearce
10. **Laboratory Guide to Human Physiology**
- Mac-Graw Hill Companies
11. **Modern Medical Microbiology**
- M R Choudhury
12. **Medical Laboratory Manual for Tropical Countries (Vol-I and Vol-II)**
- Monica Cheesbrough
13. **Parasitology**
- K D Chatterjee
14. **Jawetz, Melnick & Adelberg's Medical Microbiology**
- Geo F Brooks, Karen C. Carroll, Janet S. Butel, Stephen A Morse
15. **Hand book on Clinical Use of Blood- WHO, Geneva, Switzerland.**
16. **Medical Laboratory Technology (Vol-I,II,III)**
- Kanai L. Mukherjee
17. **Medical Laboratory Technology**
- Ramnik Sood
18. **A Concise Note on Medical Laboratory Technology**
- C R Maiti
19. **A Hand Book of Medical Laboratory Technology**
- V.H. Talib
20. **Henry's Clinical Diagnosis and Management by Laboratory Methods**
- Richard A. McPherson, Matthew R. Pincus
21. **Parks Text Book of Preventive and Social Medicine**
- K Park
22. **Ross and Wilson Anatomy and Physiology in Health and Illness**
- Anne Waugh, Allison Grant
23. **First Aid to injuries**
-St. John Ambulance Association
24. **Cliff's quick review of Microbiology**
- I. Edward Alcamo, Ph.D.
25. **Basic Principles of Immunology and Microbiology**
- Dr. Carl Thomae
26. **Pre-test Microbiology**
-Richard C.Tilton, Ph.D.
27. **Adult medical emergencies**
- Dr Graham R. Nimmo MD FRCP (Edin) FFARCSI

To my parents



Preface to the 2nd Edition

B.Sc in Health Technology (Laboratory Medicine) is a new diverse and challenging subject. Yet the text and other study materials are not available to all the students to have a strong grip on the subject. My small effort may help the students to have a quick glance to the basic subjects of medical science like Anatomy, Physiology, Community Medicine, First Aid and Hospital Practice, Parasitology and Mycology. Any suggestions and constructive criticisms from the students and Medical Technologists alike to enrich the guide in future are very much welcomed.

I thank the Almighty Allah for the publication of this 2nd Edition overcoming all the odds and hope all the students of BSc in Laboratory Medicine may find this concise handbook helpful.

Last but not the least I must acknowledge my humble gratitude to my following colleagues for their support and encouragement-

- Sayed Mahmudul Hasan, MT (Lab), Shahid Suhrawardy Medical College Hospital, Dhaka and Student of BSc in Lab medicine, IMT, Dhaka.
- MD. Shahidul Islam, MT (Lab), Mymensingh Medical College and student of BSc in Lab medicine, 3rd batch, IHT, Dhaka.
- Md. Rafiqul Islam, MT (Lab), IEDCR, DGHS, Mohakhali, Dhaka and student of BSc in Lab medicine, Bangladesh Institute of Child Health, Sher-e-Bangla Nagar, Dhaka.
- All the student of Lab Medicine, 1st Batch, IHT, Dhaka.

The Editor

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❖ Anatomy

Q-1. Draw and label a typical human cell. Define and classify cell. Enumerate the components of a cell. Give the functions of cell membrane and mitochondria.

Q-2. Describe mitotic cell division. Give the difference between mitosis and meiosis.

Q-3. Give the composition and function of bone. Classify bones morphologically. Describe Haversian system with diagram.

Q-4. Briefly describe the structure and function of Stomach. Give the name of the layers, blood supply and nerve supply of stomach. How stomach bed is formed?

Q-5. Give the difference between small and large intestine. Discuss the functions of Liver and gall bladder.

Q-6. Define mediastinum. Describe the contents of mediastinum (esp. middle mediastinum).

Q-7. Draw and label a neuron. Define and classify neuron. List the cranial nerves. Give the functions of neuron and neuroglia. Classify nervous system.

Q-8. Draw and label the bronchopulmonary segment of the both lung. What are the structures passes through the hilum of lungs.

Q-9. Define and classify tissue and epithelial tissue. Give the characteristics of epithelial cell. Define & classify the glandular epithelium.

Q-10. Define and classify joints and cartilage. Give the difference between bones and cartilages.

❖ Physiology

Q-1. Name the blood groups. Why ABO blood group is called classical blood group. State the Landsteiner's law. List the hazards of blood transfusion. How blood grouping is done in your laboratory.

Q-2. Give the functions of blood and of RBC. Describe in short the erythropoiesis. Classify WBC. Give the properties and functions of WBC.

Q-3. State the properties of cardiac muscle. List the junctional tissues of the heart. How cardiac impulse is conducted through the heart. Why SA node is called the pace maker of the heart.

Q-4. Define cardiac output, cardiac cycle and blood pressure. What are the factors affecting cardiac output. What are the changes occurs during different events of cardiac cycle?

Q-5. Enumerate the lung volumes and capacities with diagram. Define vital capacity. What are the factors affecting vital capacity? Describe surfactant.

Q-6. Give the composition and functions of saliva, gastric juice and pancreatic juice.

Q-7. Define GFR. What are the factors affecting GFR. Draw and label a nephron. Discuss the renal function tests. Give the functions of kidney.

Q-8. Describe the digestion and absorption of carbohydrate and protein.

Q-9. Define and classify Jaundice. Discuss the liver function tests.

Q-10. Write short notes on: CSF, Semen, Axon & Dendrite, and ECG.

❖ Community Medicine

Q-1. Define primary health care. What are its components? Briefly describe the principles of primary health care.

Q-2. How can you calculate safe period? Write down the indication, contraindication and complication of IUCD and oral pills.

Q-3. Define Family planning. Discuss the different methods of family planning/contraceptives.

Q-4. Define communicable diseases. List the major communicable diseases in Bangladesh. Mention the modes of transmission of disease with example. What are the levels of prevention? What is EPI and its objectives? Give the EPI schedule.

Q-5. What is malnutrition? Define & classify PEM? What are the common causes of malnutrition? Give the difference between marasmus and kwashiorkor? Enumerate the common nutritional problems (major malnutrition diseases) in Bangladesh.

Q-6. Define and classify foods & vitamins with example. Discuss the deficiency disorders of vitamins.

Q-7. What is safe water? Classify (List) the sources of water and impurities of water. How water is polluted. List the water born diseases.

Q-8. What is waste (refuse)? Classify wastes (refuse). Give the standard methods of waste (solid wastes/refuse) disposal. Define and classify latrines.

Q-9. What is air? How air is polluted and how it can be prevented? List the air born diseases. Give the composition of atmospheric air and exhaled air.

Q-10. Define health education. Mention the principle, objectives and importance of health education. Classify the media of health education. List the barriers of communication. Define health. Describe philosophy of health and different disease agents.

❖ Hospital Practice and First Aid

Q-1. Write down the duties and responsibilities of a Health (Medical) Technologist. How will you maintain your personal hygiene in hospital practice in relation to the patients?

Q-2. What is burn? What are the types of burn? Give the first aid treatment (management) of burn.

Q-3. What are the indications and contraindications of nasogastric intubations? Write down its technique of introducing a nasogastric tube.

Q-4. Define and classify fracture. How will you manage a long bone fracture?

Q-5. What is first Aid? What are the objectives of first aid? Give the contents of a first aid box.

Q-6. What is haemorrhage? Classify haemorrhage. Give the first aid treatment of haemorrhage. What is bandage? What are the types of bandage?

Q-7. Define Hospital. Classify it. Mention the services provided by a hospital.

Q-8. Define and classify a store. Write down the objectives of a store. Enumerate the criteria of an ideal store.

Q-9. What is sterilization? Classify sterilization. Discuss the different methods of sterilization (esp. chemical sterilization method) used in the laboratory.

Q-10. List the laboratory hazards with example. Give an outline of prevention of laboratory hazards. What is record? Mention the importance and procedure of patient record keeping.

❖ Parasitology

Q-1. What is host and parasite? Classify host, parasite and rhizopoda with example. What are the host parasite relationships?

Q-2. Describe the pathogenesis and lesion produced by *E. histolytica*. Write down the difference between amoebic dysentery and bacillary dysentery.

Q-3. . Discuss the laboratory diagnosis of hepatic & intestinal amoebiasis (or, Diagnosis of Amoebiasis).

Q-4. Classify Sporozoa. Name the parasites causing malaria in man. Describe the asexual cycle of malarial parasite in man.

Q-5. Describe the complication and laboratory diagnosis of malaria (esp. *P. falciparum* malaria).

Q-6. Define and classify helminthes with example. Give the differences between nematodes, cestodes and trematodes.

Q-7. Define and classify vector? What are the vector born parasitic diseases? Discuss the pathogenesis, complications and laboratory diagnosis of Kala-Azar.

Q-8. Name the intestinal nematodes. Write the complications of *Ascaris lumbricoides* with laboratory diagnosis.

Q-9. Name the common helminthes in Bangladesh. Write down the complication produced by *Ankylostoma duodenale* with laboratory diagnosis.

Q-10. Classify cestodes with example. Discuss the pathogenecity and laboratory diagnosis of *Taenia saginata*.

❖ Mycology

Q-1. Define and classify Fungus (esp. morphological & clinical) with example. What are the differences between fungus and bacteria? Mention some beneficial effects of fungus.

Q-2. Define and classify dermatophytes with example (esp. clinical types). Give the laboratory diagnosis of dermatophytes.

Q-3. What do you mean by dimorphic fungi and opportunistic fungi? Name some dimorphic fungi and opportunistic fungi? Give the difference between dimorphic fungi and opportunistic fungi.

Q-4. What are the opportunistic fungal infections? Discuss the pathogenesis & pathology and laboratory diagnosis of *Candida albicans* and *Cryptococcus neoformans*.

Q-5. Name the systemic (deep) fungi. Discuss the pathogenecity and laboratory diagnosis of *Histoplasma capsulatum*.

Q-6. Name some superficial fungal agents with diseases. Write down the clinical features of *M. phurphur* with treatment. Give the diagnosis of superficial mycoses.

Q-7. What is oral thrush? Give the laboratory diagnosis of oral thrush.

Q-8. Define and classify fungal spore with example. Discuss the fungal growth curve. Draw and label a fugal cell and describe the structure of a fungal cell.

Q-9. Briefly describe the antifungal chemotherapy.

Q-10. Write short notes on: Athletes foot, Madura mycetoma (madura foot) and Mycotoxin, Prokaryotes and Eukaryotes.

Anatomy

Q-1. Draw and label a typical human cell. Define and classify cell. Enumerate the components of a cell. Give the functions of cell membrane and mitochondria.

Answer.

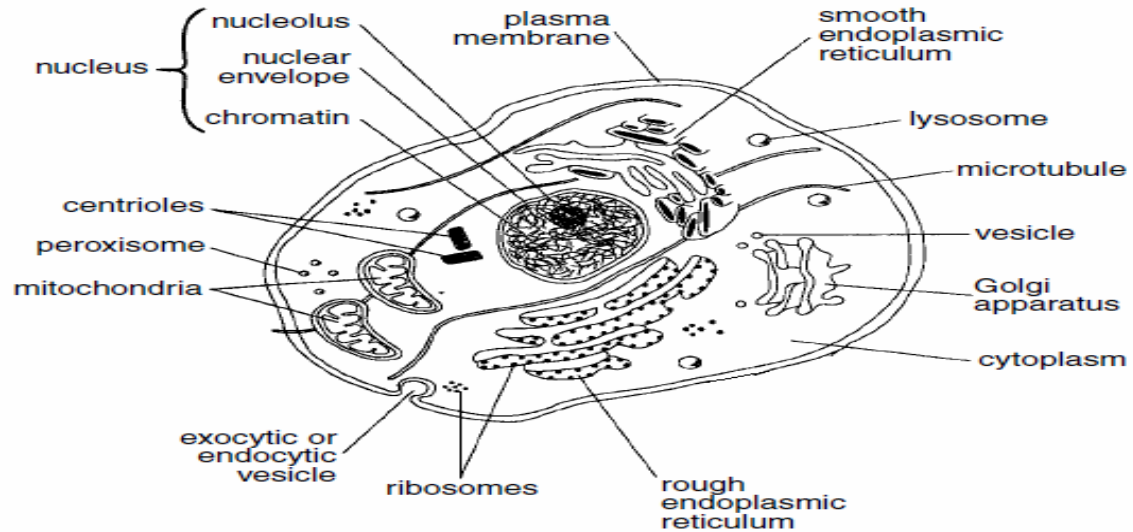


Figure- A typical cell

Cell: Cell may be defined as “the structural and functional unit of all living organisms”.

Types-

1. Eukaryotic cell
2. Prokaryotic cell

Components of cell-

A. Cell membrane

B. Protoplasm:

I. Cytoplasm-

1. Organelles-
 - i. Membranous organelles:
 - a. Mitochondria
 - b. Endoplasmic reticulum
 - c. Golgi complex
 - d. Lysosomes
 - e. Peroxisomes
 - ii. Non-membranous organelles:
 - a. Ribosomes
 - b. Centrosome
 - c. Microfilaments
 - d. Microtubules
2. Inclusions-
 - i. Glycogen
 - ii. Fat
 - iii. Pigments

II. Nucleus-

1. Nuclear membrane
2. Nucleolus
3. Nucleoplasm or nuclear sap
4. Chromatin-
 - a. Hepta chromatin
 - b. Euchromatin

Plasma membrane: It is the tough, elastic membrane that limits the protoplasmic contents of a particular cell and separates them from other cells and the external environment. It is composed of lipid and protein with a small amount of carbohydrate.

Functions of Plasma membrane-

1. The membrane maintains the shape of the cell.
2. It controls the passage of all substances that goes in or out of the cell.
3. The cell membrane forms a sensory surface. This function is most developed in nerve and muscle cell.
4. The surface of the cell membrane bears receptors that may be specific for particular molecules (e.g. Hormones or enzymes).
5. Cell membranes may show a high degree of specialization in some cells, e.g. the membranes of rod and cone cells (present in the retina) bear proteins that are sensitive to light.
6. Cell membrane plays a role in the maintenance of membrane potential.

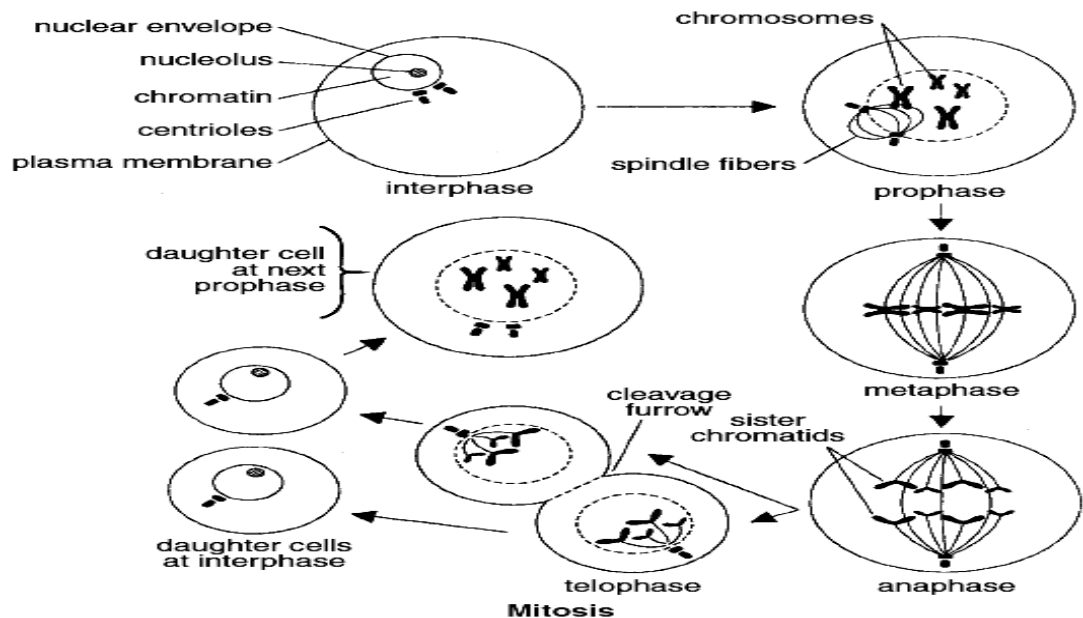
Mitochondria: They are so called as they appear either as granules or as rods (mitos= granules, chondium= rod) and are known as the power house of the cell.

Functions of Mitochondria-

1. Chief source of energy of the cell (by converting ADP to ATP).
2. It is concerned with synthesis of RNA and protein as it contains DNA.

Q-2. Describe mitotic cell division. Give the difference between mitosis and meiosis.

Answer.



The phases of mitotic cell division:

Stage	Events
Prophase	<ol style="list-style-type: none"> 1. The chromosomes coil up and become visible as short rods. Each chromosome is really two chromatids (original DNA plus its copy) still attached at a region called the centromere. 2. The nuclear membrane disappears. 3. The centrioles move toward opposite poles of the cell and organize the spindle fibers, which extend across the equator of the cell.
Metaphase	<ol style="list-style-type: none"> 1. The pairs of chromatids line up along the equator of the cell. The centromere of each pair is attached to a spindle fiber. 2. The centromeres now divide.
Anaphase	<ol style="list-style-type: none"> 1. Each chromatid is now considered a separate chromosome; there are two complete and separate sets. 2. The spindle fibers contract and pull the chromosomes, one set toward each pole of the cell.
Telophase	<ol style="list-style-type: none"> 1. The sets of chromosomes reach the poles of the cell and become indistinct as their DNA uncoils to form chromatin. 2. A nuclear membrane re-forms around each set of chromosomes.
Cytokinesis	<ol style="list-style-type: none"> 1. The cytoplasm divides; new cell membrane is formed.

The difference between mitosis and meiosis:

Traits	Mitosis	Meiosis
1. Site	1. Occurs in somatic cell	1. Occurs in sex cells
2. Daughter cells	2. Two daughter cells are produced.	2. Four daughter cells are produced.
3. Number of chromosome	3. Each daughter cell contains diploid number of chromosomes.	3. Each daughter cell contains haploid number of chromosomes.
4. Phases	4. Possesses one complete phase	4. Possesses two different phases.
5. Duration of interphase	5. Long	5. Short.
6. Prophase phase	6. Short and no divisions	6. Long and has subdivisions.
7. Chromosomes	7. Illegible	7. Visible
8. Pairing	8. No pairing of homologous chromosomes.	8. Pairing of homologous chromosomes occur forming bivalent.
9. Chiasmata and crossing over	9. No chiasmata and crossing over.	9. There is chiasmata and crossing over.
10. Redistribution of genetic materials	10. Not occur, so all the daughter cells are identical in genetic content.	10. Occur, so the daughter cells are not identical in genetic content.

Q-3. Give the composition and function of bone. Classify bones morphologically. Describe Haversian system with diagram.

Answer. Bone: Bone or osseous tissue is a special type of highly vascular mineralized and constantly changing rigid connective tissue which forms the frame work of our body.

Composition of bone: Bone consists of bone cells and of an intercellular matrix-

A. Bone cells:

1. Osteocytes
2. Osteoblasts
3. Osteoclasts

B. Intercellular matrix: Chemically it is composed of-

1. Water – 25%
2. Solid - 75%
 - a. Organic (30%), e.g. Collagen fibers, proteins, Glycosaminoglycans.
 - b. Inorganic (45%), e.g. Calcium & phosphorous mainly. Others include magnesium, potassium, sodium, bicarbonate, citrate etc.

Functions of Bone:

1. Provides shape and supports the body.
2. Protects from mechanical injury.
3. Helps in the movement of the body.
4. Contains bone marrow that manufactures blood cells.
5. Stores body calcium and phosphorous.
6. Helps to maintain electrolyte balance of the body.

Morphological classification of bones:

1. Long bones, e.g. femur, humerus, ulna, radius, tibia, fibula etc.
2. Short bones, e.g. carpals and tarsal bones.
3. Flat bones, e.g. scapula, sternum, ribs, parietal and frontal bones.
4. Irregular bones, e.g. vertebrae, hip bone and bones in the base of the skull.
5. Pneumatic bones, e.g. maxilla, sphenoid, ethmoid etc.
6. Sesamoid bones, e.g. patella, pisiform.

Haversian system: Compact bones are made up of a large number of tube like units know as Haversian system or osteons.

The Haversian system consists of the following structures-

1. Haversian canal: It is the central canal which runs parallel to the long axis of the bone. It contains the neurovascular bundle. It is surrounded by lamellae.
2. Lamellae: Each Haversian canal is surrounded by a varying number of concentric lamellae made up of bony matrix from 5-10 in numbers.
3. Lacunae: These are the small spaces between the lamellae. It contains the bone cells, the osteocytes.
4. Canaliculi: These are the fine inter communicating channels, which connects the adjacent lacunae. They contain the cell process of the osteocyte.

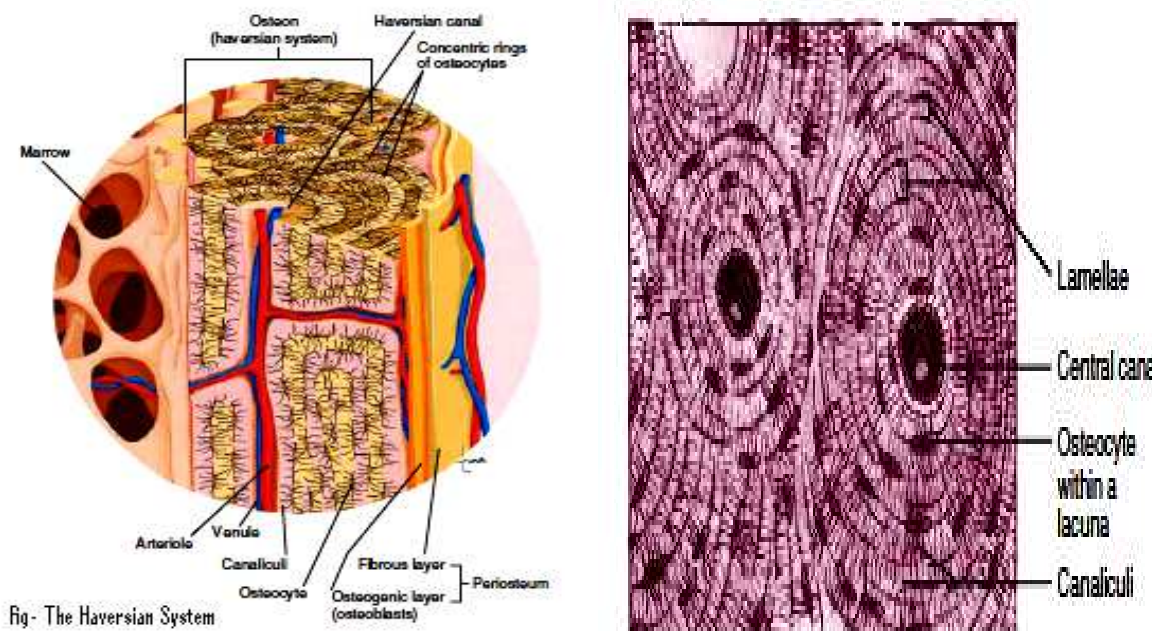


Fig- The Haversian System

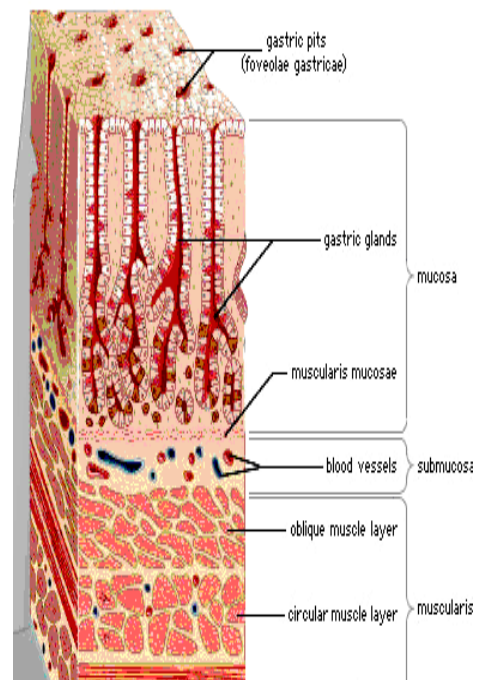
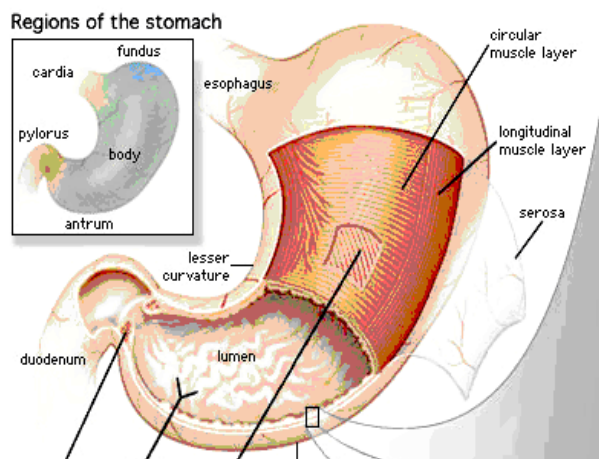
Q-4. Briefly describe the structure and function of Stomach. Give the name of the layers, blood supply and nerve supply of stomach. How stomach bed is formed?

