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NURSING

Solved Question Papers for General Nursing and Midwifery

1st Year 2026–2022

As per INC Syllabus

I Clement

5th Edition

JAYPEE

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BIOSCIENCE

2026

ANATOMY, PHYSIOLOGY AND MICROBIOLOGY

JAYPEE BROTHERS

I. Give the meaning of the following:
a. Abduction
b. Diffusion
c. Pasteurization
d. Disinfection

II. Fill in the blanks:
a. The life span of RBC is: _____
b. The smallest bone of the body is: _____
c. _____ is the largest gland in the body
d. Left atrio ventricular valves in the heart is also known as: ____valve

III. Write short notes for any four of the following:
a. Muscles of face and neck
b. Structure of lungs
c. Structure of brain
d. Sources of infection
e. Structure of lymph node

IV. Answer the following:
a. List the endocrine glands
b. Explain the structure of pituitary gland and its hormones
c. List the organ of female reproductive system
d. Explain the structure of uterus

V. State whether the following statements is ture or false:
a. The optic nerve transmits the nerve impulses od smell
b. Veins carry oxygenated blood away from the heart
c. Neuron is the functional unit of kidney
d. Rabies is a zoonotic disease

VI. Write short notes for any three of the following:
a. Physiology of vision
b. Cardiac cycle
c. Scope of microbiology in nursing
d. Metabolism of carbohydrates
e. Process of urine formation

VII. Answer the following:

a. Define immunity
b. Explain the types of immunity
c. List the types of tissues
d. Explain the functions of epithelial tissue

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I. Give the meaning of the following:

a. Abduction

In anatomy, abduction is the movement of a body part (like an arm, leg, or finger) away from the midline of the body, or moving digits (fingers, toes) apart from each other, contrasting with adduction, which brings the part toward the midline or together. Examples include raising your arm to the side (shoulder abduction) or spreading your fingers (finger abduction).

b. Diffusion

Diffusion is the process of movement of molecules under a concentration gradient. It is an important process occurring in all living beings. Diffusion helps in the movement of substances in and out of the cells.

c. Pasteurization

Paste ration is a heat treatment process, named after Louis Pasteur, that kills harmful microorganisms (pathogens) and deactivates spoilage-causing enzymes in foods like milk and juice by heating them to a specific temperature for a set time, making them safer to eat and extending their shelf life without drastically changing taste or nutritional value.

d. Disinfection

Disinfection is the process of using chemicals or heat to destroy or inactivate most harmful microorganisms (like bacteria, viruses, fungi) on inanimate surfaces, reducing them to