Answer. Stomach: The stomach is a J shaped dilated portion of the alimentary tract situated in epigastric, umbilical, and left hypochondriac regions of the abdominal cavity.

Structure of the stomach:

A. Morphological structure-

1. Cardiac part: a. Body of the stomach
b. Fundus of the stomach
2. Pyloric part: a. Pyloric antrum
c. Pyloric canal



A. Histological structure-

The stomach consists of four layers, these are from within to outward are as follows:

1. Mucosa- It contains:
 - a. Epithelium
 - b. Lanina propria, that contains-
 - i. Glands
 - ii. Capillaries and small lymphatics
 - c. Muscularis mucosa, consists of-
 - i. Inner circular layer
 - ii. Middle longitudinal layer
 - iii. Outer circular layer
2. Submucosa- It consists of loose alveolar tissue.
3. Muscularis externa- It consist of:
 - a. Inner circular layer
 - b. Outer longitudinal layer
 - c. Oblique layer
4. Serosa or adventitia- It consists of:
 - a. Adipose tissue
 - b. Blood vessels
 - c. Mesothelial covering

Functions of Stomach:

1. Motor function-
 - a. Storage: Stores large quantities of food until it can be accommodated in the duodenum.
 - b. Mixing: Stored foods are mixed with gastric secretions forming chyme.
 - c. Emptying: Chyme is slowly propelled into the small intestine.
2. Secretory functions-
 - a. Enzymes, e.g. pepsinogen, HCl, gastric lipase, gastric rennin etc.
 - b. Hormone, e.g. Gastrin.
3. Digestive functions-
Helps in the digestion of proteins and fat.
4. Absorptive functions-
Water, alcohol, haemopoietic factors are absorbed.
5. Haemopoietic function-
Intrinsic factor of Castle is released which helps in the absorption of extrinsic factor which is needed for maturation of RBC.

Blood supply of stomach:

1. Arterial supply-
 - a. 5-7 short gastric arteries- branch of splenic artery.
 - b. Left gastroepiploic artery- branch of splenic artery.
 - c. Right gastroepiploic artery- branch of gastroduodnale artery.
 - d. Left gastric artery- branch of coeliac trunk.
2. Venous drainage-
 - a. Short gastric vein to splenic vein.
 - b. Left gastro-epiploic vein to splenic vein
 - c. Right gastro-epiploic vein to superior mesenteric vein.
 - d. Right gastric vein to portal vein.
 - e. Prepyloric vein- connects right gastro-epiploic vein to the right gastric or portal vein.

Nerve supply of stomach:

The stomach is supplied by both the parasympathetic and sympathetic parts of the autonomic nervous system.

A. Parasympathetic -

1. Preganglionic from right (posterior vagal trunk) and left (anterior vagal trunk) vagus nerves.

2. Postganglionic neurons are very short and lie within the wall of the stomach.

B. Sympathetic -

1. Preganglionic fibers mainly from the thoracic splanchnic nerves.

2. Postganglionic arise in the ganglia of the celiac plexus

Stomach bed: Structures related to the posterior surface of the stomach forms the “stomach bed.”

The structures forming the stomach bed are-

- The diaphragm
- Left suprarenal gland
- Left kidney
- Splenic artery
- Pancreas
- Transverse mesocolon
- Left colic flexure
- Spleen sometimes

Q-5. Give the difference between small and large intestine. Discuss the functions of Liver and gall bladder.

Answer. The difference between small and large intestine:

Small intestine	Large intestine
1. Villi present which is the typical feature	1. No villi.
2. Crypts of Lieberkuhn seen in lamina propria are fewer and less deep.	2. Crypts of Lieberkuhn are more in number and deeper.
3. Goblet cells are less in number.	3. Goblet cells are preponderant.
4. Longitudinal coat of muscularis externa is uniformly thick.	4. Longitudinal coat of muscularis externa is thickened to form three taenia.
5. Taeniae coli is absent.	5. Taeniae coli is present.

Function of Liver:

- Metabolic function- Helps in the metabolism of carbohydrate, fat, proteins and vitamins.
- Storage functions- Stores glycogen, amino acid, iron, vitamin A & D, folic acid, Vitamin B₁₂.
- Synthetic function- Synthesize plasma proteins, glucose from glycogen and all most all the clotting factors.
- Formation and secretion of bile.
- Excretory function- Excretion of bile pigment, toxin, alcohol, drugs etc.
- Heat production- By metabolic activity.
- Haemopoietic fuction- Red cell production in foetal life.
- Haemolytic function- Destruction of red cells in adult life.
- Defensive and detoxifying functions- Kuffer cells kill the bacteria and plays a role in detoxification of some harmful substances (e.g. alcohol).

Function of gall bladder-

1. It stores the bile during interdigestion period and empties during digestion into the duodenum.
2. It concentrates the bile by mucosal absorption of water, sodium chloride, and most other small electrolytes.
3. It equalizes the pressure in the biliary system due to its concentrating power.
4. It reduces the alkalinity of bile (gall bladder is responsible for acidification of bile).
5. It secretes mucin, which is the chief source of mucin in bile.

Q-6. Define mediastinum. Describe the contents of mediastinum (esp. middle mediastinum).

Answer. Mediastinum: It is the space between the two lungs of the thoracic cavity.

Divisions of mediastinum:

1. Superior mediastinum
2. Inferior mediastinum, which is divided into Anterior, Posterior and Middle mediastinum by the intervening pericardium.

Contents of mediastinum:

It contains the heart, great blood vessels, the trachea and oesophagus, thoracic duct, right and left bronchi, descending aorta and superior vena cava, nerves (vegas, phrenic, cardiac nerves, left recurrent laryngeal nerve), lymph nodes, lymph vessels, thymus.

Contents of Middle mediastinum:

1. Heart enclosed in pericardium
2. Arteries-
 - a. Ascending aorta
 - b. Pulmonary trunk
 - c. Two pulmonary arteries
3. Veins-
 - a. Lower half of superior vena cava
 - b. Terminal part of azygos vein
 - c. Right and left pulmonary veins.
4. Nerves-
 - a. Right phrenic nerve
 - b. Deep cardiac plexus
5. Lymph nodes- Trachiobroncheal lymph node.
6. Tubes
 - a. Bifurcation of the trachea
 - b. Right and left principal bronchus.

Q-7. Draw and label a neuron. Define and classify neuron. List the cranial nerves. Give the functions of neuron and neuroglia. Classify nervous system.

Answer.

Neuron: It is the structural and functional unit of nervous tissue.

A neuron consists of –

- a. Cell body
 - i. Nucleus
 - ii. Cytoplasm (neuroplasm)
- b. Cell process
 - i. Axon
 - ii. Dendrites

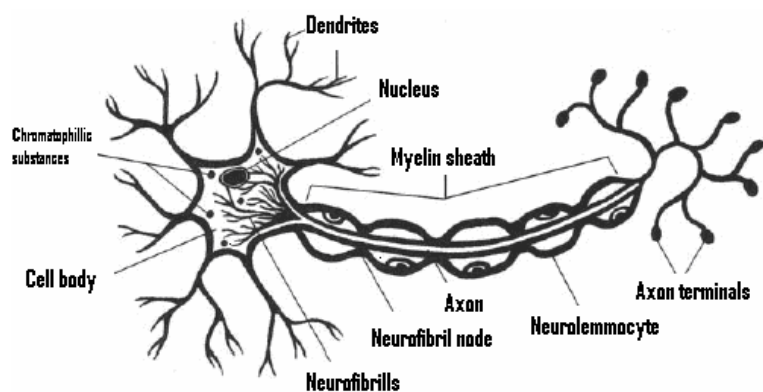


Figure- The structure of a Neuron

Classification of neurons:

- A. On the basis of number of processes (shape and size of processes)-
1. Unipolar
 2. Bipolar
 3. Pseudounipolar
 4. Multipolar
- B. On the basis of branching pattern and shape of dendritic fields-
1. Stellate
 2. Pyramidal
 3. Fusiform
 4. Glomerular
- C. On the basis of length-
1. Golgi type I
 2. Golgi type II
- D. On the basis of functions-
1. Sensory (afferent)
 2. Motor (efferent)

Cranial nerves: The name and functions of 12 pair of cranial nerves are as follows-

Number and Name	Function(s)
I Olfactory	• Sense of smell
II Optic	• Sense of sight
III Oculomotor	• Movement of the eyeball; constriction of pupil in bright light or for near vision
IV Trochlear	• Movement of eyeball
V Trigeminal	• Sensation in face, scalp, and teeth; contraction of chewing muscles
VI Abducens	• Movement of the eyeball
VII Facial	• Sense of taste; contraction of facial muscles; secretion of saliva
VIII Acoustic (vestibulocochlear)	• Sense of hearing; sense of equilibrium
IX Glossopharyngeal	• Sense of taste; sensory for cardiac, respiratory, and blood pressure reflexes; contraction of pharynx; secretion of saliva
X Vagus	• Sensory in cardiac, respiratory, and blood pressure reflexes; sensory and motor to larynx (speaking); decreases heart rate; contraction of alimentary tube (peristalsis); increases digestive secretions
XI Accessory	• Contraction of neck and shoulder muscles; motor to larynx (speaking)
XII Hypoglossal	• Movement of the tongue

Functions of neuron:

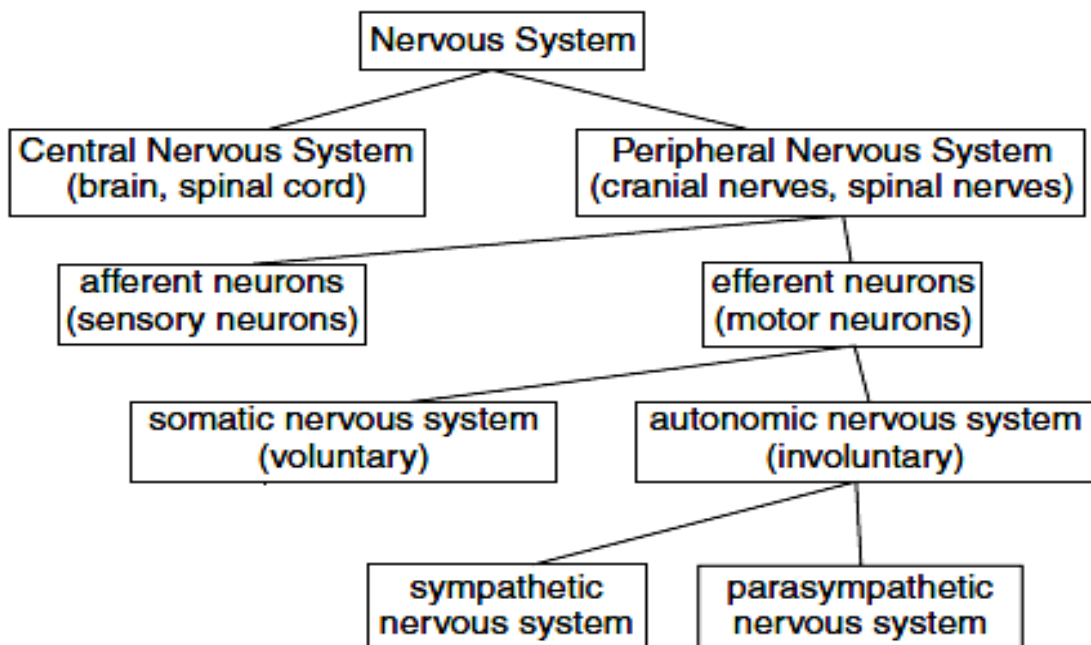
1. Conduction of impulses by all the three parts of a neuron (cell body, axon, dendrites).
2. Responsible for reception and integration of impulses.
3. Neurons in the brain are involved in production of mental activities like willing, remembering, imagining etc.

Neuroglia: The neurons of the central nervous system (CNS) are supported by several varieties of non-excitabile cells, which together are called neuroglia.

Functions of neuroglia: There are four types of neuroglia and their functions are given below-

Name	Function
Oligodendrocytes	<ul style="list-style-type: none"> Produce the myelin sheath to electrically insulate neurons of the CNS.
Microglia	<ul style="list-style-type: none"> Capable of movement and phagocytosis of pathogens and damaged tissue.
Astrocytes	<ul style="list-style-type: none"> Support neurons, help maintain K^+ level, contribute to the blood-brain barrier.
Ependyma	<ul style="list-style-type: none"> Line the ventricles of the brain; many of the cells have cilia; involved in circulation of cerebrospinal fluid.

Classification of Nervous system:



Q-8. Draw and label the bronchopulmonary segment of the both lung. What are the structures passes through the hilum of lungs.

Answer. Bronchopulmonary segments: Lung segments that are bounded from each other peripherally by veins and connective-tissue tracts and that have their own central bronchial and arterial supply. A B

2 Right lung, superior lobe. A

3 *Apical segment (S I)*. Its inferior part is wedged between the anterior and posterior segments. A

4 *Posterior segment (S II)*. Dorsal segment that lies between the apical segment and the inferior lobe of right lung. A

5 *Anterior segment (S III)*. Anterior segment located between the apical segment and the middle lobe. A

6 Right lung, middle lobe. A

7 *Lateral segment (S IV)*. Segment that consists of the dorsal part of the middle lobe and does not reach the hilum. A

8 *Medial segment (S V)*. Segment that forms the mediastinal and diaphragmatic surfaces of the middle lobe. A

9 Right lung, inferior lobe. A

10 *Superior segment (S VI)*. Apical, posterosuperior segment of the inferior lobe. A

11 *Medial basal segment (S VII)*. It does not extend to the lateral surface of the lung and is only visible from the medial and inferior surface. A

12 *Anterior basal segment (S VIII)*. Segment located between the middle lobe and diaphragm. A

13 *Lateral basal segment (S IX)*. Segment located between the posterior and anterior basal segments. A

- 14 *Posterior basal segment (S X)*. Segment located between the vertebral column and lateral basal segment. A
- 15 Left lung, superior lobe. B
- 16 *Apicoposterior segment (S I + II)*. It is composed of two segments that together form a wedge-shaped segment situated between the oblique fissure and anterior segment of the superior lobe. B
- 17 *Anterior segment (S III)*. Anterior segment of the superior lobe that is located between the superior lingular and apicoposterior segments. B
- 18 *Superior lingular segment (S IV)*. It mainly lies on the inferior lingular segment. B
- 19 *Inferior lingular segment (S V)*. It lies between the superior lingular segment and the oblique fissure. B
- 20 Left lung, inferior lobe. B
- 21 *Superior segment (S VI)*. Posterosuperior apical segment of the inferior lobe adjacent to the vertebral column. B
- 22 *Medial basal segment (S VII)*. Often indivisible from the anterior basal segment. B
- 23 *Anterior basal segment (S VIII)*. Segment between the oblique fissure and lateral basal segment. B
- 24 *Lateral basal segment (S IX)*. Segment between the anterior and posterior basal segments. B
- 25 *Posterior basal segment (S X)*. Segment adjacent to the vertebral column below the superior segment of the inferior lobe. B

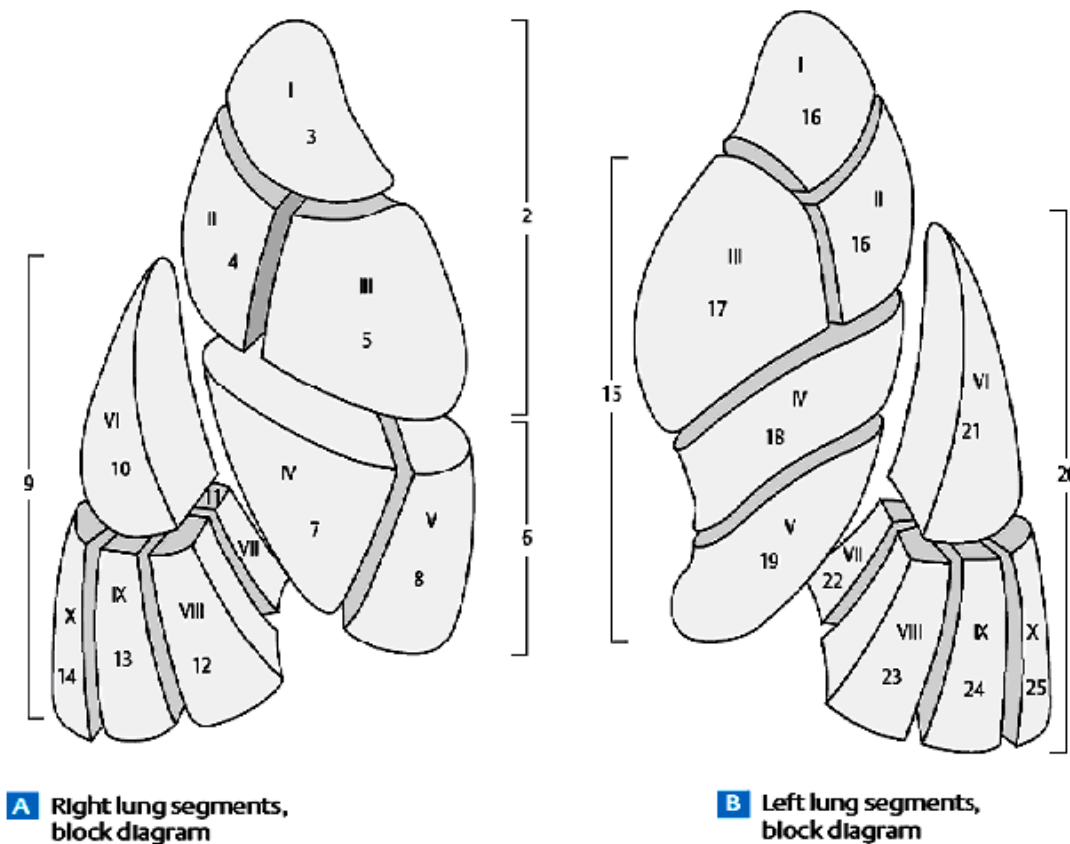


Figure- Bronchopulmonary segments of the both lungs

Hilum of the lung: It is the roughly triangular shape area, situated against the 5th to 7th thoracic vertebrae bodies and intervening discs. Structures forming the root of the lung enter and leave at the hilum.

Structures passing through the hilum of lung-

These include the primary bronchus, the pulmonary artery supplying the lung and two pulmonary veins draining it, the bronchial artery and veins, and the lymphatic and nerve supply.

Q-9. Define and classify tissue and epithelial tissue. Give the characteristics of epithelial cell. Define & classify the glandular epithelium.

Answer. Tissue: It can be defined as, “a group of cells with similar structure and function”.

Types of tissue: There are four basic types of tissue-

1. Epithelial tissue
2. Connective tissue
3. Muscle tissue
4. Nervous tissue

Epithelial tissue: It can be defined as, “a collection of closely aggregated polyhedral cells with very little intercellular substance covering the external and internal surface of the body”.

Types of Epithelial tissue:

A. Covering epithelium

1. Unilayered

a. Simple epithelium

- i. Simple squamous (e.g. endothelium)
- ii. Simple cuboidal (e.g. collecting tubule)
- iii. Simple columnar (e.g. gall bladder)

b. Pseudostratified columnar epithelium

- i. Ciliated (e.g. trachea)
- ii. Non-ciliated (e.g. male urethra)

2. Multilayered

a. Stratified epithelium

- i. Stratified Squamous epithelium
 - Keratinized (e.g. Skin, cornea)
 - Non-keratinized (e.g. vagina)
 - ii. Stratified Cuboidal epithelium
 - iii. Stratified Columnar epithelium
- b. Transitional epithelium**

B. Glandular Epithelium

1. Exocrine, e.g. Gastric gland, Salivary gland etc.
2. Endocrine, e.g. Thyroid gland, pituitary gland, hypophysis etc.

Gland/Glandular epithelium: An aggregation of glandular epithelium into a definite structure for the purpose of carrying on secretion or excretion is known as a gland.

Classification of glandular epithelium:

A. According to cellular function-

1. Unicellular, e.g. Goblet cells
2. Multicellular
 - a. Exocrine, e.g. Gastric gland, Salivary gland etc.

Endocrine, Thyroid gland, pituitary gland, hypophysis etc.

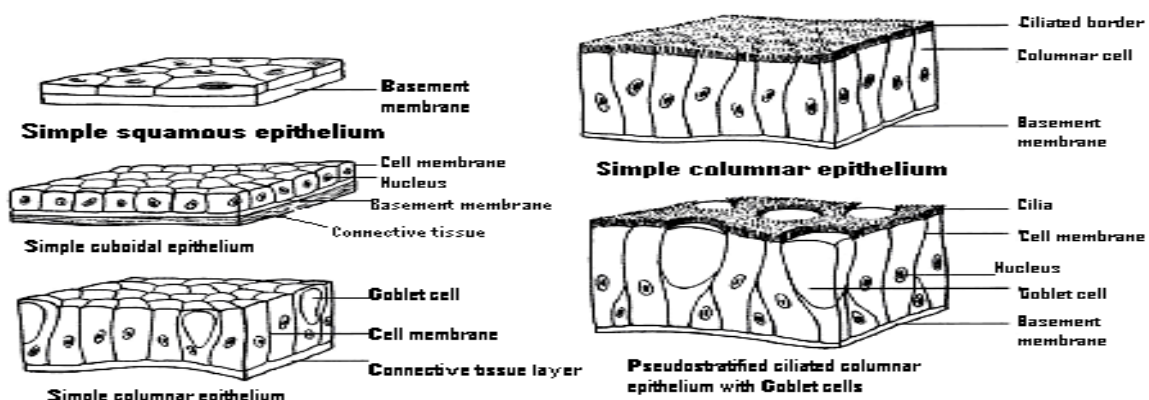


Figure – Simple epithelium

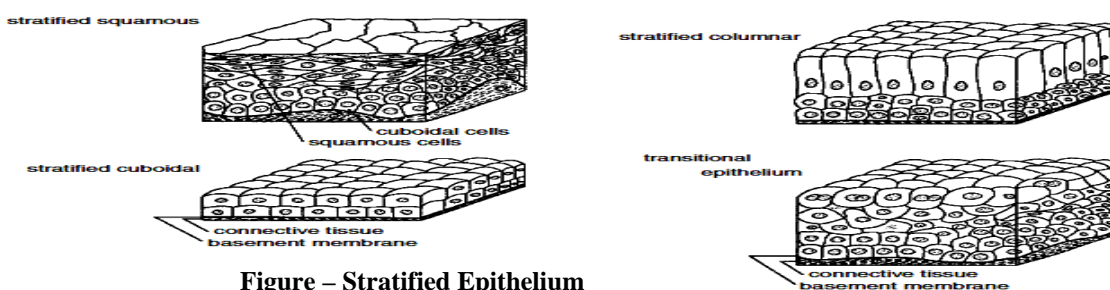


Figure – Stratified Epithelium

- B. According to mode of secretion-
 1. Holocrine, e.g. sebaceous gland of the skin, tarsal gland.
 2. Apocrine, e.g. atypical sweat glands (axillary), and mammary glands.
 3. Merocrine, e.g. endocrine glands, digestive glands.
- C. According to development-
 1. Ectodermal, e.g. glands of the skin, mammary glands, lacrimal glands, parotid gland, hypophysis cerebri etc.
 2. Endodermal, e.g. thyroid, para-thyroid glands, thymus, liver, pancreas.
 3. Mesodermal, e.g. suprarenal gland, gonads, kidneys, spleen etc.

Q-10. Define and classify joints and cartilage. Give the difference between bones and cartilages. Draw and label eye ball.

Answer. Joint: A joint or articulation is the union of any two or more bones or cartilages of the skeleton.

Classification of Joints: There are 3 main classes of joints-

1. Fibrous joints/Synarthroses/ Immoveable joints/Fixed joints, e.g. Sutures or joints of the bones of the skull.
2. Cartilagenous joints/Amphiarthroses/Slightly moveable joints, e.g. the intervertebral joints.
3. Synovial joints/Diarthroses/Freely moveable joints, e.g. joints of the knee, elbow, hip, shoulder etc.

Cartilage: Cartilage is a specialized type of dense connective tissue composed of three elements like other connective tissues, e.g. cells, fibers and ground substances.

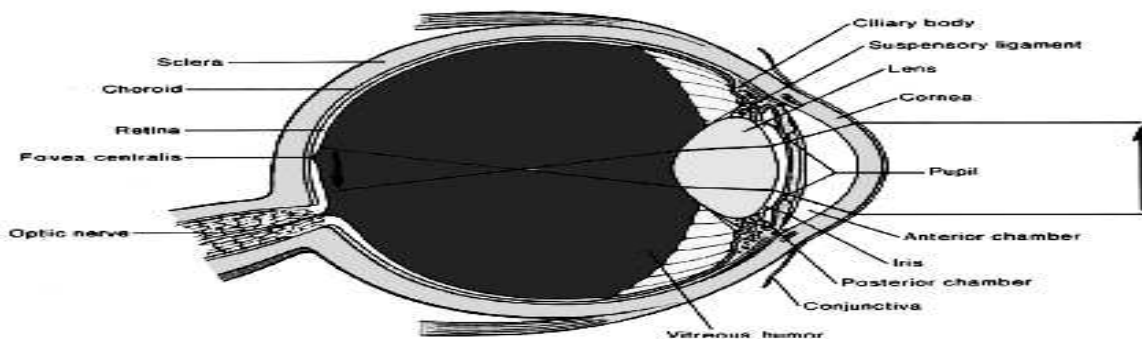
Classification of cartilages: There are 3 types of cartilages-

1. Hyaline cartilage, e.g. costal cartilage, articular cartilage, cartilage of larynx and trachea.
2. Fibrocartilages/ Fibrous cartilage, e.g. Symphysis pubis, articular disc etc.
3. Elastic cartilage, e.g. auricle or pinna of the external ear, walls of the external auditory canal, epiglottis etc.

Difference between bones and cartilages:

Bone	Cartilage
1. Intercellular matrix is calcified, so it is hard.	1. Intercellular matrix is uncalcified, so it is soft.
2. It is highly vascular.	2. It is avascular.
3. It has got nerve supply.	3. It has no nerve supply.
4. Bone are arranged in a definite pattern, termed as Haversian system.	4. No such arrangements is present.
5. It's covering is called periosteum.	5. Its covering is called perichondrium.

An eyeball is drawn and labelled below-



Physiology

Q-1. Name the blood groups. Why ABO blood group is called classical blood group. State the Landsteiner's law. List the hazards of blood transfusion. How blood grouping is done in your laboratory.

Answer. Blood group: Blood groups are the groups of blood classified according to the presence or absence of genetically inherited antigens on the surface of the cells and antibody in plasma. It can be defined as, "the antigenic make up present on various cellular and/or soluble components of blood together with the antibody and their interactions."

Important blood groups:

- | | |
|----------------|--------------|
| 1. ABO | 8. Lewis |
| 2. Rhesus (Rh) | 9. Diego |
| 3. MNS | 10. Dombrock |
| 4. Duffy | 11. Indiana |
| 5. Kell | 12. Colton |
| 6. Kidd | 13. Xg |
| 7. Lutheran | 14. P |

ABO systems/ ABO blood groups are called classical blood groups, because-

1. These are the principle blood groups and found among all the people.
2. They maintain both first and second part of Landsteiner's Law.
3. The hazards of mismatched blood transfusion of ABO blood groups are most effective and appear more quickly than others.

Landsteiner's Law: This law has 2 parts-

First part: If an agglutinin is present in the red cell membrane of a blood, the corresponding agglutinin must be absent in the plasma.

Second part: If the agglutinin is absent in the red cell membrane of a blood, the corresponding agglutinin must be present in the plasma.

Hazards/Complication of blood transfusion:

1. Acute Transfusion Reactions-
 - i. Non-haemolytic febrile reaction
 - ii. Allergic reaction
 - iii. Anaphylactic reaction
 - iv. Acute haemolytic reaction
 - v. Transfusion associated lung injury (TRALI)
 - vi. Circulatory overload
 - vii. Reactions due to bacterial contamination
 - viii. Air embolism
 - ix. Bio-chemical upsets, e.g. reduction in plasma potassium.
2. Delayed Transfusion Reactions-
 - i. Delayed haemolytic reaction
 - ii. Post-transfusion purpura
 - iii. Graft versus host disease (GVHD)
 - iv. Transfusion transmitted infections
 - v. Iron overload
 - vi. Thrombophlebitis
 - vii. Multiple microembolism

Blood Grouping in the laboratory by Slide method:

1. Take a clean glass slide and divide into three halves by a marker pen and label them as A, B and D.
2. Place a small drop of anti-A serum on the area marked A, anti-B serum on the area marked B and Anti-D serum on the area marked D.

3. Place one drop of blood in each half of the slide from a finger prick and add one to two drops of normal saline immediately to each drop. Mix the contents of the each half using separate applicator sticks or glass rods and rotate the slide gently.
4. After 2-8 minutes the mixture is observed for any agglutination and clumping both macroscopically and microscopically.
5. The interpretation is done from the following chart, where “+”= agglutination and “-” = no agglutination.

Area- “A” (Red cell and anti-A serum)	Area-“B” (Red cell and anti-B serum)	Area- “D” (Red cell and anti-D serum)	Blood Group
+	-	+	A+ve
+	-	-	A-ve
-	+	+	B+ve
-	+	-	B-ve
+	+	+	AB+ve
+	+	-	AB-ve
-	-	+	O+ve
-	-	-	O-ve

Q-2. Give the functions of blood and of RBC. Describe in short the erythropoiesis. Classify WBC. Give the properties and functions of WBC.

Answer. Blood: Blood is a fluid/ liquid connective tissue consists of plasma and cells.

Functions of blood:

1. Transport of-
 - a. Respiratory gases, O₂, CO₂.
 - b. Nutrients
 - c. Waste product for excretion
 - d. Mineral, enzymes, vitamins
 - e. Hormones
2. Defense against infection.
3. Regulation of body fluid P^H.
4. Regulation of water balance.
5. Helps to maintain body temperature.

Functions of RBC:

1. Transport of respiratory gases- O₂, CO₂.
2. Maintenance of –
 - a. Viscosity of blood
 - b. Acid base balance
3. Responsible for pigment production and blood group antigens.

Erythropoiesis: Formation of red cells under normal physiological condition is called erythropoiesis.

Stages of erythropoiesis-

1. Proerythroblast/ Pronormoblast:
 - a. Diameter- 14-20 μm
 - b. Nucleus- very large (12 μm)
 - c. Haemoglobin- absent.
2. Basophilic erythroblast/ Early normoblast-
 - a. Diameter- 12-16 μm
 - b. Nucleus- nuclei disappear.
 - c. Haemoglobin- starts to appear (very little)
 - d. Mitosis- active
3. Polychromatic erythroblast/ Intermediate normoblast-
 - a. Diameter- 10-14 μm
 - b. Haemoglobin- increased

- c. Mitosis- active
- 4. Orthochromatic erythroblast/ Late normoblast-
 - a. Diameter- 8-12 μm
 - b. Nucleus- small pyknotic.
 - c. Haemoglobin- large amount
 - d. Mitosis- ceased
- 5. Reticulocyte-
 - a. Nucleus is degenerated and extruded.
 - b. Diameter- slightly larger than erythrocyte
 - c. Contains a small amount of basophilic material
 - d. Shape- biconcave disc.
- 6. Mature erythrocyte-
Formed by disappearing of the basophilic material. It takes about 7 days from pronormoblast to reticulocyte and 1 or 2 more days from reticulocyte to mature erythrocyte.

Classification of WBC-

- 1. Granulocytes-
 - a. Neutrophils (Polymorphs.) : 2000-7500/ μl of blood. 40-75%
 - b. Eosinophils : 100-400/ μl of blood. 1-4%
 - c. Basophils : 0-100/ μl of blood. 0-1%
- 2. Agranulocytes-
 - a. Lymphocytes : 2000-4500/ μl of blood. 20-45%
 - b. Monocytes : 200-800/ μl of blood. 2-8%



Figure- White Blood cells

TYPE	AVG. NO. MM ³	ORIGIN	DESCRIPTION	FUNCTION
Neutrophils	5400	Bone marrow	Lobed nucleus, fine granules	Phagocytosis
Eosinophils	275	Bone marrow	Lobed nucleus, red or yellow granules	May phagocytize antigen-antibody complexes
Basophils	35	Bone marrow	Obscure nucleus, large purple granules	Release heparin, histamine, and serotonin
Lymphocytes (B cells, T cells)	2750	Lymphoid tissues	Round nucleus, little cytoplasm	Produce antibodies, destroy specific target cells
Monocytes	540	Lymphoid tissues	Kidney-shaped nucleus	Phagocytosis

Q-3. State the properties of cardiac muscle. List the junctional tissues of the heart. How cardiac impulse is conducted through the heart. Why SA node is called the pace maker of the heart.

Answer. Properties of the cardiac muscle-

1. Excitability

It is the ability of the cardiac muscle to respond to a stimulus.

2. Contractility

The cardiac muscle has the ability to contract isometrically and isotonically.

a. Isometric contraction: The length remains constant but the tension increases e.g. early phase of ventricular systole.

b. Isotonic contraction: The tension remains constant while the length shortens e.g. late phase of ventricular contraction.

Contractility obeys "All or None Law" and "Starling Law"

i. All or None Law:

A threshold stimulus will cause contraction

A higher threshold (Suprathreshold) cause a similar contraction

A lower threshold (Subminimal) cause no contraction

ii. Starling Law:

The further the stretch of the muscle fibers, the stronger is the contraction up to a certain limit beyond which the muscle fibers can no longer contract stronger even with greater stretch of the muscle fibers.

3. Conductivity

It is the ability of the myocardial fibers to spread conduction along the conduction system all over the heart.

4. Rhythmicity

It is the ability of the heart to contract with regular intervals of relaxation (the distance between consecutive beats or myocardial contractions is almost equal or the duration of relaxation is almost the same)

Junctional tissues of the heart: The specialized tissue of the heart which are concerned for generating rhythmical impulses and conducting these impulses rapidly throughout the heart are collectively known as junctional tissue of the heart.

Name of the junctional tissues with velocity of conduction and rate of impulse generated-

Tissues	Velocity of conduction (meter/ second)	Rate of impulse generation (Impulse/ minute)
i. Sino-atrial node	0.05	70-80
ii. Internodal pathway	1	60
iii. Atrioventricular node	0.05	40-60
iv. Bundle of His & its branches	1	30-36
v. Purkinje fiber	4	15-40

Conductive system of heart:

1. Sino-atrial node (SA node) in which the normal rhythmic impulse is generated.
2. Internodal pathway, which conduct the impulse from the SA node to the AV node.
3. AV node (Atrioventricular node), in which the impulse from the atria is delayed before passing into the ventricles.
4. AV bundle (Bundle of His), which conducts the impulse from the atria into the ventricles.
5. Right and left bundle branches.
6. Purkinje fibers, which conduct the cardiac impulse to all parts of the ventricles.

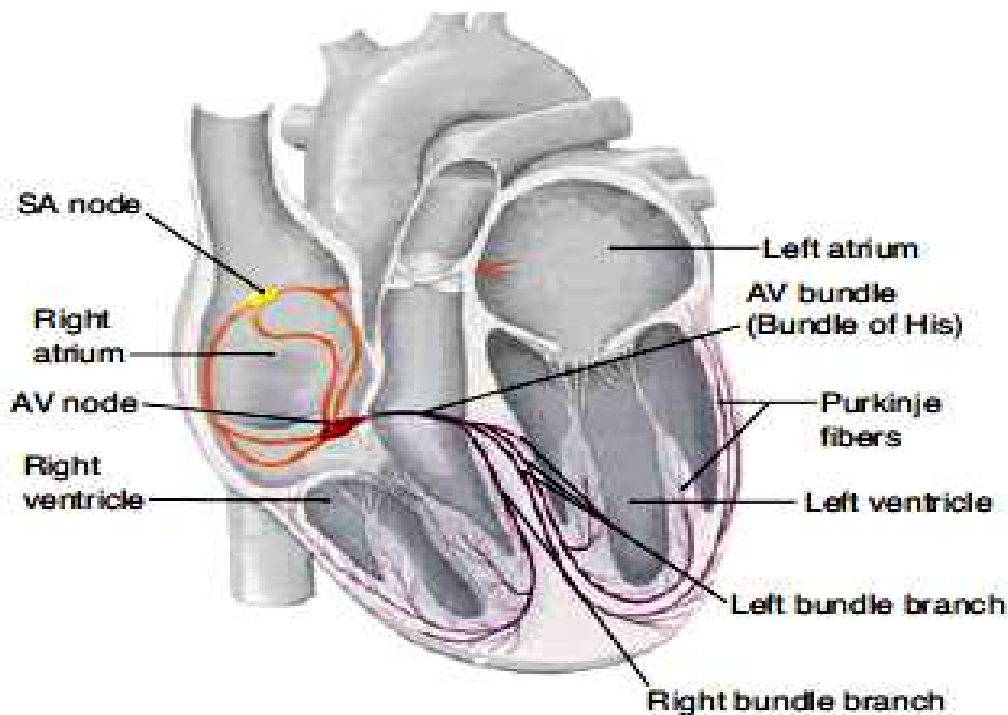


Figure- Conduitive system of heart

Sinus node (or, SA node) as the pace maker of the heart: The general meaning of pacemaker is that the rider or runner who sets the pace of the race.

The sinus node normally is the pace maker of the heart since it has the highest autorhythmicity, dictating the rate of beating of entire heart. In other words-

1. Sinus node generates the cardiac impulse at first.
2. It maintains the normal cardiac rhythm, and
3. The rate and rhythm originated by the sinus node is higher than that of any other part of the heart.

Q-4. Define cardiac output, cardiac cycle and blood pressure. What are the factors affecting cardiac output. What are the changes occurs during different events of cardiac cycle?

Answer. Cardiac output: Cardiac output is the quantity of blood pumped into the aorta each minute by heart.

$$\text{Cardiac output} = \text{Heart Rate} \times \text{Stroke volume}$$

Cardiac cycle: The period from the beginning of one heart beat to the beginning of the next is called the cardiac cycle. In other words, cardiac cycle is the sequence of events associated with one complete cycle of contraction and relaxation of the heart.

$$\text{Cardiac cycle} = \frac{1}{\text{Heart beat}}$$

Blood pressure: It is the lateral pressure exerted by the blood on the vessel wall while flowing through it. It can also be defined as, "the lateral pressure exerted by the moving column of blood on the vessel wall per unit area (sq. mm) by its contained blood while flowing through it."

$$\text{Blood pressure} = \text{Cardiac output} \times \text{Peripheral resistance}$$

Types of blood pressure-

1. Systolic pressure
2. Diastolic pressure
3. Pulse pressure
4. Mean pressure

Factors affecting/influencing cardiac output:

- A. Physiological-
 1. Age: increase with age.
 2. Sex: 10-20% less in females.
 3. Surface area
 4. Posture
 5. Exercise
 6. Emotion
 7. Temperature
- B. Pathological-
 1. Hyperthyroidism
 2. Anaemia
 3. Fever
 4. Fibrillation and flutter
 5. Other conditions: e.g. Paget's disease, atrio-venous fistula.

Changes taking place in the heart during cardiac cycle:

1. Changes in pressure-
 - a. Intraventricular pressure change
 - b. Intra-atrial pressure change
 - c. Pressure change within aorta
 - d. Pressure change within pulmonary artery
2. Changes in volume
 - a. Atrial volume change
 - b. Ventricular volume change
3. Production of heart sound and apex beat
4. Production of pulse and appearance of pulse wave.
5. Electrical changes
6. Electro-cardiogram (ECG) changes
7. Systemic, pulmonary and coronary circulation changes.

Q-5. Enumerate the lung volumes and capacities with diagram. Define vital capacity. What are the factors affecting vital capacity? Describe surfactant.

Answer. Lung Volumes and Lung Capacities-

The volume of air held by the maximally filled lungs can be divided into four non-overlapping volumes. These volumes are defined as follows:

- *Tidal Volume (VT)*: the volume of gas inspired or expired in a single respiratory cycle. This volume can be increased or decreased by calling on inspiratory or expiratory reserve volumes.
- *Inspiratory reserve volume (IRV)*: the maximum volume of gas that can be inhaled starting at the end of a normal inspiration
- *Expiratory reserve volume (ERV)*: the maximum volume of gas that can be exhaled starting from the end of a normal expiration
- *Residual volume (RV)*: the volume of gas that remains in the lungs after a maximum expiration.

Measures of lung air content that include more than one volume are called capacities:

- *Total lung capacity (TLC)*: the total amount of gas in the lungs at the end of a maximum inspiration = the sum of RV, ERV, VT, and IRV.
- *Vital capacity (VC)*: the maximum volume of gas that can be inspired after a maximum expiration = the sum of the ERV, VT and IRV
- *Functional residual capacity (FRC)*: the amount of gas in the lungs at the end of a normal expiration = the sum of the ERV and RV
- *Inspiratory capacity (IC)*: the maximum amount of gas that can be inspired starting from the FRC = the sum of VT and IRV

- **Forced vital capacity (FVC):** the amount of gas that can be expelled from the lungs by expiring as forcibly as possible, after a maximum inspiration.

The diagram of lung volumes and capacities are given below-

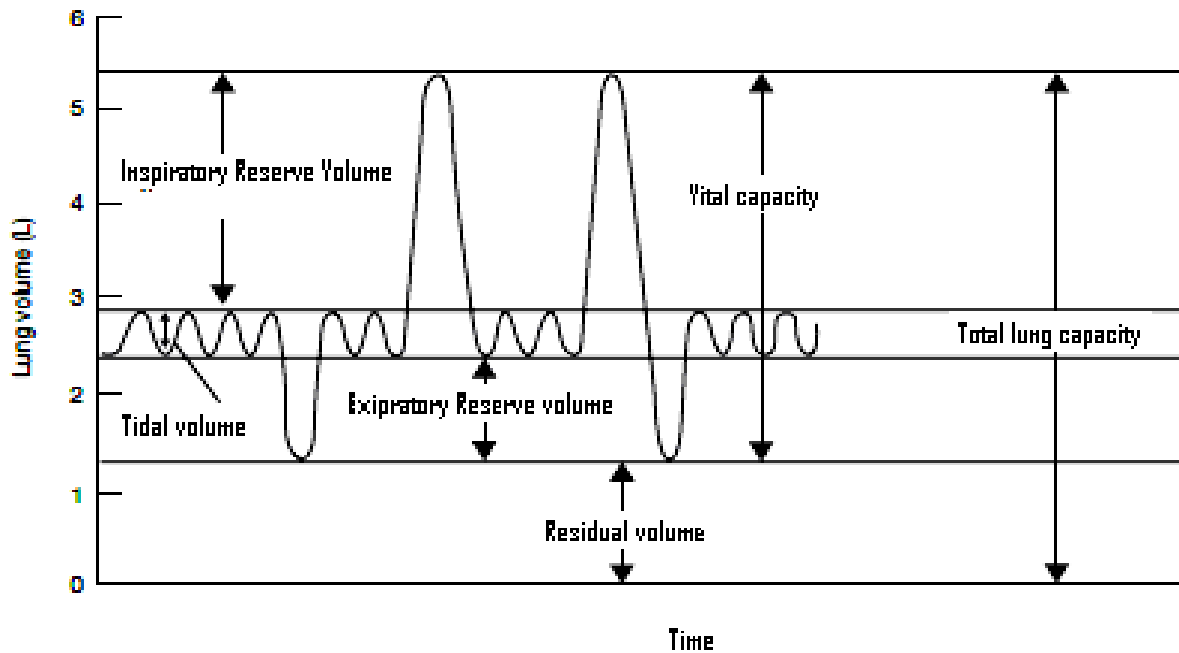


Figure- Lung volumes and capacities

Vital capacity: It is the maximum amount of air that a person can expel from the lungs after first filling the lungs to their maximum extent and then expiring to the maximum extent.

Significance of vital capacity:

1. An important lung function test.
2. Gives an idea about the condition of lung.
3. Assists in the assessment of different lung diseases, e.g asthma.

Factors affecting vital capacity:

1. Air way resistance
2. Strength of cardiac muscle
3. Pulmonary compliance
4. Others-
 - a. Age and sex
 - b. Posture
 - c. Surface area
 - d. Anatomical built of the lung

Surfactant: It is a lipoprotein complex secreted by the type II alveolar epithelial cells.

Composition-

Dipalmitoylphosphatidylcholine	-	62%
Phosphatidylglycin	-	05%
Other phospholipids	-	10%
Natural lipids	-	13%
Proteins	-	08%
Carbohydrate	-	02%

Functions of surfactant:

1. Reduction of surface tension.
2. Increase in alveolar radius.
3. Reduction of pulmonary capillary infiltration which helps to prevent pulmonary oedema.
4. Stabilization of the alveoli.
5. Surfactant keeps the lungs from collapsing.

Q-6. Give the composition and functions of saliva, gastric juice and pancreatic juice.

Answer. Composition of Saliva:

- A. Water- 99.5%
- B. Solid- 0.5%
 - 1. Organic (0.3%):
 - a. Enzymes- Ptyalin (salivary alpha-amylase), lingual lipase, carbonic anhydrase phosphatase, lysozymes.
 - b. Others- Mucin, urea, cholesterol, amino acids, blood groups substances (antigen of ABO blood group).
 - 2. Inorganic (0.2%):
 - NaCl, KCl, acid and alkaline sodium phosphate, calcium phosphate, CaCO₃, KHCO₃ etc.
 - 3. Gases: O₂, N₂, CO₂.

Functions of Saliva:

- 1. Mechanical functions-
 - a. It keeps the mouth moist and helps in speech.
 - b. It facilitates swallowing.
 - c. It helps in preparing food stuffs into bolus, suitable for digestion.
 - d. It dilutes hot and irritant food, thus preventing injury of the mucus membrane.
 - e. Saliva acts as a lubricant.
 - f. It washes down the food debris, thereby prevents bacterial growth.
- 2. It helps in taste.
- 3. Digestive functions- it breaks down boiled starch into maltose by ptyalin.
- 4. Excretory functions- it excretes urea, some heavy metals (Pb, Bi etc), thyocyanates, certain drugs like iodine, alkaloids such as morphine, antibiotics like penicillin.
- 5. It helps in water balance.
- 6. Buffering action
- 7. Non-specific defence- Lysozymes, immunoglobulin combat invading microbes.

Composition of Gastric juice:

- A. Water- 99.45 %
- B. Solid – 0.55%
 - 1. Organic (0.4%)
 - a. Enzymes: Pepsinogen, gastric lipase, gastric amylase, gastric rennin, gelatinase.
 - b. Intrinsic factor
 - c. Mucus
 - d. Gastrin
 - 2. Inorganic (0.15%)
 - a. Cations: Na⁺, K⁺, Mg²⁺, H⁺
 - b. Anions: Cl⁻, HPO₄²⁻, SO₄²⁻
 - c. HCl, CaCl₂, Ca₃(PO₄)₂

Functions of Gastric juice:

- 1. Digestive functions-
 - a. Helps in the digestion of protein and fat.
 - b. Water content of the gastric juice further liquefies the food swallowed making it easier for complete digestion and absorption.
- 2. Functions of HCl-
 - a. Provides optimal P^H for other enzymes to act on the food.
 - b. Kills the bacteria and microbes.

- c. Causes hydrolysis of all food stuffs.
- 3. Haemopoietic functions-
Gastric juice is required for the absorption of Vitamin B₁₂, essential factor for maturation of red cells.
- 4. Functions of mucus-
Protection and lubrication.
- 5. Functions of Gastrin-
 - a. Stimulate HCl secretion
 - b. Increase gastro-intestinal motility.
 - c. Increase pancreatic secretion.
 - d. Necessary for the growth of gastro-intestinal mucosa.

Composition of Pancreatic juice:

- A. Water- 98.5%
- B. Solid- 1.55%
 - a. Organic
 - i. Enzymes-
 - 1. Proteolytic- Trypsinogen, Chymotrypsinogen, Procarboxypolypeptidase, Elastases, Nuclease (Ribonuclease), Deoxyribonuclease (DNAase).
 - 2. Carbohydrate splitting enzyme- Pancreatic α -amylase.
 - 3. Fat splitting enzyme- Pancreatic lipase, cholesterol esterase, phospholipase.
 - ii. Trypsin inhibitor
 - b. Inorganic
 - i. Anions: Cations: Na⁺, K⁺, Mg²⁺, Ca⁺⁺
 - ii. Cations: HCO₃⁻, Cl⁻, HPO₄²⁻, SO₄²⁻

Functions of pancreatic juice:

- 1. Digestive function-
Pancreatic juice contains digestive enzymes for all the foods, i.e. carbohydrate, protein and fat.
 - a. Pancreatic amylase digests starch.
 - b. Trypsin digests protein.
 - c. Lipase digests fat.
- 2. Neutralizing action-
Pancreatic bicarbonate (HCO₃⁻) neutralizes the acid chyme and provides an optimal P^H for the action of the pancreatic enzymes.
- 3. Others-
Pancreatic juice also contains two nucleases, which are enzymes that break down nucleic acid molecules into nucleotides.

Q-7. Define GFR. What are the factors affecting GFR. Give the functions of kidney. Draw and label a nephron. Discuss the renal function tests.

Answer. GFR (Glomerular filtration rate): The quantity of glomerular filtrate formed each minute in all the nephrons of both kidneys is called glomerular filtration rate (GFR). It is approximately 125ml/minute.

Factors affecting GFR:

- 1. Change in renal blood flow.
- 2. Changes in glomerular capillary hydrostatic pressure.
- 3. Changes in hydrostatic pressure in Bowmans' capsule.
- 4. Changes in concentration of plasma proteins (i.e. changes in plasma colloidal osmotic pressure).
- 5. Changes in filtration co-efficient (K_f).

Functions of kidney:

- 1. Excretion of metabolic wastes and foreign chemicals.

2. Regulation of water and electrolyte balance.
3. Regulation of body fluid osmolality and electrolyte concentration.
4. Regulation of acid base balance.
5. Regulation of arterial pressure.
6. Secretion, metabolism and excretion of hormone.
7. Gluconeogenesis.

Nephron: It is the structural and functional unit of the kidney.

Parts of a nephron-

1. Renal capsule:
 - a. Glomerulus
 - b. Bowmans capsule
2. The renal tubule:
 - a. Proximal convoluted tubule
 - b. Distal convoluted tubule
 - c. Junctional or connecting tubule

Functions of a nephron-

Each nephron performs three basic functions, which in the kidney produces urine. These three functions are as follows-

1. Filtration in the glomeruli
2. Tubular reabsorption.
3. Tubular secretion

Each kidney is made up of approximately one million tiny units of nephrons.

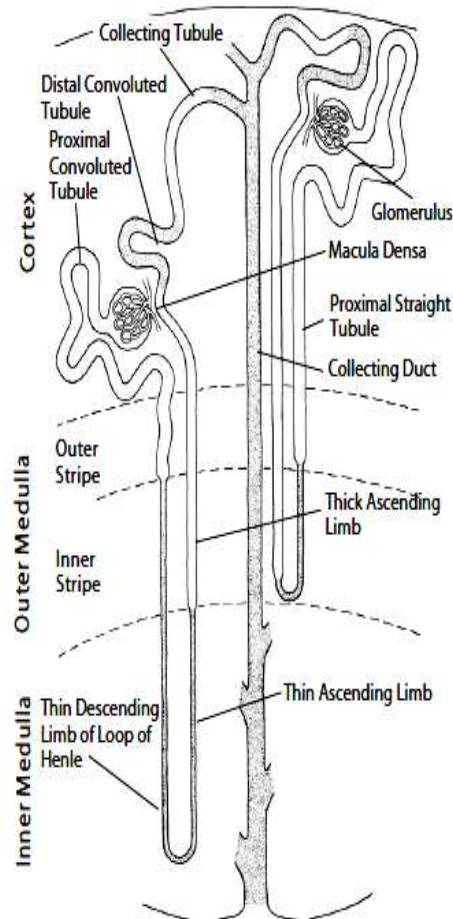


Figure- A nephron

Renal function tests:

1. Renal clearance tests-
 - a. Inulin clearance test
 - b. Urea clearance test
 - c. Creatinine clearance test
 - d. Para-aminohippuric acid clearance test.
2. Blood analysis as Renal function test-
 - a. Estimation of blood urea
 - b. Estimation of blood creatinine
 - c. Estimation of blood uric acid
3. Physical analysis of urine as Renal function test-
 - a. Volume of urine formed each day/ 24 hrs urine volume.
 - b. Specific gravity of urine.
4. Chemical analysis of urine as Renal function test-
 - a. Presence of normal constituents in abnormal amounts (e.g. urea, uric acid)
 - b. Presence of abnormal constituents (e.g. albumin, blood, glucose).

Q-8. Describe the digestion and absorption of carbohydrate and protein.

Answer. Digestion of carbohydrate:

1. In the mouth-
Boiled starch is converted to maltose by salivary α -amylase.
2. In the stomach-
No digestion.
3. In the intestine-
The carbohydrate splitting enzymes of small intestine acts on food and digest all the disaccharide in the following way:

- a. Maltose is converted to two molecules of glucose by maltase.
- b. Lactose is converted to glucose and galactose by lactase.
- c. Sucrose is converted to glucose and fructose by sucrase
- d. Trehalose is converted to glucose by trehalase.

The end products of carbohydrate digestion are – Fructose, glucose and galactose.

Absorption of carbohydrate: The end products of carbohydrate are monosaccharide and disaccharide. About 80% of monosaccharide are absorbed in the form of glucose and others in the form of galactose, fructose etc.

1. Absorption of glucose and galactose by sodium co-transport.
2. Absorption of fructose by facilitated diffusion.

Digestion of protein:

1. In the stomach-
 - a. Pepsin (with HCl) converts protein to peptones.
 - b. Rennin produces casein from casinogen, and
 - c. Pepsin (with HCl) turns casein into peptones.
2. In the small intestine-
 - a. Trypsin and chymotrypsin reduces protein and peptone to polypeptides.
 - b. Peptidase further reduces polypeptides to amino acids.

Absorption of protein: Proteins are absorbed in the form of amino acids and di or tri-peptidase.

1. Amino acids- At least seven different transport system
 - a. Five of these require Na^+ and co-transport amino acids.
 - b. Two of those also require Cl^-
 - c. Other two transport systems are independent of Na^+ .
2. Di and tri-peptidase-

Transported to enterocytes by a system required H^+ instead of Na^+ .

Q-9. Define and classify Jaundice. Discuss the liver function tests.

Answer. Jaundice: Jaundice may be defined as, “yellow discolouration of the skin, sclera and mucous membrane due to increased bilirubin concentration in the body fluid above normal.” So, yellow discolouration of the skin, mucous membrane and internal organs is called jaundice.

Classification of jaundice:

1. Haemolytic or pre-hepatic jaundice
2. Hepatocellular or hepatic jaundice
3. Obstructive or cholestatic or post hepatic jaundice

Liver function tests (LFT): The tests which are used to assess the condition or disease of liver.

- i. Pigment metabolism-
 1. Blood:
 - a. Serum Bilirubin
 - b. Vanden Bergh’s reaction/ Vanden Bergh’s test.
 - c. Icteric index
 2. Urine:
 - a. Bile salts
 - b. Bile pigment
 3. Stool:
 - a. Stercobilinogen
 - b. Bilirubin
- ii. Enzymatic functions
 1. SGPT (Serum glutamic pyruvic transaminase)/ALT (Alanine aminotransferase)

2. SGOT (Serum glutamic oxaloacetic transaminase)/AST (Asparate aminotransferase)
3. LDH (Lactic dehydrogenase)
4. Alkaline phosphatase
5. γ glutaryl transferase.
6. Serum isocitrate dehydrogenase.
- iii. Synthetic activity-
 1. Serum albumin
 2. Serum albumin globulin ratio
 3. Prothrombin time
 4. Clotting time and APTT (activated partial thromboplastin time)
- iv. Metabolic activities-
 1. Carbohydrate metabolism:
 - a. Glucose tolerance test
 2. Protein metabolism:
 - a. Serum total protein
 3. Fat & lipid metabolism:
 - a. Serum total cholesterol
 - b. Stool for faecal fat
 - c. Serum Triglycerides
 - d. Cholesterol ester
 - e. Abnormal lipoproteins
- v. Detoxification activity-
 1. Blood ammonia level
 2. Hippuric acid test
- vi. Excretion of foreign substance-
 1. Bromsulphthalein test/ Bromsulphthalein (Sulfobromophthalein) clearance test
 2. Rose Bengal test
- vii. Serological tests-
 1. Mitochondrial antibody
 2. Antinuclear and smooth muscle antibody
 3. Viral antigens and antibodies:
 - a. Hepatitis A virus
 - b. Hepatitis B virus
 - c. Hepatitis C virus
 - d. Hepatitis D virus/ Delta virus
 - e. Hepatitis E virus
- viii. Liver biopsy
- ix. Miscellaneous -
 1. Serum α fetoprotein
 2. Serum ferritin level.
 3. Total iron binding capacity
 4. Serum α_1 - antitrypsin

Q-10. Write short notes on: Axon & Dendrite, CSF, Semen.

Answer. Axon and dendrite: The difference between axon and dendrite-

Trait	Axon	Dendrite
1. Number	1. Always single in a neuron.	1. May be single or multiple.
2. Site of origin in the cell body	2. Arises from the nerve cell body at the axon hillock.	2. Arises from any part.
3. Size	3. Longer	3. Short.
4. Branching	4. Usually unbranched, if branched, branches are few.	4. Usually branched.
5. Functional	5. Motor	5. Sensory.
6. Nissl granules	6. Histologically, nissl granules absent.	6. Histologically, nissl granules present.
7. Direction of impulse	7. It carries impulse away from cell body.	7. It carries impulse toward the cell body.

- Cerebrospinal fluid (CSF): It is a clear, colourless fluid found in the ventricles of brain, cisterns around the brain, and subarchnoid spaces around both the brain and the spinal cord.

Site of formation of CSF-

- a. Choroid plexus of lateral, third and fourth ventricle.
- b. Diffuse from the brain itself.

Rate of formation-

On an average 20 ml/hour or 500 ml a day.

Mechanism of formation of CSF-

- a. Filtration: minor role
- b. Secretion: main process.

Character of CSF-

- i. Appearance : Clear
- ii. Colour : Colourless
- iii. Consistency : Liquid
- iv. P^H : Alkaline in reaction
- v. Specific gravity : 1.004-1.006
- vi. Volume : about 150 ml in adults
- vii. Pressure : 110 – 130 mm of H_2O .
- viii. Osmolality : 289 m osm/kg H_2O
- ix. PCO_2 : 50.2 mm of Hg.

Composition of CSF-

- A. Water- 99.13%
- B. Solid- 0.87%
 - a. Protein : 15- 45 mg/dl
 - b. Glucose : 50- 80 mg/dl
 - c. Cells : 0-5 lymphocytes/cu.mm of blood.
 - d. Electrolytes : Na^+ , K^+ , Ca^{2+} , Mg^{2+} , Cl^- , HCO_3^-
 - e. Others : Urea, creatinine.

Functions of CSF-

1. Protective functions: Protects brain and spinal cord.
2. Regulation of the contents of the skull.
3. Supply of nutrients to brain.
4. Excretion of the products of neural metabolism.
5. Circulatory functions

- Semen: The fluid that is ejaculated at the time of orgasm consisting of sperms, and the secretion of the seminal vesicles, prostate, Cowper's gland (and probably the urethral gland) is called semen.

Characteristics of semen-

- a. Colour : White and opalescent
- b. Consistency : Turbid and viscid
- c. P^H : Slightly alkaline (7.3- 7.5)
- d. Specific gravity : 1.028
- e. Volume : On an average 2- 5 ml/ ejaculation.

Composition of semen-

- a. Semenal fluid: 60%
 - i. Fructose
 - ii. Phosphorylcholine
 - iii. Ergothioneine
 - iv. Ascorbic acid
 - v. Prostaglandins
- b. Prostatic secretions: 20%
 - i. Spermine

- ii. Citric acid
- iii. Cholesterol and phospholipids
- iv. Zinc
- v. Acid phosphate
- c. Spermatozoa: 05%
- d. Others: 15%
 - i. Phosphate
 - ii. Bicarbonate
 - iii. Hyaluronidase etc.

- ECG: The body is a good conductor of electricity, potential differences generated by the depolarization and repolarization of the myocardium can be detected on the surface of the body and recorded which is known as an **electrocardiogram (ECG)**. The *P wave* indicates depolarization of the atria. The *QRS complex* is the record of ventricular depolarization; the *T wave*, of ventricular repolarization. The short flat segment between S and T represents the refractory state of the ventricular myocardium; that between P and Q, a nonconductive phase of the AV node, during which atrial systole can be completed.

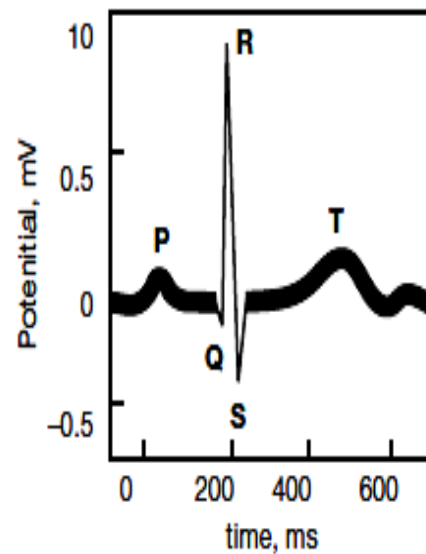


Figure : A normal electrocardiogram.

The fewer our wants, the nearer we resemble the gods. - Socrates.

Community Medicine

Q-1. Define primary health care. What are its components? Briefly describe the principles of primary health care.

Answer. Primary health care: An international conference in Alma-Ata, USSR (1978) defined primary health care as, “Essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and the country can afford to maintain at every stage of their development in the spirit of self-determination.”

Elements/ Components of Primary Health Care (PHC): The Alma Ata declaration has outlined 8 essential components of primary health care-

1. Education concerning prevailing health problems and the methods of preventing and controlling them.
2. Promotion of food supply and proper nutrition.
3. An adequate supply of safe water and basic sanitation.
4. Maternal and child health care, including family planning.
5. Immunization against major infectious diseases.
6. Prevention and control of locally endemic diseases.
7. Appropriate treatment of common diseases and injuries, and
8. Provision of essential drugs.

Principles of primary health care: Primary health care (PHC) is based on 4 principles-

1. Equitable distribution: Health service should be accessible to all sections of the society with special attention to the needy and vulnerable groups. Health services must be shared equally by all people irrespective of their ability to pay and all (rich or poor) must have access to health services.
2. Community participation: Involvement of individuals, families, communities (social worker, health personnel, school teacher, political, religious and local leaders) in promotion of their own health and welfare including self care. It is an essential ingredient of primary health care. Thus the community should participate in the planning, implementation and maintenance of health services.
3. Multisectorial approach: It should be attained by the joint efforts of health sector and other health related sectors, such as education, food and agriculture, rural development, non-governmental organizations (NGOs) and other voluntary organizations.
4. Appropriate technology: Appropriate technology has been defined as, “technologically that is scientifically sound, adapted to local needs and acceptable to those who apply it and those for whom it is used, and that can be maintained by the people themselves in keeping with principle of self reliance with resources the community and country can afford.”

Q-2. How can you calculate safe period? Write down the indication, contraindication and complication of IUCD and oral pills.

Answer. Safe period: This is also known as “calendar method” first described by Ogino in 1930. The method is based on the fact that ovulation occurs from 12 to 16 days before the onset of menstruation.

Calculation of safe period-

The shortest cycle minus 18 days gives the first day of fertile period. The longest cycle minus 10 day gives the last day of the fertile period. For example, if a woman’s menstrual cycle varies from 26 to 31 days; the fertile period during which she should not have intercourse would be from the 8th day (26-18=08) to the 21st day (31-10=21) of the menstrual period. All other days before and after the fertile period would be “safe period”.

Indication of IUCD (intra-uterine contraceptive device):

1. When other methods have failed or are inapplicable.
2. When oral contraceptives are contraindicated or some women are fearful of the pills.
3. Especially valuable in the case of feckless and irresponsible women (and husbands) and for mental defectives and social misfits.
4. If personnel are available to fit them, they can be applied to communities of women with the object of population control.

Contraindication of IUCDs:

1. Absolute contraindications-
 - a. Active pelvic infections
 - b. Pregnancy
2. Relative contraindications-
 - a. Women having irregular and heavy periods, uterine fibroids or other pelvic disease.
 - b. Present or past pelvic infection of any kind.
 - c. Anatomic uterine anomaly (e.g. bicornuate uterus).
 - d. Nulliparous women.
 - e. History of previous caesarean section or hysterotomy of any kind.
 - f. Purulent cervicitis
 - g. Post partum endometritis
 - h. Recurrent sexually transmitted diseases.
 - i. Multiple sexual partners
 - j. History of ectopic pregnancy
 - k. Impaired coagulation.
1. Unacceptable side effects during previous trials.

Complication/Side effects/Disadvantages of IUCDs:

1. Fainting and collapse of the patient at the time of IUCD insertion.
2. Bleeding and iron deficiency anaemia may occur.
3. Painful menstruation (dysmenorrhage).
4. Pelvic inflammatory diseases, e.g. pelvic actinomycosis.
5. Cervical injury.
6. Perforation of the uterus
7. Ectopic pregnancy
8. Accidental pregnancy
9. Spontaneous expulsion.

Indication of oral pill:

1. Contraceptives
2. To reduce premenstrual bleeding
3. Dysmenorrhoea
4. Abnormal uterine bleeding
5. Dysfunctional uterine bleeding
6. Functional ovarian cyst
7. Benign breast disease
8. Sterility
9. Endometriosis
10. Menopause

Contraindication of oral pills:

1. Absolute contraindications-
 - i. Thromboembolic diseases or history of thrombophlebitis.
 - ii. Cerebrovascular accident
 - iii. Ischaemic heart disease
 - iv. Breast cancer
 - v. Liver diseases (liver tumour or impaired liver function)

- vi. Oestrogen dependent neoplasm
 - vii. Vaginal bleeding of unknown cause
 - viii. Pregnancy
 - ix. History of pregnancy related cholestasis.
2. Relative contraindications-
- i. Migraine headache
 - ii. Hypertension
 - iii. Diabetes
 - iv. Asthma
 - v. History of herpes of pregnancy
 - vi. Sickle cell disease
 - vii. Elective surgery

Complications/ disadvantage/Adverse effects/ demerits of oral pills:

- 1. Most common side effects-
 - a. Bleeding irregularities, including missed periods (amenorrhoea), scanty bleeding or breakthrough bleeding.
 - b. Weight gain.
 - c. Skin changes, acne and chloasma.
 - d. Breast tenderness or fullness.
 - e. Benign liver tumours (adenomas)
 - f. Depression or mood changes.
- 2. More serious but less common side effects-
 - a. Hypertension
 - b. Stroke
 - c. Thrombotic diseases
 - d. Gall stones
 - e. May develop cervical cancer with increase duration of use.
- 3. Temporary side effects-
 - a. Nausea and vomiting
 - b. Migraine
 - c. Loss of libido (due to dryness of vagina and emotional changes)
 - d. Candida vulvitis and vaginitis.
 - e. Leucorrhoea (increased cervical secretion)

Q-3. Define Family planning. Discuss the different methods of family planning/contraceptives.

Answer. Family planning: An Expert Committee (1971) of the WHO defined family planning as, “a way of thinking and living that is adopted voluntarily, upon the basis of knowledge, attitudes and responsible decision by individuals and couples, in order to promote the health and welfare of the family group and thus contribute effectively to the social development of a country.”

Another Expert Committee defined and described family planning as follows; “Family planning refers to practices that help individuals or couples to attain certain objectives-

- a. to avoid unwanted births
- b. to bring about wanted births
- c. to regulated the intervals between pregnancies
- d. to control the time at which births occur in relation to the ages of the parent.
- e. to determine the number of children in the family.”

Different methods of family planning/contraceptives: Mainly two-temporary methods and permanent methods. It is enumerated below-

- I. Temporary methods/ Spacing methods
 - 1. Barrier methods-
 - a. Physical methods
 - i. Condom

- ii. Vaginal diaphragm
- iii. Cervical cap
- iv. Vaginal sponge
- b. Chemical methods
 - i. Foam
 - ii. Creams, jellies and pastes
 - iii. Suppositories
 - iv. Soluble films
- c. Combine methods
- 2. Intrauterine devices (IUD)/ Intrauterine contraceptive devices (IUCD)
- 3. Hormonal methods
 - a. Oral pills
 - i. Combined pill - oestrogen and progestogen
 - ii. Mini-pill - progestogen only pill
 - iii. Sequential pill - 2 weeks oestrogen and then in 3rd week both oestrogen and progestogen.
 - iv. Post coital pill - once a month pill (long acting pill)
 - v. Male pill
 - b. Depot (slow releasing) preparations
 - i. Injectables - Depot provera
 - ii. Subcutaneous implant - Norplant
 - iii. Vaginal rings
 - c. IUCD releasing hormones, e.g. progestasert.
- 4. Post conceptional methods
 - a. Menstrual regulation (MR)
 - b. Menstrual induction (MI)
- 5. Miscellaneous
 - a. Abstinence
 - b. Coitus interruptus
 - c. Safe period (rhythmic method)
 - d. Natural family planning methods
 - i. Basal body temperature method (BBT)
 - ii. Cervical mucus method
 - iii. Symptothermic method
 - e. Breast feeding
 - f. Birth control vaccine

II. Permanent methods

1. Male sterilization (Vasectomy)
2. Female sterilization (Tubectomy/ tubal ligation).

Q-4. Define communicable diseases. List the major communicable diseases in Bangladesh. Mention the modes of transmission of disease with example. What are the levels of prevention? What is EPI and its objectives? Give the EPI schedule.

Answer. Communicable disease: Communicable disease is a disease which can be transmitted from one host or reservoir to another through transference of a sufficient quantity of the causative agent.

Major Communicable disease in Bangladesh:

- A. Top 10 communicable diseases-
The following 10 priority communicable diseases in Bangladesh are jointly prepared by NIPSOM and WHO.
 1. Diarrhoeal disease
 2. Tuberculosis
 3. Malaria
 4. Measles
 5. Tetanus
 6. Diphtheria
 7. Pertussis, or Whooping cough

8. Polio
 9. Intestinal worm infestation
 10. Scabies
- B. Other communicable diseases are-
1. Leprosy
 2. Infective hepatitis
 3. Rabies
 4. Syphilis
 5. Gonorrhoea
 6. Typhoid and paratyphoid fever
 7. Influenza
 8. Chicken pox
 9. Mumps
 10. Filariasis
 11. Kala-Azar

Mode of transmission of diseases: Disease or communicable diseases may be transmitted from the reservoir or source of infection to a susceptible individual in many ways, depending upon the infectious agent, portal of entry and the local ecological conditions. The mode of transmission of infectious disease may be classified as below-

A. Direct transmission:

1. Direct contacts, e.g. STDs, Tuberculosis.
2. Droplet infections, e.g. Tuberculosis, Diphtheria.
3. Contact with soil, e.g. Tetanus, Mycoses.
4. Inoculation with skin or mucosa, e.g. Rabies virus by dog bite.
5. Transplacental (vertical), e.g. Syphilis, Hepatitis B.

B. Indirect transmission:

1. Vehicle- borne, e.g. Cholera, Polio, Brucellosis.
2. Vector borne, e.g. Malaria, Dengue fever
 - a. Mechanical
 - b. Biological, .e.g. microfilariae in mosquito.
3. Air borne-
 - a. Droplet nuclei, e.g. Tuberculosis, measles.
 - b. Dust, e.g. Tuberculosis.
4. Fomite borne, e.g. Typhoid, Bacillary dysentery.
5. Unclean hands and fingers, e.g. intestinal parasites, hepatitis A, eye and skin infections, dysentery, diarrhoea.

Prevention: It's in a narrow sense, means averting the development of a pathological state. In broader sense, it includes all the steps including definitive therapy that stops the progress of disease at any stage of its course.

Levels of prevention-

The disease process in man or community can be intercepted at various levels in the course of its natural history. In this respect, there are five levels of prevention or intervention, which are as follows-

- | | | |
|----------------------------------|---|----------------------|
| a. Health promotion | } | Primary Prevention |
| b. Specific protection | | |
| c. Early diagnosis and treatment | } | Secondary Prevention |
| d. Disability limitation | | |
| e. Rehabilitation | } | Tertiary Prevention |

EPI: In May 1974, WHO officially launched a global immunization programme known as "Expanded Programme on Immunization (EPI)", to protect all the children of the world against six vaccine preventable diseases, namely-

diphtheria, whooping cough, tetanus, poliomyelitis, tuberculosis and measles by the year 2000.”

Objectives of EPI (Expanded Programme on Immunization):

1. To reduce morbidity and mortality from six preventable diseases- diphtheria, whooping cough, tetanus, poliomyelitis, tuberculosis and measles.
2. To reduce disability from poliomyelitis.
3. To reduce infant and maternal mortality rate.

EPI Schedule: The EPI schedule recommended by WHO is given below-

Age	Vaccine
Birth	BCG, oral polio
6 weeks	DPT, oral polio
10 weeks	DPT, oral polio
14 weeks	DPT, oral polio
9 months	Measles

Additionally, to protect women and newborn child against tetanus, WHO has also recommended five doses of Tetanus Toxoid (TT), which is now also a part of the Expanded Programme on Immunization (EPI). The doses are-

1 st dose	= after 15 years
2 nd dose	= after 4 weeks from the 1 st dose
3 rd dose	= after 6 months from the 2 nd dose
4 th dose	= after 1 year from the 3 rd dose
5 th dose	= after 1 year from the 4 th dose

Q-5. What is malnutrition? Define & classify PEM? What are the common causes of malnutrition? Give the difference between marasmus and kwashiorkor? Enumerate the common nutritional problems (major malnutrition diseases) in Bangladesh.

Answer. Malnutrition: It has been defined as, “a pathological state resulting from a relative or absolute deficiency or excess of one or more essential nutrients.” It comprises four forms-

- a. Under nutrition
- b. Overnutrition
- c. Imbalance
- d. Specific deficiency

Causes of Malnutrition:

1. An inadequate intake of food, both in quantity and quality.
2. Infections notably diarrhoea, respiratory infections, measles and intestinal worms.
3. Poor socio-economic and environmental conditions.
4. Large family size.
5. Poor mental health
6. Failure of lactation
7. Premature termination of breast feeding and adverse cultural practice relating to child rearing and weaning.
8. Lack of elementary knowledge about food and nutrition.
9. Gastrointestinal disorders
10. Bad cooking practice
11. Fever
12. Surgery
13. Drug therapy.

PEM (Protein energy malnutrition): Protein energy malnutrition is a spectrum of disease conditions ranging from growth failure to overt marasmus or kwashiorkor.

Classification of PEM-

Waterlow's classification defines two groups for protein energy malnutrition-

1. Malnutrition with retarded growth, in which a drop in the height/age ratio points to chronic condition- shortness or stunting.
2. Malnutrition with a low weight for a normal height, in which the weight for height ratio is indicative of an acute condition of rapid weight loss or wasting.

Difference between marasmus and kwashiorkor:

Features	Marasmus	Kwashiorkor
Clinical	Always present	
1. Muscle wasting	1. Obvious	1. Sometime hidden by oedema.
2. Fat wasting	2. Severe loss of subcutaneous fat	2. Fat often retained but not firm.
3. Oedema	3. None	3. Present in lower legs, and usually in face and lower arms.
4. Weight for height	4. Very low	4. Low, but may be marked by oedema.
5. Mental changes	5. Sometimes quiet and apathetic.	5. Irritable, moaning, apathetic.
Clinical	Some times present	
6. Appetite	6. Usually good.	6. Usually poor.
7. Skin changes	7. Usually none	7. Diffuse pigmentation, sometimes "flaky point dermatosis".
Clinical	Some times present	
8. Hair changes	8. Seldom	8. Sparse, silky, easily pulled out.
9. Hepatic enlargement	9. None	9. Sometimes, due to accumulation of fat.
Bio-chemical		
10. Serum albumin	10. Normal or slightly decreased.	10. Low (less than 3gm/dl of blood)
11. Urinary urea per gm creatinine	11. Normal or decreased	11. Low
12. Plasma/amino acid ratio	12. Normal	12. Elevated
Others		
13. Moon face	13. None	13. Often
14. Growth retardation	14. Severe	14. Less than that of marasmus.

Major nutritional/ malnutrition problem of Bangladesh:

1. Low birth weight
2. Protein energy malnutrition (PEM)
3. Vitamin A deficiency- Night blindness, total blindness and Xerophthalmia.
4. Iron deficiency- Hypochromic microcytic anaemia
5. Khesari dhal intoxication- Neurolathyrisism.
6. Iodine deficiency- Endemic goiter.

Q-6. Define and classify foods & vitamins with example. Discuss the deficiency disorders of vitamins.

Answer. Food: Food is a composite mixture of substances which when consumed performs certain function in the body.

Classification of food:

- A. Classification on by origin-
 1. Foods of animal origin, e.g. eggs, beef, milk etc.
 2. Foods of plant or vegetable origin, e.g. rice, fruits, pulses, nuts etc.
- B. Classification on chemical composition-
 1. Protein, e.g. eggs, beans etc.
 2. Fat, e.g. beef, soybean oil etc.
 3. Carbohydrate, e.g. rice, wheat etc.
 4. Vitamin, e.g. lemon, eggs, liver etc.
 5. Mineral, e.g. sea fish, cheese, cod liver oil etc.
- C. Classification on predominant function-
 1. Body building food, e.g. milk, meat, poultry, fish, eggs, pulses etc.
 2. Energy giving food, e.g. cereals, sugars, fats and oils etc.
 3. Protective foods, e.g. vegetables, fruits, milk etc.

Vitamins: Vitamins are low molecular weight mass organic compounds occurring in natural foods, which are required in minute amounts for the maintenance of optimal health.

Classification of vitamins: Vitamins are classified into two broad groups as below-

1. Fat soluble vitamins, e.g. Vitamin A, D, E, K.
2. Water soluble vitamins, e.g. Vitamin B complex, Vitamin C.

Deficiency disorders of Vitamins:

1. Vitamin A deficiency disorders-
 - a. Ocular: Xerophthalmia (night blindness, conjunctival xerosis, Bitot's spots, corneal xerosis and keratomalacia).
 - b. Extra-ocular manifestations: Follicular hyperkeratosis, anorexia and growth retardation.
2. Vitamin D deficiency disorders-
 - a. Rickets
 - b. Osteomalacia
3. Vitamin K deficiency disorders-
 - a. Generalized bleeding manifestation due to hypoprothrombinaemia.
 - b. Considerably prolonged clotting time.
4. Vitamin E deficiency disorders-
 - a. May cause skin problem and sterility, but exact functions of Vitamin E is not known.
5. Vitamin B complex deficiency disorders-
 - a. Thiamine (Vitamin B₁) deficiency:
 - i. Beriberi
 - ii. Wernicks encephalopathy
 - b. Riboflavin (Vitamin B₂) deficiency:
 - i. Angular stomatitis
 - ii. Cheilosis
 - iii. Glossitis
 - iv. Nasolabial dyssebacia
 - c. Niacin deficiency:
 - i. Pellagra
 - ii. Glossitis
 - iii. Stomatitis

- d. Pyridoxine (Vitamin B₆) deficiency:
 - i. Peripheral neuritis.
- e. Folate deficiency:
 - i. Megaloblastic anaemia
 - ii. Glossitis
 - iii. Cheilosis
 - iv. GIT disturbances, e.g. diarrhoea.
 - v. Infertility or sterility (due to severe deficiency).
- f. Cyanocobalamin (Vitamin B₁₂) deficiency:
 - i. Megaloblastic anaemia
 - ii. Demyelinating neurological lesions in the spinal cord.
- 6. Vitamin C (Ascorbic acid) deficiency-
 - a. Scurvy- which is characterized by:
 - i. Swollen and bleeding gums
 - ii. Subcutaneous bruising
 - iii. Bleeding into the skin or joints
 - iv. Delayed wound healing
 - v. Anaemia and
 - vi. Weakness.

Q-7. What is safe water? Classify (List) the sources of water and impurities of water. How water is polluted. List the water born diseases.

Answer. Safe water: Safe water is, "one that does not cause any harm, even when ingested over prolonged periods."

The safe and wholesome water has been defined as the water that is-

- a. Free from pathogenic agents
- b. Free from harmful chemical substance
- c. Pleasant to taste, i.e. free from colour and odour; and
- d. Usable for domestic purposes.

Classification of sources of water/ Sources of water: There are three main source of water-

- 1. Rain
- 2. Surface water
 - a. Impounding Reservoirs
 - b. Rivers and streams
 - c. Tanks, ponds and lakes
 - d. Sea water
- 3. Ground water
 - a. Wells-
 - i. Shallow well
 - ii. Deep well
 - iii. Artesian well
 - b. Springs

Impurities of water/ Water pollution: Water is polluted by-

A. Natural impurities

- 1. Dissolved gases (e.g. nitrogen, carbon dioxide, hydrogen sulphide etc).
- 2. Dissolved minerals (e.g. salts of calcium, magnesium, sodium etc)
- 3. Suspended impurities (e.g. clay, silt, sand and mud)
- 4. Microscopic organisms.

B. Impurities due to human activities

- 1. Sewage- which contains decomposable organic matter and pathogenic agents.
- 2. Industrial and trade wastes- which contain toxic agents ranging from metal salts to complex synthetic organic material.
- 3. Agricultural pollutants- which comprises fertilizers and pesticides.

4. Physical pollutants, viz. heat (thermal pollution), and radio active substances.
5. Water vessels wastes- which comprise used oils and other organic and chemical wastes from fishing boats, ships etc that pollutes the sea and river water mainly.

Water borne diseases/ Hazards of water pollution:

- A. Infective water borne diseases (or, Biological hazards)-
 1. Those due to the presence of an infective agents:
 - a. Viral- Viral hepatitis A, hepatitis E, Poliomyelitis, rotavirus diarrhoea in infants.
 - b. Bacterial- Typhoid and paratyphoid fever, bacillary dysentery, Esch. coli diarrhoea, cholera.
 - c. Protozoal- Amoebiasis, Giardiasis.
 - d. Helmenthic- Round worm, thread worm, hydatid disease.
 - e. Leptospiral- Weil's disease.
 2. Those due to presence of an aquatic host:
 - a. Snail- Schistosomiasis
 - b. Cyclops- Guinea worm, Fish tape worm.
- B. Non-infective water borne diseases (or, chemical hazards)-
 1. Salts of Pb, Zn, Fe may cause constipation and Fe may also cause dyspepsia.
 2. Prolonged use of water containing Pb salt causes Plumbism.
 3. Salts of magnesium and aluminium may cause diarrhoea.
 4. Excess fluoride may cause dental fluorosis.
 5. Excess of phosphorus causes phosphorus poisoning.
 6. Rotten vegetable materials may cause diarrhoea and also causes some gastro-intestinal disorders.

Q-8. What is waste (refuse)? Classify wastes (refuse). Give the standard methods of waste (solid wastes/refuse) disposal. Define and classify latrines.

Answer. Waste: Wastes are unwanted and discarded materials which are no longer useful.

Types of Waste:

1. Solid waste-
 - a. Refuse
 - b. Excreta or litter
2. Liquid waste-
 - a. Slop water
 - b. Sullage
 - c. Sewage

Refuse: Waste materials from homes, restaurants and other establishments in the community. It includes mainly garbage, rubbish and ashes.

Classification of refuse:

1. According to physical characteristics-
 - a. Dry refuse, e.g. paper, dust, ashes etc.
 - b. Wet refuse, e.g. Garbage.
2. According to putrefying ability-
 - a. Putrefiable, e.g. Garbage.
 - b. Non-putrefiable, e.g. Glass, polythene bags, empty cans etc.
3. According to burning characteristics-
 - a. Combustible, e.g. Paper, dry leaves, straw etc.
 - b. Non-combustible, e.g. Brick, dirt, broken piece of crockery etc.

Disposal of wastes/ Disposal of refuses: Sanitary disposal of refuse include safe and efficient-

1. Storage: The ideal method is to put the household refuse in galvanized or plastic container fitted with lids. For the storage of refuses of a community- dustbins (metal or brick made) are placed at suitable locations.
2. Collection and transport: Usually municipal authority collects the refuse by conservancy personnel using cart-wheels and mechanized vehicles. Specially designed vehicles carry the refuse to the place of final disposal or destruction.
3. Final destruction/end treatment of wastes: It is done by the following methods:
 - a. Dumping- Throwing of refuses in a low lying area away from human habitation for the reclamation of land.
 - b. Sanitary land filling- Depositing refuses are dumped and adequately covered with a layer of earth or sand at the end of each day's operation.
 - c. Incineration- It is the destruction of refuse by combustion inside a closed chamber.
 - d. Others-
 - i. Composting
 - ii. Burial
 - iii. Manure pit etc.

Latrine: A latrine is a device where one can ease oneself in response to the call of nature with proper privacy. A sanitary latrine can be defined as, "a latrine which is properly located, well constructed and protected against contamination where a person can ease oneself with proper privacy at the time of natural call."

Types of Latrine:

1. Service latrines-
 - a. Pale or bucket type of latrine
2. Sanitary latrines (non-service type)-
 - a. Bore hole latrine
 - b. Dug well latrine
 - c. Water seal latrine
 - d. Septic tank
 - e. Aqua privy
 - f. Chemical closet
3. Temporary latrines useful for camps-
 - a. Shallow latrine
 - b. Deep trench latrine
 - c. Pit latrine
 - d. Bore hole latrine

Parts of a water seal sanitary latrine:

- a. Super structure
- b. Squatting plate
- c. Pan
- d. Trap
- e. Connecting pipe
- f. Pit

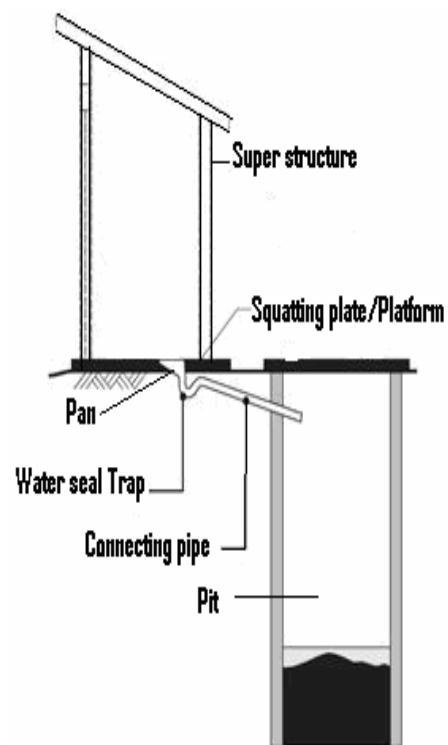


Figure- A Sanitary Latrine

Q-9. What is air? How air is polluted and how it can be prevented? List the air born diseases. Give the composition of atmospheric air and exhaled air.

Answer. Air: Air is a mechanical mixture of gases and not a chemical compound. The immediate environment of man comprises of air on which depends all form of life.

Air pollution: Air pollution is defined as, “the presence of harmful substances in the air in excessive amount which is detrimental to man or his environment.”

Sources of Air pollution:

1. Automobiles and other automotive transport-
Vehicles, vessels and air craft emit hydrocarbons, carbon monoxide, carbon dioxide, lead, nitrogen oxide and particulate matter.
2. Industrial processes-
Chemical industries, metallurgical industries, oil refineries, fertilizer factories and cement factories produce CO₂, heat, dust, fume and other wastes.
3. Combustion-
Industrial and domestic combustion of coal, gases, fire wood produces CO₂, CO, soot, dust and sulphur dioxide.
4. Decomposition of organic matter-
Decomposition of animal and vegetable matter, sewage etc produce CO₂, H₂O, NH₃, marsh gases, ammonium hydrogen sulphide, carbon disulphide.
5. Natural phenomenon-
Respiration of man and animals, radio active substances in the nature, forest fire and volcanoes.
6. Miscellaneous-
Burning refuses, insecticide spraying, incineration, nuclear energy programme etc.

Air borne diseases:

1. Diseases due to droplet infectious and droplet nuclei-
 - a. Bacterial: Tuberculosis, diphtheria, whooping cough and pulmonary anthrax.
 - b. Viral: Chicken pox, measles, mumps, influenza and small pox.
2. Diseases due to inhalation of air borne harmful agents-
Inhalation of non-infective dust, toxic and non-toxic industrial particles may cause-
 - a. Pneumoconiosis, which includes siderosis, silicosis, bysinosis, anthracosis, lead poisoning and bagasosis.
 - b. Chronic bronchitis
 - c. Bronchogenic carcinoma.

Composition of Air:

Element	Out door Air	Expired Air
Nitrogen	78.62 %	74.50 %
Oxygen	20.84%	15.70%
Carbon dioxide	0.04%	3.60%
H ₂ O	0.50%	6.20%

Q-10. Define health education. Mention the principle, objectives and importance of health education. Classify the media of health education. List the barriers of communication. Define health. Describe philosophy of health and different disease agents.

Answer. Health education: The National Conference on Preventive Medicine in USA has defined health education as, “Health education is a process that informs, motivates and helps people to adopt and maintain healthy practices and life styles, advocates environmental changes as needed to facilitate this goal and conducts professional training and research to the same end.”

Principle of Health education:

1. Interest
2. Participation
3. Known to unknown
4. Comprehension

5. Reinforcement
6. Motivation
7. Learning by doing
8. Soil, seed and sower
9. Good human relation
10. Leaders

Objectives/ Aims of Health education: The WHO has formulated the aims/objectives of health education as follows-

1. Informing people-
To create awareness of people in terms of health education and to ensure that health valued as an asset in the community.
2. Motivating people-
To equip the people with skill, knowledge and attitudes to enable them solve their health problems by their own actions and efforts.
3. Guiding into action-
To promote the development and proper use of health services.

Importance of health education/ Helps of the community by health education:

1. Nutrition
2. Environmental sanitation
3. Control of communicable diseases
4. Population control and Family planning
5. Family health care
6. Prevention of accidents, the field of mental health and occupational health
7. Control of non-communicable diseases by early information and awareness.
8. For specific protection drive (e.g. anti-mosquito drive)
9. A patient of communicable disease should know how to live in the family and community.
10. Long drawn treatment for chronic diseases.
11. Antenatal care of pregnant woman and proper baby care.
12. Informing the people about health services that are available in the community and to make the best use of them.
13. Reduction in maternal and infant mortality rate.

Classification of media of health education:

A. Spoken words-

1. Didactic methods:
 - a. Chalk and black board
 - b. Microphone
 - c. Slide
 - d. Projection
 - e. Posters etc.
2. Socratic method:
 - a. Group discussion
 - b. Panel discussion
 - c. Symposium
 - d. Seminar
 - e. Workshop
 - f. Role playing
 - g. Demonstration.
 - h. Programmed instruction.

B. Visual media-

1. Chalk and black board
2. Chart, maps and graphs.
3. Posters, journals, papers, pamphlets.

4. Text book, work book.
5. Photograph, slides
6. Flannel graph- pictures, drawings, illustrations.
7. Exhibits- objects, models, specimens.

C. Mass media-

1. Television
2. Radio
3. Films/Video
4. Press
5. Posters
6. Health magazines
7. Health exhibitions
8. Health museum.

Barriers of communication-

1. Physiological: difficulty in hearing, expression etc.
2. Psychological: emotional disturbances, neurosis etc.
3. Environmental: noise, invisibility, congestion etc.
4. Cultural: Level of knowledge and understanding, customs, beliefs, religion, attitude etc.

Health: WHO (1948) defined health as, “Health is a complete state of complete physical, mental and social wellbeing and not merely an absence of disease or infirmity.”

Philosophy of health: In recent years, a new philosophy of health is acquired, which may be stated as below-

1. Health is a fundamental human right.
2. Health is the essence of productive life and not the result of ever increasing expenditure on medical care.
3. Health is intersectorial.
4. Health is an integral part of development.
5. Health is central to the concept of quality of life.
6. Health involves individuals, state and international responsibility.
7. Health and its maintenance is a major social investment.
8. Health is world wide social goal.

Disease agent: The disease “agent” may be defined as, “a substance, living or non-living or a force, tangible or intangible, the excessive presence or relative lack of which is the immediate cause of particular disease.”

Classification of Disease agent:

1. Biological agent, e.g. bacteria, virus, protozoa, fungus etc.
2. Chemical agents-
 - a. Endogenous, e.g. Serum bilirubin, Ketone bodies etc.
 - b. Exogenous, e.g. metals, fumes, dusts, gases etc.
3. Nutritional agents, e.g. Excess food, lack of food or vitamins.
4. Immunological agents, e.g. agammaglobulinaemia.
5. Social agents, e.g. poverty, unhealthy life style, social isolation etc.

Genius must be born, it can never be taught. - Dryden

Hospital Practice and First Aid

Q-1. Write down the duties and responsibilities of a Health (Medical) Technologist. How will you maintain your personal hygiene in hospital practice in relation to the patients?

Answer. The duties and responsibilities of a health (medical) technologist:

1. Place the well-being of the sick above your interest.
2. Be loyal to your laboratory profession by maintaining high standard of work and striving to improve your professional skills and knowledge.
3. Work scientifically and with complete honesty.
4. Do not misuse your professional skills or knowledge for personal gain.
5. Never take anything from your place of work that does not belong to you.
6. Do not disclose to a patient or any unauthorized person the result of your investigation.
7. Treat with strict confidentiality any personal information that you may learn about a patient.
8. Respect and work in harmony with the other members of your hospital staff or health centre team.
9. Be at all time courteous, patient and considerate to the sick and their relatives.
10. Promote health care and the prevention and control of diseases.
11. Follow safety procedures and know how to apply first aid.
12. Do not drink alcohol during laboratory working hours or when on emergency stand by.
13. Use equipment and laboratory ware correctly and with care.
14. Do not waste reagents or other laboratory supplies.
15. Fulfill reliably and completely the terms and conditions of your employer.

Maintenance of personal hygiene in hospital practice in relation to the patients: Personal hygiene is the health care of own self for which a person himself is responsible. For the maintenance of personal hygiene the following factors should be considered-

1. Habit
2. Indigestion
3. Constipation
4. Control of body weight
5. Fatigue
6. Anger
7. Sleep
8. Sleeplessness or insomnia
9. Constitution
10. Heredity
11. Cleanliness
12. Baths
13. Oral hygiene
14. Hands, feet and nails
15. Eyes and ears
16. External genitals
17. Posture
18. Exercise
19. Clothing
20. Sex

Q-2. What is burn? What are the types of burn? Give the first aid treatment (management) of burn.

Answer. Burns: Burns are injuries that result from dry heat like fire, flame, a piece of hot metal, the sun, and contact with high tension electric current or by lightning or friction.

Scalds are caused by moist heat due to boiling water, steam, oil, hot tar etc.

Types of Burn:

- A. On the depth of burn-
1. Partial thickness burn: The epidermis is involved. Dermis and appendages are spared. Blister is formed.
 2. Full thickness burn: It involves the entire epidermis and extends into the dermis or more deeply.
- B. On the degree of burn-
1. First degree burn: When the skin is only reddened.
 2. Second degree burn: When there are blisters on the skin.
 3. Third degree burn: When there is destruction of deeper tissues and charring.

Management / Treatment of Burns (or, burns and scalds):

- A. Management of major burns/ serious burns-
1. Keep the casualty quiet and reassure him.
 2. Wrap him in clean cloth.
 3. Do not remove the adhering particles of charred clothing.
 4. Cover the burnt area with sterile clean dressing and bandages.
 5. Keep him warm but don't over heat him.
 6. If hands and feet are involved keep them above the level of the victim's heart.
 7. Treat for shock, if any.
 8. Shift the casualty to the nearest hospital as soon as possible.
- B. Management of minor burns-
1. Clean the area gently with clean water.
 2. Submerge the burnt area in cold water.
 3. Remove the burnt cloths but don't forcibly remove adherent portion of charred clothing.
 4. Apply a solution of salt and water (one teaspoon full to a glass of water) in out of the way places.
 5. Do not apply any greasy substance and cotton wool directly over the burnt area.
 6. Cover the burnt area with dry dressing.
 7. Give warm drinks for example sweetened tea or coffee.

Q-3. What are the indications and contraindications of nasogastric intubations? Write down its technique of introducing a nasogastric tube.

Answer. Nasogastric intubation: It is a medical process involving the insertion of a plastic tube (NG tube) through the nose, past the throat, down into the stomach.

Indications of nasogastric intubation:

1. Therapeutic purposes-
 - a. Feeding
 - b. Administration of drugs
 - c. Aspiration of stomach content.
2. Diagnostic purpose: Gastric juice analysis

Contraindications of nasogastric intubation:

1. Skull fracture, severe facial fracture.
2. Obstructed airway or oesophagus.
3. Patients with gastric bypass surgery.

Technique of nasogastric intubation:

1. Wear sterile gloves and look for any nasal obstruction or deviation which may hinder the process.
2. The end of the tube is lubricated with local anaesthetic such as 2% xylocaine.
3. Insert the tube into one of the patient's anterior nares. The tube should be directed aiming down and back as it moved through the nasal cavity and down into the throat.
4. When the tube enters the oropharynx and glides down the posterior pharyngeal wall, the patient may gag; in this situation, if patient is awake and alert, is asked to mimic swallowing and the tube continues to be inserted as the patient swallows.
5. One the tube is past the pharynx and enters the oesophagus; it is easily inserted down into the stomach.
6. Confirmation- it is done by:
 - a. Aspirate the content and test the P^H, the stomach contents are highly acidic (below P^H 5.5)
 - b. Inject bubble and hear it with stethoscope.
 - c. X-ray of the chest and abdomen.
7. After confirmation fix the tube with nose by micropore.

Q-4. Define and classify fracture. How will you manage a long bone fracture?

Answer. Fracture: A fracture is the partial or complete bend, crack or breakage of a bone.

Types of fracture/ Classification of fracture:

1. Simple fracture (or, closed fracture) - in which a bone only is divided, without external wound.
2. Compound fracture (or, open fracture) – in which there is laceration of the integuments.
3. Complicated fracture- that is attended with diseases or accidents.
4. Green-stick fracture – in which one side of the bone is broken, and the other bent.
5. Impacted fracture- in which there is compression of the fragments of the broken bone.
6. Articular fracture- fractures entering into a joint.
7. Minuted fracture- in which there is fragmentation of the bone.
8. Dendate fracture- one in which the end of the fragments are inter-locked.
9. Multiple fracture- two or more fractures in the same bone.

Management of fracture/ Management of a long bone fracture:

1. Steady and support the injury part immediately so that no movement is possible. This stops further injury and helps to stop bleeding.
2. Immobilize the fracture area and the joints on both side of fracture (above and below the fracture side) by-
 - a. using bandages, and or
 - b. using splints where available and when a first aider is confident of their use.
3. There may be more than one fracture in the same patient or ever in the same bone.
4. If there is no immediate danger to life, temporary attention to fracture is enough.
5. Treat the fracture on the spot, so that the fracture ends are established and patient is ready to transport.
6. Handle very gently, avoid all unnecessary movements of the injured parts.
7. Treat for shock if any.
8. If broken ends of the bones show out, don't wash the wounds or apply antiseptics to the ends of the bone.

9. Never attempt to bring the bones to normal position or reduce fracture.
10. Move the patient to the hospital as quickly as possible.

Q-5. What is first Aid? What are the objectives of first aid? Give the contents of a first aid box.

Answer. First aid: First aid is the first assistance or treatment given to a casualty for any injury or sudden illness before the arrival of an ambulance or qualified medical expert. First aid can also be defined as, "the immediate assistance given to a person suffering from disease, accidents or any illness before complete medical and surgical treatment provided by the medical expert."

The objectives/ aims of first aid:

1. To preserve life
2. To prevent the worsening of the condition.
3. To promote recovery.

First aid kit: First aid kit is the box which contains the essential articles that helps in giving the proper first aid.

Contents of a first aid kit: A small first aid kit may contain the following-

1. Band aid (adhesive and non-adhesive)
2. Gauze
3. Roller bandage
4. Sterilized cotton wool (absorbent)
5. Scissors (sharp and blunt)
6. Sterilized dressings (assorted sizes)
7. Paracetamol and aspirin tablets
8. Mouth to mouth resuscitator (plastic)
9. Triangular bandage
10. Safety pins
11. Antiseptic solution or 70% alcohol
12. Torch light
13. Personal protective equipments (e.g. gloves, goggles, surgical masks).
14. Other optional items may include-
 - a. BP instruments and stethoscope
 - b. Thermometer
 - c. Lighter

Q-6. What is haemorrhage? Classify haemorrhage. Give the first aid treatment of haemorrhage. What is bandage? What are the types of bandage?

Answer. Haemorrhage (or, bleeding): It is the escape of blood from a blood vessel due to severity of the injury. It is common cause of death in accidents.

Classification of haemorrhage:

Haemorrhage are of two varieties-

1. External haemorrhage
2. Internal haemorrhage

Again, on severity haemorrhage or bleeding are of two types-

1. Minor haemorrhage/ minor bleeding
2. Major haemorrhage/ major bleeding

Management:

A. Minor bleeding-

Minor bleeding is usually at work and at play. It results from injured capillaries. There is no need to get frightened. The bleeding will stop by itself or by firm pressure and bandaging, keeping the limb elevated.

B. Major bleeding -

It is the result of an injury to a large blood vessel or when person suffer from some blood disorders. Management is given according to sign-symptoms and sent to the hospital as soon as possible.

C. External bleeding-

1. Bring the sides of the wound together and press firmly.
2. Place the casualty in a comfortable position and raise the injured part (if no bone fracture is suspected).
3. Press on the pressure point firmly for 10 to 15 minutes.
4. Apply a clean and larger than the wound and press it firmly with the palm until bleeding becomes less and finally stops.
5. If bleeding continues, do not take off the original dressing, but add more pads.
6. Finally, bandage firmly but not too tightly.
7. Finally, bandage firmly but not too tightly.
8. Treat for shock, if any.
9. Get the casualty to hospital as soon as possible.

D. Internal bleeding-

1. Lay the casualty down with head low. Raise his legs by the use of pillows etc.
2. Keep him calm and relaxed. Reassure him. Don't allow him to move.
3. Keep up the body heat with thin blankets, rugs or coats.
4. Don't give him anything to eat or drink and don't apply hot water or ice bags to chest or abdomen.
5. Take him to the hospital as soon as possible.

Bandage: A strip of material such as gauze used to protect, immobilize, compress, or support a wound or injured body part.

Types of bandage:

1. **Triangular bandage-**
Bandage contains three ends, the largest called "base or point" and other two are called "ends"
2. **Roller bandage-**
Long strip of bandage of various lengths and widths.

Q-7. Define Hospital. Classify it. Mention the services provided by a hospital.

Answer. Hospital: A WHO Expert Committee in 1963 proposed the following working definition of a hospital, "A hospital is a residential establishment which provides short term and long term medical care consisting of observational, diagnostic, therapeutic and rehabilitative service for persons suffering or suspected to be suffering from a disease or injury and for parturients. It may or may not also provide services for ambulatory patients on an out patient basis."

Classification of hospital: According to ownership, hospitals are of mainly two types-

1. **Government hospitals:** These are run under the direct supervision of the Government.
2. **Private (or, public) hospitals:** These are run by the non-governmental organizations, public companies, professional body or any other individual. They may be sometime funded or aided by the Government but they have an independent administrative set up.

Both Government and Private hospitals can be divided into following categories-

1. General Hospital
2. Specialized Hospital
3. Teaching Hospitals
4. Clinics

Service provided by Hospitals:

1. Intensive care and long term stay & care.
2. Special facilities for surgery, child birth etc.
3. Diagnostic tests facilities (e.g. pathological tests, X-ray etc).
4. Outdoor consultation and so forth.
5. May have ambulance services.
6. Some hospital may have research facilities.

Q-8. Define and classify a store. Write down the objectives of a store. Enumerate the criteria of an ideal store.

Answer. Store: Normally store means a place where the commodities are kept for future use. Store can be defined as, “department or function associated with the holding and issuance of inventory items.”

Types of Store-

1. Primary store-
Large quantities of different items are stored for future and issued gradually. The items issued from primary stores are not used directly. It acts as a long term storage facility.
2. Secondary store-
Small quantities of different items are stored for immediate or near future use and the items issued are generally used directly after issuance for the store. It acts as a short term storage facility.

Objective of a store:

1. To store items for future of immediate use.
2. To preserve and protect the different items until they can be put to use.
3. To ensure the supply of various items in the time of need.
4. To facilitate the continuity of work by preserving and supplying necessary items.
5. To help prepare a future plan by assessing the stock of different items of a store.
6. To ensure integrity and optimum conditions of the different items kept in the store.

Criteria of an ideal store:

1. Adequate floor and storage space with ceiling height within the store should be greater than 10 feet.
2. A floor that is well constructed with a surface that is non-slip, impermeable to liquids and resistant to those chemicals that are stored.
3. Walls should be smooth, free from cracks, impermeable to liquids and easily washable.
4. The doors should open outwards and exit routes must never be obstructed.
5. The store room should be protected from direct sun light and violent wind.
6. The storage facility should include refrigeration for some vaccines and some chemicals, fire proof locks for the storage of inflammable chemical etc.
7. A good illumination is necessary.
8. The store should be near but separate from the place of work.

Q-9. What is sterilization? Classify sterilization. Discuss the different methods of sterilization (esp. chemical sterilization method) used in the laboratory.

Answer. Sterilization: It is the process by which all viable micro-organisms including spores are killed or eliminated. It can also be defined as, “the process by which living organisms including spores are destroyed or mechanically removed from different materials.”

Classification of sterilization: Three main methods-

1. Physical methods: Killing organisms by heat, cold, drying, radiations etc.
2. Chemical methods: Destroying organisms by employing chemicals, e.g. Lysol, phenol, hydrogen peroxide, halogens etc.
3. Filtration: Removing organisms mechanically by filtering, e.g. Seitz, unglazed porcelain etc. This method is employed for fluids which are likely to be destroyed or damaged by heat or by other procedures.

Discussion on different methods of sterilization:

I. Physical method

A. Heat-

1. High temperature

a. Dry heat:

- i. Incineration
- ii. Flaming
- iii. Hot air oven

b. Moist heat:

- i. Boiling
- ii. Steaming
 - With pressure: e.g. Autoclave
 - Without pressure: e.g. Koach steamer, Arnolds steamer, Tyndalization.

c. Pasteurization:

- i. Holding method
- ii. Flash method

2. Low temperature

- a. Water bath
- b. Vaccine bath
- c. Inspissator

B. Radiation- e.g. X-rays, γ -rays, β -rays, UV rays, cathode rays, infrared rays etc.

C. Cold

D. Drying

II. Chemical methods

1. Ethyl alcohol: 70% is used as disinfectant mainly skin.
2. Phenol, lysol and detol: Mainly used as disinfectant for floors and utensils.
3. Halogens: Chlorine is used as water disinfectant and iodine as skin disinfectant.
4. Aldehyde: Formaldehyde can kill spore and used in the sterilization of rooms, beddings, clothings etc.
5. Ethylene oxide: Gaseous disinfectant used to sterilize plastic and rubber goods, complex apparatus and other materials which are spoiled by heat.
6. Acriflavin and gentian violet

7. Perchloride of mercury (1 in 1000) and silver nitrate: used in prevention of eye infections of newborns.
8. Surface active agents: Soap and detergents are used to disinfect a wide variety of items, articles, clothings, hand washing etc.

III. Filtration:

1. On a large scale-
 - a. Biological or slow sand filter
 - b. Mechanical or rapid sand filter
2. On a small scale-
 - a. Pasteur chamberland filter
 - b. Berkefeld filter
 - c. Ketadyn filter

Q-10. List the laboratory hazards with example. Give an outline of prevention of laboratory hazards. What is record? Mention the importance and procedure of patient record keeping. Write short notes on- Bed pan, urinal, Enema, Autoclave, Catheterization, Dressing, Vaccine, Antibiotics, Insulin, Shock, Anaphylactic shock.

Answer. Laboratory hazards: The main hazards and accidents associated with medical laboratory works are as follows-

A. Infection: Infection can be caused by-

1. Pathogens being inhaled in aerosols (airborne droplets) when snap-closing specimen containers, dispensing or pipetting infectious material or fluids or centrifuging infectious material in open buckets.

2. Pathogens being ingested from contaminated fingers, or in food that has been contaminated, e.g. by being stored in a laboratory refrigerator. Care should be taken to avoid the fingers or other parts of the body touching infected material.

3. Pathogens enter the skin through needle punctures, cuts, scratches, insect bites, sores or other open skin lesions.

B. Burns: Burns may be caused by-

1. Flammable chemicals and stains or by reagents catching a light.

2. Fires from spirit lamps, Bunsen burners, lighted tapers (e.g. when heating Zeilh-Neelsens stain) or from faulty electric equipment or overloaded circuits. Spirit lamp and Bunsen's burner should not be used in direct sunlight because in bright light the flame is very difficult to see.

3. Corrosive chemicals being spilt on the skin or ingested when mouth pipetting.

C. Cuts: Cuts may be caused by-

1. Breakage.

2. Using glassware that is cracked or has damaged edges.

3. Walking on glass chippings.

D. Harmful effects of toxic chemicals: Harmful effects of toxic chemicals may be caused by-

1. Inhaling fumes from toxic chemicals.

2. Ingesting toxic chemicals by mouth pipetting.

3. Skin contact with toxic chemicals.

E. Injuries from explosion: Injuries from explosions can be caused by-

1. Incompatible chemicals exploding.

2. Leaking gas exploding.

F. Electric shocks: Electric shocks can be caused by-

1. Faulty technique.

2. Incorrect installation of equipment.

3. Touching exposed live wires.

Prevention of laboratory hazards: Laboratory hazards can be prevented by taking following measures-

1. Proper training and knowledge about laboratory works.
2. Working with care and caution.
3. Working environment should be quiet, peaceful and comfortable with adequate lights.
4. The rooms should be well ventilated.
5. The equipments and reagents should be placed properly.
6. Work bench should be clean and tidy.
7. Work load should be evenly distributed among workers.
8. Equipments, reagents and rooms should be labelled with signs and caution to alert the visitors and workers to avoid accidents.
9. Properly design the building and the laboratories.
10. Install fire alert and other protective system.

Record/ Medical record: A medical record (or, a patient record/ Health record) is a systematic documentation of an individual or patient's medical history and care.

Importance/purpose of medical record:

1. It helps in the continuity of care to individual patient.
2. Medical record can serve as a basis for planning patient care of the individual suffering from same conditions.
3. It has an important medico-legal purpose protecting the rights of the patient and the health professionals.
4. It can serve as a teaching or research material.
5. Medical records of a community or a country may aid the Government in the future plan of action for the health related issues in that community or country.

Procedure of patient's record keeping/ components of a medical record: Procedure of patient's record keeping includes the fulfillment of the following components-

1. Demographic: includes patients name, address, occupation, sex, age, race, religion, health insurance number etc.
2. Medical history: includes-
 - i. Surgical history
 - ii. Obstetric history
 - iii. Medications and medical allergies
 - iv. Family history
 - v. Social history
 - vi. Habits
 - vii. Growth chart and development history- essential for children.
3. Medical encounters: includes-
 - a. Chief complaint
 - b. History of present illness
 - c. Physical examination
 - d. Assessment and plan
 4. Orders: written orders are included if any.
 5. Progress note
 6. Test results: e.g. blood test result, biopsy result, ECG, EMG, X-ray report etc.
 7. Other optional informations set by the hospital or by the legal system of the country.

Short notes on-

➤ **Bed pan:** A bedpan or bed pan is an object used for the toileting of a bedridden patient in a health care facility, usually made of a metal, glass, or plastic receptacle. A bed pan can be used for both urinary and fecal discharge. Many diseases can confine a patient to bed, necessitating the use of bedpans, including Alzheimer's disease, Parkinson's disease, apoplexia cerebri and dementia. Additionally, many patients may be confined to a bed temporarily as a result of a temporary illness, injury, or surgery, thereby necessitating the use of a bed pan. Bedpans are usually constructed of stainless steel and may be cold, hard and uncomfortable. On the other hand, stainless steel is easy to clean and durable, and bacteria have little chance to survive. Also, the supporting area of some products is very small and prolonged use can cause pressure ulcers. To solve these problems, new ergonomic bedpans have been developed, which support the patient with a larger area of warm plastic. Some designs completely cover the genitalia during use, offering protection and an extra measure of privacy. On the other hand, the material is difficult to clean, and plastic may be a reservoir for microorganisms.

➤ **Urinals:** A urinal is a bottle for urination. It is most frequently used in health care for patients who find it impossible or difficult to get out of bed. Urinals allow the patient who has cognition and movement of his arms to toilet independently. Urinals can also be used for measuring the amount of urine produced by a patient on input & output (I & O), even if not used by the patient for toileting. Generally, patients who are able to are encouraged to walk to the bathroom or use a bedside commode as opposed to a urinal. The prolonged use of a urinal has been shown to lead to constipation or trouble urinating. Urinals are most frequently used for male patients due to the ease of their use with male anatomy. While female urinals exist, they are more difficult to use, and the common practice for females is to use a bedpan. Female urinals require a wider opening and must be placed between the legs. Female urinals are more practical for a woman in a wheelchair than in a bed.

➤ **Enema:** An enema (plural enemata or enemas) is the procedure of introducing liquids into the rectum and colon via the anus. The increasing volume of the liquid causes rapid expansion of the lower intestinal tract, often resulting in very uncomfortable bloating, cramping, powerful peristalsis, a feeling of extreme urgency and complete evacuation of the lower intestinal tract. An enema has the advantage over any laxative in its speed of action, and some people prefer it for this reason. Enemas can be carried out as treatment for medical conditions, such as constipation and encopresis, and as part of some alternative health therapies. They are also used to administer certain medical or recreational drugs. Enemas have been used for rehydration therapy (proctoclysis) in patients for whom intravenous therapy is not applicable.

➤ **Autoclave:** An autoclave is an instrument used to sterilize equipment and supplies by subjecting them to high pressure saturated steam at 121 °C for around 15–20 minutes depending on the size of the load and the contents.

Uses of Autoclave-

Autoclaves are widely used in microbiology, medicine, tattooing, body piercing, veterinary science, mycology, dentistry, chiropody and prosthetic fabrication. Many autoclaves vary in size and function depending on the media they are sterilizing.

Typical loads include laboratory glassware, surgical instruments, medical waste, patient care utensils, animal cage bedding, and Lysogeny broth.

➤ **Catheterization:** The process of inserting a catheter is catheterization. In most uses, a catheter is a thin, flexible tube ("soft" catheter), though in some

uses, it is a larger, solid ("hard") catheter. A catheter left inside the body, either temporarily or permanently, may be referred to as an indwelling catheter. A permanently inserted catheter may be referred to as a permcath (originally a trademark). An intermittent catheter is a temporarily catheter you use four to six times a day to empty your bladder.

Uses-

Placement of a catheter into a particular part of the body may allow:

- a. draining urine from the urinary bladder as in urinary catheterization, e.g., the intermittent catheters or Foley catheter or even when the urethra is damaged as in suprapubic catheterisation.
- b. drainage of urine from the kidney by percutaneous (through the skin) nephrostomy.
- c. drainage of fluid collections, e.g. an abdominal abscess
- d. administration of intravenous fluids, medication or parenteral nutrition with a peripheral venous catheter
- e. angioplasty, angiography, balloon septostomy, balloon sinuplasty, cardiac electrophysiology testing, catheter ablation. Often the Seldinger technique is used.
- f. direct measurement of blood pressure in an artery or vein
- g. direct measurement of intracranial pressure

➤ Dressing: A dressing is an adjunct used by a person for application to a wound to promote healing and/or prevent further harm. A dressing is designed to be in direct contact with the wound, which makes it different from a bandage, which is primarily used to hold a dressing in place.

Usage of dressings-

Applying a dressing is a first aid skill, although many people undertake the practice with no training - especially on minor wounds. Modern dressings will almost all come in a prepackaged sterile wrapping, date coded to ensure sterility. This is because it will come in to direct contact with the wound, and sterility is required to fulfil the 'protection from infection' aim of a dressing.

➤ Vaccine: A vaccine is a biological preparation that improves immunity to a particular disease. A vaccine typically contains an agent that resembles a disease-causing microorganism, and is often made from weakened or killed forms of the microbe or its toxins. The agent stimulates the body's immune system to recognize the agent as foreign, destroy it, and "remember" it, so that the immune system can more easily recognize and destroy any of these microorganisms that it later encounters.

Vaccines can be prophylactic (e.g. to prevent or ameliorate the effects of a future infection by any natural or "wild" pathogen), or therapeutic (e.g. vaccines against cancer are also being investigated; see cancer vaccine).

➤ Antibiotics: An antibiotic is a compound or substance that kills or slows down the growth of micro-organisms. With increased knowledge of the causative agents of various infectious diseases, antibiotic(s) has come to denote a broader range of antimicrobial compounds, including anti-fungal and other compounds.

The term "antibiotic" was coined by Selman Waksman in 1942 to describe any substance produced by a microorganism that is antagonistic to the growth of other microorganisms in high dilution.[3] This definition excluded substances that kill bacteria but are not produced by microorganisms (such as gastric juices and hydrogen peroxide). It also excluded synthetic antibacterial compounds such as the sulfonamides. Many antibacterial compounds are relatively small molecules with a molecular weight of less than 2000 atomic mass units.

➤ **Insulin:** Insulin is a hormone central to regulating carbohydrate and fat metabolism in the body. Insulin causes cells in the liver, muscle, and fat tissue to take up glucose from the blood, storing it as glycogen in the liver and muscle.

Insulin stops the use of fat as an energy source by inhibiting the release of glucagon. With the exception of the metabolic disorder diabetes mellitus and Metabolic syndrome, insulin is provided within the body in a constant proportion to remove excess glucose from the blood, which otherwise would be toxic. When blood glucose levels fall below a certain level, the body begins to use fat as an energy source through glycogenolysis, for example, by transfer of lipids from adipose tissue to the liver for mobilization as an energy source. As its level is a central metabolic control mechanism, its status is also used as a control signal to other body systems (such as amino acid uptake by body cells). In addition, it has several other anabolic effects throughout the body

➤ **Shock:** Shock is a disorder that result from systemic hyperfusion due to reduction either in cardiac output or in effective circulatory volume.

Types of shock-

- a. Cardiogenic shock
- b. Hypovolaemic shock
- c. Septic shock
- d. Anaphylactic shock
- e. Neurogenic shock.

Clinical presentation of shock-

- a. Tachypnoea
- b. Tachycardia
- c. Hypotension
- d. Poor peripheral perfusion
- e. Abnormal mental state
- f. Oliguria

➤ **Anaphylactic shock:** Anaphylactic shock is anaphylaxis associated with systemic vasodilation that results in low blood pressure. It is also associated with severe bronchoconstriction to the point where the individual is unable to breathe.

Sign and symptoms of anaphylactic shock-

- a. Anaphylactic shock
- b. Skin eruptions and large bumps
- c. Localised oedema, especially around the face
- d. Weak and rapid pulse
- e. Breathlessness and cough due to narrowing of airways and swelling of the throat

The man who views the world at fifty the same as he did at twenty
has wasted thirty years of his life. -- Muhammad Ali

Parasitology

Q-1. What is host and parasite? Classify host, parasite and rhizopoda with example. What are the host parasite relationships?

Answer. Host: An organism which harbours the parasite is known as host. In other words, host is the organism that gives shelter and nourishment to the parasite.

Parasite: A living organism which receives nourishment and shelter from another organism where it lives and gives nothing in return, more over it may produce some problem to the host. Parasite can be defined as, “an organism that lives on or in another organism and obtains nourishment and causes some damage to its host.”

Classification of host:

1. Definitive host-
Host which harbours the adult or sexual stage of parasite. e.g. Human in case of filaria.
2. Intermediate host-
Host which harbours the larval or asexual stage of the parasite. e.g. Human in malarial parasite.
3. Accidental host-
When a host harbours a parasite with which it has no usual parasitic relation.
 - f. Permissive host: where parasite can complete its lifecycle.
 - g. Non-permissive host: where parasite can not complete its life cycle.
4. Paratenic host-
A host which harbours the parasite until a definitive host is reached. Here development occurs. It may or may not be necessary for the parasite. e.g. Pseudophylludian cestoda.
5. Reservoir host-
It is a vertebrate animal that harbours the parasites and spreads infection to other vertebrates as vector for long time. e.g. Dog in case of Leishmania donovani.

Classification of parasite:

A. According to the structure of the body-

1. Protozoa: Consisting of single cell like unit which is morphologically and functionally complete. e.g. Entamoeba, Giardia etc.
2. Metazoa: Consisting of multiple cells, making up a complex organism. e.g. Ankylostoma duodenale, Taenia saginata, Ascaris lumbricoides etc.

B. According to habitat-

1. Ectoparasite: lives outside on the surface of the body of the host. e.g. Lice.
2. Endoparasite: live inside the body of the host. e.g. Entamoeba histolytica.
3. Temporary parasite: visits its host for a short time.
4. Permanent parasite: leads a parasitic life throughout whole of its life.
5. Facultative parasite: lives a parasitic life when opportunity arises.
6. Obligatory parasite: can not exist without a parasitic life.
7. Occasional/accidental parasite: attacks an unusual host.
8. Wandering or aberrant parasite: happens to reach a place where it can not live.
9. Intermittent parasite: parasite that lives in a host only at times, being free living during the intervals.

Classification of Rhizopoda (Sarcodina): This class has following five orders-

1. Order Amoebida (Tubulida)
2. Order Thecamoebida (Thecida)
3. Order Hyalodiscida (Flabellida)
4. Order Mayorellida (Conopodida)
5. Order Acanthamoebida (Acanthopodida)

Host parasite relationship/ Association of living things:

1. Symbiosis-
When two species of living organism live together and get mutual benefit to each other.
2. Commensalism-
Association of two living organisms where one gets the benefit without harming its host or others.
3. Parasitism-
An association in which the parasite derives benefit and the host gets nothing in return, but always suffers some injury or damage.

Q-2. Describe the pathogenesis and lesion produced by *E. histolytica*. Write down the difference between amoebic dysentery and bacillary dysentery.

Answer. Pathogenesis of *Entamoeba histolytica*: The trophozoite emerges from the ingested cyst (metacyst) after activation of the excystation process in the stomach and duodenum. The metacysts divide rapidly producing four amoebulae (one for each cyst nucleus), each of which divide again to produce eight small trophozoites per infective cyst. These pass down the caecum and produce a population of lumen dwelling trophozoites. The trophozoites multiply by binary fission. In the majority of infections (about 90%), it remains luminal and the trophozoites multiply by bacteria feeding colony, ultimately encyst and pass out in the feces. Disease result when the trophozoites of *E. histolytica* invade the intestinal epithelium.

Lesion produced/ pathology of *Entamoeba histolytica*:

1. Primary or intestinal lesions-
 - a. Acute amoebic dysentery
 - b. Chronic intestinal amoebiasis:
 - i. Single latent ulcer in the caecum
 - ii. Multiple small superficial ulcers scattered through out the large gut.
 - iii. Thickened caecum and colon with occasional stricture formation.
 - iv. Amoeba in the caecum and other part of large gut.
 - v. Pigmented or non-pigmented scar.
2. Secondary or Extra-intestinal lesions or metastatic lesions –
 - a. Amoebic liver abscess:
 - i. Multiple small abscesses involving the whole organ.
 - ii. A large solitary abscess usually in the posterosuperior surface of the right lobe.
 - b. Lungs:
 - i. Primary- Small multiple abscess, may be in one or both lungs.
 - ii. Secondary- A single abscess present in the lower lobe of the right lung.
 - c. Brain: A single abscess in one of the cerebral hemisphere.
 - d. Spleen: Splenic abscess.
 - e. Skin: Granulomatous ulceration.
 - f. Urogenital tract: Direct abscess via urogenital opening may give rise to amoebic vaginitis, amoebic ulcer of penis (rare).

Difference between amoebic dysentery and bacillary dysentery:

Points	Amoebic dysentery	Bacillary dysentery
1. Types of lesion	1. Necrotic	1. Suppurative
2. Cells	2. Mononucleated.	2. Polymorphonuclears
3. Depth of ulcer	3. Deep	3. Shallow
4. Edge of ulcer	4. Undermined	4. Sharp
5. Shape of ulcer	5. Flask-shaped	5. "Snail tract"
6. Intervening mucosa	6. Normal	6. Inflamed
7. Organism in lesions	7. E. histolytica	7. Shigella species.
8. Liver abscess	8. Not uncommon	8. Uncommon
9. Stool		
A. Macroscopic		
a. Number of motions	a. 6-8 times a day	a. Over ten times a day
b. Amount	b. Relatively copious	b. Small
c. Odour	c. Offensive	c. Odourless (alkaline)
d. Colour	d. Dark red	d. Bright red
e. Consistency	e. Not adherent to container	e. Adherent to the bottom of the container.
f. Nature	f. Faecal matter with altered blood and mucus	f. Fresh blood and mucus
B. Chemical		
a. Reaction	a. Acidic	a. Alkaline
C. Microscopic		
a. RBC	a. In rouleaux	a. Discrete
b. Cellular exudate	b. Scanty	b. Plenty
c. Pus cell	c. Few	c. Plenty
d. Macrophages	d. Very rare	d. Present
e. Eosinophils	e. Present	e. Rare
f. Pyknotic body	f. very common	f. Nil
g. Ghost cell	g. Nil	g. Numerous
h. Parasite	h. Trophozoites of E. histolytica	h. Nil
i. Bacteria	i. Few, non-motile	i. Numerous, motile
j. Charcot Leyden Crystal	j. Present	j. Nil
k. Epithelial cell	k. Common	k. Generally absent.
D. Culture	E. coli and other normal flora	Shigella

Q-3. . Discuss the laboratory diagnosis of hepatic & intestinal amoebiasis (or, Diagnosis of Amoebiasis).

Answer. Diagnosis of Amoebiasis:

I. Diagnosis of intestinal amoebiasis-

A. Acute amoebic dysentery

1. Examination of stool-
 - a. Naked eye: An offensive, dark brown semi-solid stool, acid in reaction, admixed with blood, mucus and much fecal matter.
 - b. Microscopic:
 - i. There is scanty cellular exudate consisting of pyknotic bodies, few pus cells, macrophages, RBC present in clumps, Charcot Leyden crystals present.
2. Examination of blood- Moderate leukocytosis.
3. Serological- usually not positive.

B. Chronic amoebiasis

1. Examination of stool-
 - a. Cyst of E. histolytica may be found in smear preparation by concentration method.

- b. Cultural examination (in Dobell's diphasic & Cleveland media) may show the parasite.
- c. Animal inoculation to test the virulence of the strain isolated.
2. Blood picture- Not characteristic.
3. Serological-
 - a. Enzymoeba test
 - b. ELISA to detect galactose adhesin
 - c. Amoebic antigen
 - d. Antibody detection in serum
 - e. Complement fixation test (CFT)
 - f. Immunofluorescence test.
- II. Diagnosis of Hepatic amoebiasis-
 - A. Abscess material:
 1. Collection-
 - a. Aspiration: Exploratory puncture may be done.
 - b. During leparotomy
 2. Examination-
 - a. Naked eye examination: The material is liquid in consistency, anchovy sauce coloured, necrosed tissue with clots.
 - b. Microscopic examination: Necrosed liver cells, debris, a few leukocytes and plenty red blood cells are present. The material rarely contains amoebae as the trophozoites lives in the wall of the abscess.
 - B. Stool examination: The findings of dysentery or just cysts may be found in 15-50% cases of liver abscess. Endoscopic material from intestine may be examined.
 - C. Routine blood examination:
 1. Leukocytosis- WBC count may be 15000-20000/cu.mm. of blood having about 80% neutrophils.
 2. ESR- 50-100 mm in 1st hour.
 3. Anaemia- Normocytic normochromic.
 - D. Stool culture
 - E. Immunodiagnosis:
 1. Antibody detection- tests to detect specific antibody against E. histolytica.
 2. Indirect haemagglutination assay (IHA) test- It is a specific and sensitive test.
 3. Indirect Fluorescence Antibody Test (IFAT)- The test is positive in 95% cases of hepatic amoebiasis and intestinal amoebiasis and about 60% cases of amoebic dysentery.
 4. Latex agglutination technique
 5. Antigen detection in stool.
 - F. Others:
 1. Ultrasonography
 2. CT scan

Q-4. Classify Sporozoa. Name the parasites causing malaria in man. Describe the asexual cycle of malarial parasite in man.

Answer. Sporozoa: Sporozoa infecting man are divided into tow main groups:

1. Intestinal sporozoa-
Here, after sexual union, the development of oocyst occurs in the passed faeces on the soil and infection is transmitted by contamination.
2. Blood inhabiting sporozoa-
Here, the sexual union takes place inside the insect host and the infection is transmitted by inoculation.

Parasites causing malaria in man: Four species of the *Plasmodium* causes malaria in man-

1. *P. vivax*: Vivax malaria (Benign tertian malaria)
2. *P. malariae*: Malariae malaria (Quartan malaria)
3. *P. falciparum*: Falciparum malaria (Malignant tertian malaria)
4. *P. ovale*: Ovale malaria.

Malarial parasite passes its life in two stages- sexual cycle (sporogony) in female anopheline mosquito and asexual (schizogony) in man.

Asexual cycle (or, Schizogony) of malaria in man: Human cycle starts with the introduction of sporozoites by the bite of an infected anopheline mosquito. It comprises of the following stages-

a. Pre-erythrocytic schizogony-

The sporozoites disappear from the blood within half an hour and enter the parenchymal liver cells (hepatocytes). The sporozoites become round or oval schizont (pre-erythrocytic schizont) and its nucleus divides forming a large number of merozoites. The first generation of merozoites are known as cryptozoites. This phase of development is called pre-erythrocytic schizogony and takes about 8 days in *P. vivax*, 6 days in *P. falciparum* and 9 days in *P. malariae*. The weakened parasitized liver cell ruptures and thereby the first generation large numbers of merozoites are set free.

b. Erythrocytic schizogony-

After escaping from liver cells the merozoites enter into RBC and starts further development and multiplication and passes through the stages of trophozoites, schizont and merozoites. Each cycle of erythrocytic schizogony lasts about 48- 72 hours; in *P. vivax*, *P. falciparum*, and *P. ovale* 48 hours and in *P. malariae* 72 hours. After that the infected RBC ruptures with the liberation of the merozoites. The clinical attack of malaria occurs at this stage. The liberated merozoites enter fresh RBC and repeat the cycle.

c. Gametogony-

Some of the merozoites instead of developing into trophozoites and schizonts give rise to form which are capable of sexual function after leaving the human host. These are called gametocytes and developed in RBC of capillaries of internal organs. The maturation is complete in 96 hours. Gametocytes do not cause any febrile reaction in human host.

d. Exo-erythrocytic schizogony-

After the establishment of erythrocytic schizogony cycle, the initial liver phase (pre-erythrocytic phase) disappears completely in *P. falciparum* whereas in *P. vivax*, *P. malariae* and in *P. ovale* it persists in the form of a local liver cycle. This phase is known as exo-erythrocytic schizogony and is responsible for the relapse of malaria.

Q-5. Describe the complication and laboratory diagnosis of malaria (esp. *P. falciparum* malaria).

Answer. Complication of malaria/ Complication of Falciparum malaria:

1. Severe anaemia
2. Jaundice
3. Cerebral malaria- The most serious complication, manifested by confusion and coma. Death occurs in 20-50% cases.
4. Black water fever
5. Diarrhoea
6. Hypoglycaemia, especially with quinine treatment.
7. Acute tubular necrosis
8. In pregnancy- Maternal death and abortion, still birth, low birth weight of foetus.
9. Others- Pulmonary oedema, hypotensive shock.

Laboratory diagnosis of malaria:

A. Direct evidence-

1. Microscopic examination of blood films:
 - a. Thick film- used for quick detection of parasite
 - b. Thin film- used for identifying the species.
2. Sternal puncture and bone marrow examination
3. Culture: It requires special media and mainly done to differentiate the trophozoites of *P. vivax* from that of *P. falciparum*.

B. Indirect evidence-

1. Blood:
 - a. Hb% - 8gm/dl or less
 - b. RBC - 3 million/cu.mm of blood or less
 - c. WBC - 4000/cu.mm of blood or less
 - d. DC of WBC - Relative lymphocytosis and monocytosis.
2. Serological:
 - a. ICT for malaria
 - b. Henry's Melanin flocculation test.
 - c. Complement fixation test
 - d. Passive haemagglutination test
 - e. Immunofluorescence test
 - f. Gel precipitation test
 - g. ELISA
3. Others:
 - a. PCR- to detect Plasmodium nucleic acid
 - b. In severe case of *P. falciparum* infection, there may be oliguria and casts, red cells and protein found in urine.

Q-6. Define and classify helminthes with example. Give the differences between nematodes, cestodes and trematodes.

Answer. Helminth: Helminths are multicellular, bilaterally symmetrical animals having having three germ layers (triploblastic metazoa).

Classification: The helminths of importance to human are divided into to main groups-

1. Phylum Nematelminths, which includes-
 - a. Class Nematoda, or nematodes, e.g. *Ascaris lumbricoides*, *Ankylostoma duodenale*, *trichuris trichiura* etc.
2. Phylum Platyhelminths, which includes-
 - a. Class Cestoidea, or cestode, e.g. *Taenia solium*, *Taenia saginata*, *Hymenolepis nana*, *Echinococcus granulosus* etc.
 - b. Class Trematoda, or trematode, .e.g. *Schistosoma haematobium*, *Schistosoma mansoni*, *Fasciola buski*, *Fasciola hepatica* etc.

Difference between nematodes, cestodes and trematodes:

Points	Nematodes	Cestode	Treatmtoe
1. Shape	Elongated, cylindrical, unsegmented	Tape like, segmented	Leaf-like, unsegmented.
2. Sexes	Seperate	Hermaphrodite	Hermaphrodite except <i>Schistosoma</i> .
3. Alimentary canal	Present, complete with anus	Absent	Present, but incomplete, no anus.
4. "Head" end	No sucker, no hooks. Buccal capsule in some	Suckers, often with hooks.	Suckers, no hooks.
5. Body cavity	Present	Absent	Absent
6. Example	<i>Ascaris lumbricoides</i> , <i>Ankylostoma duodenale</i> , <i>trichuris trichiura</i> etc	<i>Taenia saginata</i> , <i>Hymenolepis nana</i> etc.	<i>Schistosoma haematobium</i> , <i>Fasciola buski</i> etc.

Q-7. Define and classify vector? What are the vector born parasitic diseases? Discuss the pathogenesis, complications and laboratory diagnosis of Kala-Azar.

Answer. Vector: It is an arthropod or any other living carrier (e.g. snail) that transports an infectious agent to a susceptible host or individual.

Classification of vector:

- A. Vertebrate animal, e.g. monkey, dogs etc.
- B. Non-vertebrates, mainly arthropods, e.g. insects, flies and bugs etc.

Vector born parasitic diseases:

Vector	Diseases
1. Winged arthropods-	
a. Mosquito:	
i. Female anopheles -	Malaria
ii. Female culex -	Bancroftian filariasis.
b. House fly -	Amoebiasis, Helmenthic infestation.
c. Sand fly -	Kala-azar, Oriental sore, Espundia.
d. Tsetse fly -	Sleeping sickness
e. Black fly -	Onchocerciasis
f. Reduviid bug -	Chagas disease
2. Wingless arthropods-	
a. Rat flea -	Hymenolepsis diminuta, H. nana.
b. Cyclops -	Fish tapeworm and Guinea worm disease
3. Others-	
a. Snail -	Schistosomiasis
b. Dog -	Amoebiasis, tape worm, Hydatid disease
c. Monkey -	Amoebiasis
d. Pig -	Fasciolopsis buski, Balantadiasis
e. Cat -	Toxoplasma gondii.

Pathogenesis of Kala-Azar: The infective promastigotes are introduced by the bite of infected female sandfly. Promastigotes spread from the site of inoculation and rapidly change to amastigotes after phagocytosis by macrophages and other cells of the reticuloendothelial system especially in liver, spleen, lymph nodes and bone marrow. The amastigotes multiply within macrophages filling the cytoplasm of the macrophages. The infected cells burst, the released LD bodies are again phagocytosed and the process is repeated producing Kala-azar. In some cases, Post Kala-azar Dermal Leishmaniasis (PKDL) occurs 1-2 years after cure of Kala-azar.

[N.B. Promastigotes are found in sandfly and amastigotes are found in humans and other vertebrate animals e.g. dogs].

Complications of Kala-Azar:

1. Pyrexia or Fever
2. Splenomegaly, enlargement of spleen
3. Hepatomegaly, enlargement of liver
4. Lymphadenopathy
5. Hyperplasia of bone marrow
6. Rough and dry skins often pigmented.

Laboratory diagnosis of Kala-azar:

A. Direct evidence-

1. Microscopic examination of stained smears demonstrate the LD bodies:
 - a. Smears from spleen, liver or iliac crest puncture.
 - b. Smears from buffy coat of haematocrit.

- c. A thick blood film.
2. Culture: In NNN (Navy, MacNeal and Nicolle) media incubated at 22°C for 1- 4 weeks for development of promatigote.
 - B. Indirect evidence-
 1. Blood picture:
 - a. Anaemia
 - b. Leukopenia with relative lymphocytosis and monocytosis. Eosinophils are few or absent.
 2. Aldehyde test (AT)
 3. Antimony test (Chopra's test)
 4. Complement fixation test
 5. Serological tests:
 - a. Direct agglutination test (DAT)
 - b. Rapid latex agglutination test
 - c. K39 antigen strip test, or ICT for Kala-Azar
 - d. ELISA using 70 Da antigen
 - e. IFAT (Indirect fluorescence antibody test)
 6. Others:
 - a. PCR (polymerase chain reaction)

Q-8. Name the intestinal nematodes. Write the complications of *Ascaris lumbricoides* with laboratory diagnosis.

Answer. The intestinal nematodes/ Classification of intestinal nematodes:

- A. Intestinal nematodes
 - a. Small intestine-
 1. *Ascaris lumbricoides* (round worm)
 2. *Ankylostoma duodenale* (Hookworm)
 3. *Nector americanus*
 4. *Strongyloides stercoralis*
 5. *Trichuris spiralis*
 - b. Caecum and vermiform appendix-
 1. *Enterobius vermicularis*
 2. *Trichuris trichiura*
- B. Somatic or tissue nematodes
 - a. Lymphatic system-
 1. *Wuchereria bancrofti*
 2. *Brugiyia malayi*
 - b. Conjunctiva-
 1. *Loa loa*.
 - c. Subcutaneous tissue-
 1. *Loa loa*
 2. *Onchocerca volvulus*
 3. *Dracunculus medinensis* (Guinea worm)
 - d. Mesentery-
 1. *Mansonella ozzardi*
 2. *Dipetalonema perstans*
 - e. Lungs-
 1. *Strongyloides stercoralis*.

Complication of *Ascaris lumbricoides*:

1. Manifestations due to adult worm-
 - a. Malnutrition mainly in children
 - b. Fever due to toxic body fluid of the worm.
 - c. Urticaria (allergy) may occur
 - d. Intestinal obstruction
 - e. Due to migration of adult worm (Ectopic Ascariasis), there may be:
 - i. Appendicitis

- ii. Obstructive jaundice and pancreatitis
 - iii. In case of children, vomiting and even may block the respiratory pass causing asphyxia.
 - iv. In liver the adult worm may produce chronic granulomatous lesion.
2. Effects due to eggs-
 - a. Ova in the biliary canaliculi and liver may produce inflammatory changes.
 3. Effects due to migrating larvae-
 - a. In lung: Loeffler's syndrome
 - b. Larvae in systemic circulation from lungs may rarely produce lesions in various organs like the brain, heart and kidney.

Laboratory diagnosis of *Ascaris lumbricoides*:

A. Direct evidence-

1. Finding adult worms:
 - a. In stool or vomit
 - b. X-ray diagnosis- after a barium swallow X-ray, there may be an opaque shadow (string-like shadow) in the intestine.
2. Finding of eggs:
 - a. In stool: Direct microscopic examination of stool in saline preparation and floatation & concentration method will reveal the characteristic eggs of *Ascaris lumbricoides*.
 - b. In bile: After intubation of duodenale contents.

B. Indirect evidence-

1. Blood examination- may show eosinophilia.
2. Dermal reaction (allergic) test.

Q-9. Name the common helminthes in Bangladesh. Write down the complication produced by *Ankylostoma duodenale* with laboratory diagnosis.

Answer. The common helminths of Bangladesh:

1. *Ascaris lumbricoides* (Round worm)/ AL
2. *Ankylostoma duodenale* (Hook worm)/ AD
3. *Trichuris trichiura* (Whipworm)/ TT
4. *Enterobius vermicularis* (Pinworm)/ EV
5. *Taenia saginata* (beef tape worm)
6. *Hymenolepis nana* / H. nana

Complication of *Ankylostoma duodenale*:

1. Effects due to hookworm larvae-
 - a. Skin lesions:
 - i. Ground itch or ankylostoma dermatitis
 - ii. Creeping eruption- rare.
 - b. Lung lesions: very rare.
 - i. Minute haemorrhages with eosinophilic infiltration.
2. Effects due to adult worms-
 - a. Anaemia: Iron deficiency microcytic hypochromic anaemia due to chronic blood loss.
 - b. Intestinal lesions
3. Eosinophilia may be present.

Laboratory diagnosis of *Ankylostoma duodenale*:

A. Direct evidence-

1. Examination of stool:
 - a. Macroscopical or naked eye examination of stool to find out adult worm.

- b. Microscopic examination of stool- to detect eggs (floatation technique can be used).

B. Indirect evidence-

1. Blood: May show microcytic hypochromic anaemia and eosinophilia.
2. Stool:
 - a. Occult blood test- often positive
 - b. Charcot Leyden crystals are often seen.

Q-10. Classify cestodes with example. Discuss the pathogenicity and laboratory diagnosis of *Taenia saginata*.

Answer. Cestode: Cestode or tapeworms are the members of the class Cestoidea of the phylum Platyhelminths.

Classification of cestodes: According to habitat-

1. Intestinal tape worms: Adult worms live in the intestine of the humans.
 - a. *Taenia saginata* (Beef tapeworm)
 - b. *Taenia solium* (Pork tapeworm)
 - c. *Hymenolepis nana* (Dwarf tapeworm)
 - d. *Hymenolepis diminuta* (Rat tapeworm)
 - e. *Diphyllobothrium latum* (Fish tapeworm)
 - f. *Diphylidium caninum* (Double pored Dog tapeworm)
2. Tissue tapeworms (larva stage):
 - a. Hydatid cyst of *Echinococcus granulosus* (Dog tapeworm), *E. multilocularis*.
 - b. *Cysticercus cellulosae* of *Taenia solium*.
 - c. *Coenurus cerebralis* of *Multiceps multiceps*.
 - d. *Prelocercoid cerebralis* of *Sparganum mansonii* and *Sparganum proliferum*.

Pathogenicity/ Clinical feature of *Taenia saginata*:

1. Abdominal discomfort
2. Chronic indigestion
3. Intestinal disorder
4. Diarrhoea
5. Occasionally anaemia

Laboratory Diagnosis of *Taenia saginata*:

1. Stool examination-
 - a. Naked eye examination is made for segments. It is examined for scolex after and anthelmintic.
 - b. Microscopic examination from characteristic eggs.
2. Scotch tape or cellophane tape swabs may be used for swabbing perianal regions to recover and demonstrate gravid proglottides and eggs.

Between two evils, choose neither; between two goods, choose both.

- Tryon Edwards

Mycology

Q-1. Define and classify Fungus (esp. morphological & clinical) with example. What are the differences between fungus and bacteria? Mention some beneficial effects of fungus.

Answer. Fungus: Fungi are heterotrophic eukaryotic organisms and are generally multicellular (except yeast) and filamentous.

Classification of Fungus:

A. Morphological classification-

1. Mould: Characters-

- a. Filamentous or mycelial and are multicellular.
- b. Have vegetative and aerial mycelia
- c. Form spores and spread by spores
- d. Only locally invasive.

Example- Ringworm fungi or dermatophytes.

2. Yeasts: Characters-

- a. Unicellular
- b. Cells are spherical or ellipsoidal
- c. Reproduce by budding
- d. Spread rarely though the host body.

Example- Cryptococcus neoformans.

3. Yeast like fungi: Character-

- a. Grow partly as yeast and partly as molds.
- b. Form pseudomycelium.

Example- Candida albicans.

4. Dimorphic fungi: Character-

- a. Grow either as yeast or molds.
- b. Grow as molds in culture media at 22°C and also in soil (saprophytic phase).
- c. Grow as yeasts in culture media at 37°C or in animal body (parasitic phase).

B. Classification on reproduction-

1. Perfect fungi: They have sexual reproduction which is the teleomorph.
2. Imperfect fungi: Fungi that lack sexual reproduction. Only asexual reproduction.

C. Clinical Classification of fungus/ Classification on Pathogenicity/ Types of infections/ Site of infections-

Types of infection	Causative organism	Disease
1. Superficial mycoses	Malassezia furfur	Pityriasis versicolor Seborrhoeic dermatitis
2. Cutaneous mycoses	Dermatophytes Candia	Dermatophytosis (Ring worm) Candidiasis (skin & oral)
3. Subcutaneous mycoses	Sporothrix schenckii Exophiala Rhinosporidium	Sporotrichosis Tinea nigra Rhinosporidiasis
4. Systemic/ Deep mycoses	Histoplasma capsulatum Blastomyces dermatitidis Coccidioides immitis Paracoccidioides brasiliensis	Histoplasmosis Blastomycosis Coccidioidomycosis Paracoccidioidomycosis
5. Opportunistic mycoses	Aspergillus Candida Mucor Rhizopus	Aspergillosis Candidiasis Zygomycosis (Mucoromycosis) Zygomycosis

D. Classification on spore production-

1. Sexual spore producing fungi
2. Asexual spore (conidium) producing fungi

Difference between bacteria and fungus:

Characters	Bacteria	Fungus
1. Size	Relatively small (1 μm)	Relatively long (4 μm)
2. Nucleus	Prokaryotic	Eukaryotic
3. Nuclear membrane	No nuclear membrane	Nuclear membrane present
4. Cytoplasm	Mitochondria and endoplasmic reticulum absent	Mitochondria and endoplasmic reticulum present.
5. Cell membrane	Sterols absent (except Mycoplasma)	Sterols present
6. Cell wall	Peptidoglycan	Chitin
7. Spores	Endospores for survival and not for reproduction	Sexual and asexual spores for reproduction.
8. Ribosomes	70 S ribosomes	80 S ribosomes
9. Thermal dimorphism	None	Yes (some)
10. Mode of reproduction	Asexual	Both sexual and asexual
	Binary fission	Sporing and budding
11. Growth phase	4 Growth phases	6 Growth phases.
12. Metabolism	Many obligate anaerobes; may or may not require organic carbon	No obligate anaerobes; require organic carbon.
13. Culture	Mostly grow at 37°C	Mostly grow at lower temperature (22°C)
	No aerial hyphae on artificial culture media.	Aerial hyphae on artificial culture media.
14. Host	Can kill the host	Rare have lethal effects on host.

Beneficial effects of fungus:

1. Fungus as a food or used in food preparations-
 - a. There are many fungi which are used as food, such as mushrooms, truffles, quorn, shitake etc.
 - b. Fungi are also used for some food preparation, e.g. yeasts are used to ferment wine, beers. Yeasts are also used in the bakery to produce bread.
2. Fungi used in industries and agriculture-
 - a. Fungi are used in the production of ethanol which is used in the industries to produce different chemicals such as citric acid, gluconic acid and biological detergents. Fungi also help in dyeing different garments.
 - b. Fungi are used in agriculture for pest control and to protect crops from diseases.
3. Fungi used in Scientific Research-
 - a. Fungi are also used for many scientific studies and research.
 - b. Fungi are also studied for bio-genetic and their relation with other organisms.
4. Fungi used in medicine-
 - a. Fungi are used to produce antibiotics and other drugs and chemical agent which have significant medical importance.

Q-2. Define and classify dermatophytes with example (esp. clinical types). Give the laboratory diagnosis of dermatophytes.

Answer. Dermatophytes: Dermatophytes are a group of related fungi that infect skin, hair and nails by virtue of their ability to use keratin.

Classification of dermatophytes:

- A. Dermatophytes are classified into three Genera-
 1. Epidermatophyton, e.g. *E. floccosum*.
 2. *Micosporum*, e.g. *M. canis*, *M. gypseum*, *M. audouini*.
 3. *Trichophyton*, e.g. *T. mentagrophytes*, *T. interdigitale*, *T. rubrum*.
- B. Classification on habitat-
 1. Geophilic lives in soil, e.g. *M. gypseum*, *T. terrestre*.
 2. Zoophilic lives in animals, e.g. *M. canis*, *T. simii*
 3. Arthrophilic lives in human, e.g. *E. floccosum*, *T. rubrum*
- C. Clinical types of Dermatophytes-
 1. *Tinea corporis*: Ring worm of non-hairy skin.
 2. *Tinea cruris*: Ring worm of the groin, known as jock itch.
 3. *Tinea pedis*: Causes Athlete's foot.
 4. *Tinea manuum*: Infecting palm and fingers
 5. *Tinea burbae*: Causes lesions in beard hair.
 6. *Tinea capitis*: Ring worm of the scalp.
 7. *Tinea unguium*: Ring worm of the fingers and toe nails.

Laboratory diagnosis of dermatophytes/ Ringworm/ Dermatophytosis:

1. Specimens-
Collect the material from the lesions. Scrapping from skin, clipping from nail and plucked out hair from infected areas.
2. Wood's lamp-
Hairs infected with *Micosporum* species show fluorescence under Wood's light in dark room.
3. Microscopy-
Place a drop of 20% KOH or NaOH on a slide and put the material in it. Cover with coverslip. Examine immediately and after 20 minutes for branching hyphae and chains of arthrospores.
4. Culture-
Inoculate specimens into Sabouraud agar slants containing antibiotics like chloramphenicol and cycloheximide to suppress the bacterial growth. Study the characteristics of colonies and nature of spores (macroconidia and microconidia) every 4-5 days. Maltose agar can also be used. Cultures are incubated at room temperature (22°C) and retained for three weeks before being discarded.

Q-3. What do you mean by dimorphic fungi and opportunistic fungi? Name some dimorphic fungi and opportunistic fungi? Give the difference between dimorphic fungi and opportunistic fungi.

Answer. Dimorphic fungi: The fungi that grow either as yeasts or as molds depending upon the environments of growth. Usually, they grow as molds in culture media at 22°C and in soil. On the other hand, they grow as yeast in culture media at 37°C and in the body of the animal host.

Opportunistic fungi: The fungi that usually don't cause disease but may cause diseases in an individual having impaired defense or given suitable environment.

Name of some dimorphic fungi:

1. *Sporothrix schenckii*
2. *Histoplasma capsulatum*
3. *Coccidioides immitis*
4. *Blastomyces dermatitidis*
5. *Rhinosporidium seeberi*

Name of some opportunistic fungi:

1. Candida species, e.g. *Candida albicans* (most common).
2. Rhinosporidium seeberi
3. Pneumocystis carinii
4. Aspergillus species
5. Cryptococcus neoformans
6. Rhizopus and Mucor

Difference between dimorphic fungi and opportunistic fungi:

Dimorphic fungi	Opportunistic fungi
1. All shows dimorphism.	1. Not all have dimorphic characters.
2. Most live in soil.	2. Most live in living animals.
3. Not communicable from man to man.	3. May be communicable from man to man.
4. Most causes systemic mycoses.	4. Can affect almost all the parts of the body.
5. Serological findings are mostly uncertain.	5. Serological findings are helpful in diagnosis in most cases.
6. Generally slow growers.	6. Grows faster than that of Dimorphic fungus.

Q-4. What are the opportunistic fungal infections? Discuss the pathogenesis & pathology and laboratory diagnosis of Candida albicans and Cryptococcus neoformans.

Answer. The opportunistic fungal infections:

Types of infection	Causative organism	Disease
Opportunistic mycoses	Aspergillus	Aspergillosis
	Candida	Candidiasis
	Mucor	Zygomycosis (Mucoromycosis)
	Rhizopus	Zygomycosis
	Cryptococcus neoformans	Cryptococcosis

Pathogenesis of Candida albicans:

1. Superficial lesions at locations where it is colonized as a normal flora.
2. Deep invasion from surface, and
3. Systemic disease in debilitated or immunosuppressed patients, particularly if cell mediated immunity is impaired.

Pathology of Candida albicans/ Candida species:

1. Cutaneous and mucosal Candidiasis-
 - a. Mouth
 - b. Female genitalia, e.g. vulvovaginitis
 - c. Cutaneous candidiasis
 - d. Nails- invasions of nail and nail plate.
2. Systemic candidiasis-
Kidney, heart, meninges, skin of the eye may be involved.
3. Chronic mucocutaneous candidiasis

Laboratory diagnosis of Candidiasis/ Candida albicans:

1. Specimens-
Swab, scrapings from superficial lesions, blood, CSF, urine or other material.
2. Direct microscopy-
Candida yeast cells can be detected in unstained or Gram stained preparations of skin, urine, vaginal discharge, CSF or other exudate from mucosal surface.

The yeasts are oval, small, measuring 2-4 μm in diameter. Single budding of the cells may be seen. If stained smear, the yeasts are can often be seen attached to pseudohyphae. Both the yeasts and pseudohyphae are Gram-positive.

Skin and nail scrapings are placed with 10% KOH and examined under the microscope.

3. Culture-

Materials are cultured on Sabouraud agar media at 37°C and at room temperature (22°-25°C). In 37°C *Candida albicans* is identified by production of germ tubes or chlamydospores. On Sabouraud agar incubated at room temperature- soft, cream coloured colonies are formed.

4. Serology-

- a. Antibody titre against group A candida
- b. Agglutination test
- c. Indirect fluorescence test
- d. Precipitation test

5. Skin test-

Candida skin test

Pathology and Pathogenesis of *Cryptococcus neoformans*: Infection is initiated by inhalation of the yeast cell which is in nature are dry, minimally encapsulated, and easily aerosolized. The primary pulmonary infection may be asymptomatic or may mimic influenza like respiratory infection, often resolving spontaneously. In patients who are compromised, the yeasts may multiply and disseminate to other parts of the body, but preferentially to the central nervous system, causing cryptococcal meningoencephalitis. Other common sites of dissemination include skin, adrenals, bone, eye and prostate gland. The inflammatory reaction is usually minimal or granulomatous.

Laboratory diagnosis of *Cryptococcus neoformans*:

a. Specimens-

Spinal fluid, tissue, exudates, sputum, blood and urine. Biopsy materials from cutaneous ulcers can be formol fixed and may be also examined by frozen sections. Spinal fluid is centrifuged before microscopic examination and culture.

b. Routine CSF examination-

Protein is increased. Sugar is normal or low. Cell count is raised.

c. Microscopy-

The material is examined in wet preparation directly and after mixing with indian ink which leads to capsule to stand out around the cell. Immunofluorescence staining can also be done.

d. Culture-

Inoculated on Sabouraud agar and incubated at 37°C or 22°C or both for 2-3 days and colonies are studied.

e. Serology-

Serum and CSF may be examined for both antigen and antibody. Latex agglutination tests are done.

Q-5. Name the systemic (deep) fungi. Discuss the pathogenicity and laboratory diagnosis of *Histoplasma capsulatum*.

Answer. Name of some systemic (deep/endemic/dimorphic) fungi:

1. *Histoplasma capsulatum*
2. *Coccidioides immitis*
3. *Coccidioides posadasii*
4. *Blastomyces dermatitidis*
5. *Paracoccidioides brasiliensis*

Pathogenecity (or, Pathology) and Pathogenesis of *Histoplasma capsulatum*: Inhaled conidia develop into yeast cells and are engulfed by alveolar macrophages. They replicate within macrophages. It spreads throughout the body especially liver, spleen, bone marrow, lymph nodes. If immunocompetent person inhale a heavy inoculum then they develop a self-limiting flue-like syndrome. On radiographic examination, there is hilar lymphadenopathy with pulmonary infiltrates. Chronic pulmonary histoplasmosis is usually a reactivation of a dormant lesion. Severe disseminated histoplasmosis involves the reticuloendothelial system- there is lymphadenopathy, enlarged liver & spleen, fever and anaemia. If untreated high mortality. Mucocutaneous ulcer of nose, mouth, tongue can occur. It usually occurs in infants, elderly and immunosuppressed individuals including AIDS patients.

Laboratory Diagnosis of Histoplasmosis/ *Histoplasma capsulatum*: *Histoplasma capsulatum* is a dimorphic fungus with yeast forms occurring in tissues.

1. Specimen-
H. capsulatum yeasts are found in sputum or in bone marrow aspirate or blood buffy coat preparations in generalized infection.
2. Direct microscopy-
The yeasts can be seen in the cytoplasm of endothelial and mononuclear cells in Giemsa stain preparations. H. capsulatum yeasts are small, round or oval cells measuring 1-4 µm in diameter.
3. Culture-
Histoplasma produces mycelial growth with spores when cultured on Sabouraud agar at room temperature (22°C). Small microconidia and characteristic large, spiny macroconidia are produced. Yeasts form is found when grown at 37°C.
4. Serology-
Immunodiffusion and complement fixation test.
5. Skin test with histoplasmin-
The reaction is delayed type of hypersensitivity like tuberculin test.

Q-6. Name some superficial fungal agents with diseases. Write down the clinical features of M. phurphur with treatment. Give the diagnosis of superficial mycoses.

Answer.

Types of infection	Causative organism	Disease
1. Superficial mycoses	<i>Malassezia furfur</i>	Pityriasis versicolor Seborrhoeic dermatitis
	<i>Exophiala werneckii</i>	Keromycosis (Tinea nigra)
	<i>Piedraia hortae</i>	Black piedra
	<i>Trichosporon species</i>	White piedra

Treatment of M. phurphur: Daily application of selenium sulphite. Topical oral azoles may also be used. Other alternative includes- Sodium thiosulphate lotion 20%, Propylene glycol 50% in water, Tretinoin cream etc.

Clinical feature of M. phurphur/ Pityriasis versicolor/ Tinea versicolor: Lesions appear as hyperpigmented or hypopigmented patches, commonly found in chest, back, neck and arms and may also be found in the face, scalp, legs and abdomen. The colour varies according to the normal pigmentation of the patient, exposure of the area to the sunlight and severity of the disease.

Laboratory diagnosis of superficial mycoses/ M. phurphur:

1. Specimen-
Skin scraping or scalping from the infected lesion.

2. Direct microscopy-
 - a. *M. phurphur* is easily recognized in a 10-20% KOH or lactophenol cotton blue preparation by the presence of clusters of round, thick walled, budding cells and short pieces of thick septate hyphae.
 - b. Yeast cells and hyphae can also be stained by Grams staining.
3. Lesions are fluorescence under Wood's lamp.
4. Culture-
Malassezia species are lipophilic yeasts and required lipid in the medium for growth. Culture technique is not considered appropriate for the diagnosis.

Q-7. What is oral thrush? Give the laboratory diagnosis of oral thrush.

Answer. Oral thrush: Thrush that occurs on tongue, lips, gums and palate with white adherent patches mainly consists of epithelial cells, yeasts and pseudohyphae.

The laboratory diagnosis of oral thrush:

1. Specimens-
Swab, scrapings from the lesions.
2. Direct microscopy-
 Candida yeast cells can be detected in unstained or Gram stained preparations.
 The yeasts are oval, small, measuring 2-4 μm in diameter. Single budding of the cells may be seen. If stained smear, the yeasts are can often be seen attached to pseudohyphae. Both the yeasts and pseudohyphae are Gram-positive.
 Scrapings are placed with 10% KOH and examined under the microscope.
3. Culture-
 Materials are cultured on Sabouraud agar media at 37°C and at room temperature (22°-25°C). In 37°C *Candida albicans* is identified by production of germ tubes or chlamydospores. On Sabouraud agar incubated at room temperature- soft, cream coloured colonies are formed.
4. Serology-
 - a. Agglutination test
 - b. Indirect fluorescence test
 - c. Precipitation test

Q-8. Define and classify fungal spore with example. Discuss the fungal growth curve. Draw and label a fungal cell and describe the structure of a fungal cell.

Answer. Fungal spore: It is the resting as well as the reproductive stage of the fungus.

Classification of fungal spore:

1. Sexual spore/ Telemorphic spore-
 - a. Ascospores: Following meiosis 4-8 meiospores are formed within the cell called anascus. e.g. *Coccidioides*, *Candida*, *Microsporum* etc.
 - b. Basidiospores: Following meiosis 4 meiospores are formed on the surface of a specialized structure called a basidium. e.g. Mushrooms, *Cryptococcus neoformans* etc.
 - c. Zygosporangia: Following meiosis a large thick walled zygosporangium is formed. e.g. *Rhizopus*, *Absidia*, *Mucor*, *Pilobolus* etc.
2. Asexual spore (or, conidia)/ Anamorphic spore -
 - a. Sporangiospore: A spore produced within a swollen spherical cell (sporangium) at the ends of a specialized hypha called a sporangiophore. e.g. *Rhizopus*.
 - b. Arthrospore (Arthroconidia): Arthrospores are formed by fragmentation of hyphae, e.g. in dermatophytes, *Coccidioides immitis*.

- c. Blastospore (Blastoconidia): It is formed by budding as in yeasts. e.g. Saccharomyces, Cladosporium.
- d. Chlamydospores (Chlamydoconidia): Cells in a hypha that enlarge and develop thick wall. e.g. Candida albicans.

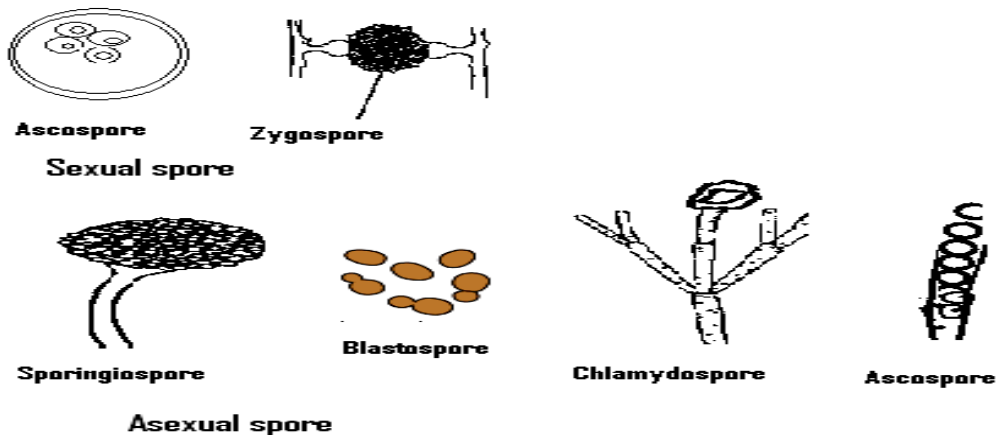


Figure- Fungal spore

Fungal growth curve: Fungal growth in a medium follows the growth phase of lag, log, linear, slowing, stationary and autolytic.

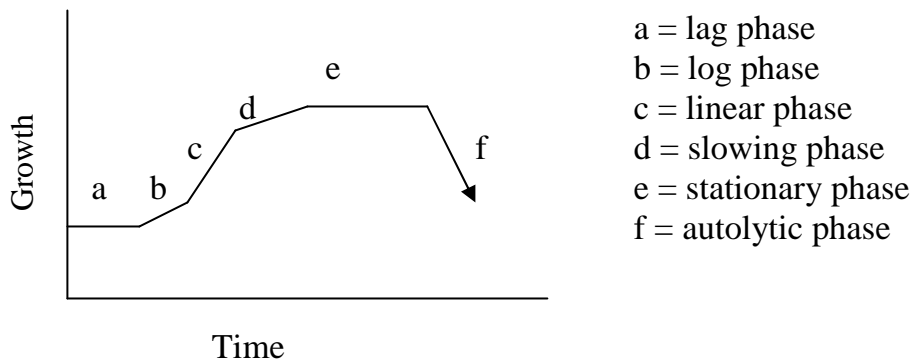


Figure- Fungal Growth Curve

Fungal Cell Structure:

1. Cell wall- It provides shape, rigidity, strength and osmotic protection. It contains:
 - a. Mannoprotein
 - b. Glucan
 - c. Chitin
2. Cell membrane- It is a lipid bilayered structure composed of phospholipid and sterol (ergosterol and zymosterol). It contains:
 - a. Nucleus
 - b. Nuclear membrane
 - c. Endoplasmic reticulum
 - d. Mitochondria
 - e. Secretary apparatus

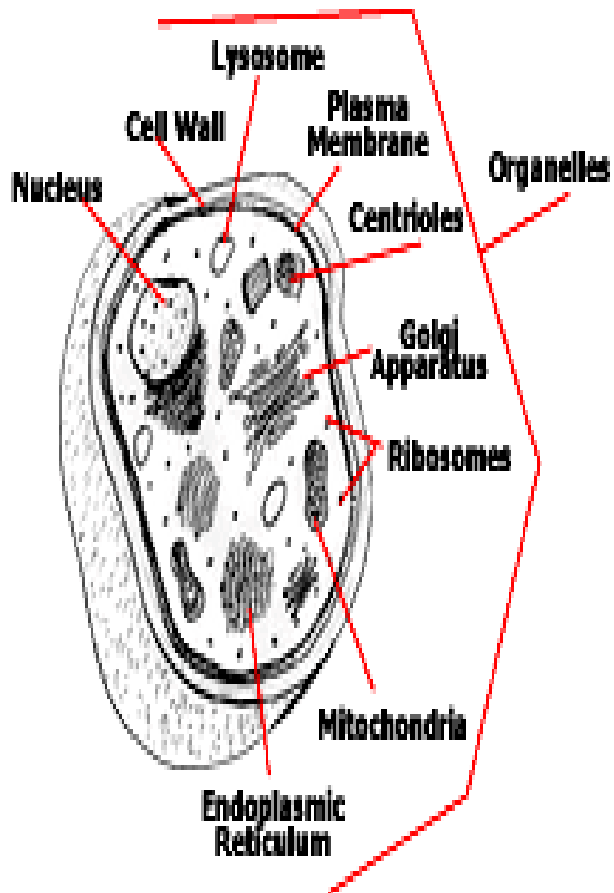


Figure- A fungal cell

Q-9. Briefly describe the antifungal chemotherapy.

Answer. Antifungal chemotherapy: The use of drugs to treat the fungal infections is known as antifungal chemotherapy.

Classification of antifungal chemotherapy:

- A. Inhibitor of cell membrane-
 - a. Polyenes:
 - 1. Amphotericin B
 - 2. Nystatin
 - b. Azoles:
 - 1. Imidazole
 - 2. Miconazole
 - 3. Ketoconazole
 - 4. Clotrimazole
 - c. Triazoles:
 - 1. Fluconazole
 - 2. Itraconazole
 - d. Second generation Azole: Vericonazole
 - e. Allylamines:
 - 1. Terbinafine
 - 2. Naftifine
- B. Inhibitor of chitin: Nikkomycin
- C. Inhibitor of glucan: Echinocandin
- D. Inhibitor of mannoprotein: Pradimicin
- E. Inhibitor of DNA synthesis: Flucytosine
- F. Inhibitor of protein synthesis: Sordarin

Q-10. Write short notes on: Athletes foot, Madura mycetoma (madura foot) and Mycotoxin.

Answer.

- **Athlete's foot (or, Tinea pedis):** A dermatophytosis that is primary restricted to the interdigital areas of the foot is called Tinea pedis which is commonly known as Athletes foot.

Location of lesions-

Interdigital spaces on foot of persons wearing shoes.

Clinical feature-

1. Acute: itching, red vesicular.
2. Chronic: itching, scaling, fissure.

Most common causative agent-

1. *T. rubrum*
2. *T. mentagrophytes*
3. *E. floccosum*

- **Madura mycetoma (Madura foot)/ Maduramycosis:** Mycetoma is a chronic granulomatous disease of the subcutaneous and deep tissue. Progressive destruction of tissue leads to loss of function of the affected site. The foot is commonly affected, therefore, also known as Madura foot.

Organisms that causing mycetoma-

1. Fungus causing mycetoma: e.g. *Madurella grisea*
2. Actinomycetes causing mycetoma: e.g. *Actinomyces madurae*.

Laboratory diagnosis-

1. Direct microscopy: Few granules are crushed and examined in two preparations- one in Grams stain and the other in 10-20% KOH.
2. Culture: Mainly done to differentiate species
3. Serology: Done rarely, most cases on research purposes.

- **Mycotoxin:** Mycotoxins are poisonous chemical substances produced by some fungi that may cause acute or chronic intoxication and damage. The mycotoxins are secondary metabolites and their effects are not dependent on fungal infection or viability.

Some common mycotoxins-

1. Aflatoxin from *Aspergillus flavus*: contaminated food is associated with hepatocellular carcinoma.
 2. Mycotoxins of *Amanita phalloides* (poisonous mushrooms): cause a dose related disease called mycetismus. Cooking has little effect on the potency of these toxins and may cause damage to liver and kidneys.
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- Prokaryotes and eukaryotes. Because of their characteristics, microorganisms join all other living organisms in two major groups of organisms: prokaryotes and eukaryotes. Bacteria are prokaryotes (simple organisms having no nucleus or organelles) because of their cellular properties, while other microorganisms such as fungi, protozoa, and unicellular algae are eukaryotes (more complex organisms whose cells have a nucleus and organelles). Viruses are neither prokaryotes nor eukaryotes because of their simplicity and unique characteristics.

Talkers are no good doers. – Shakespeare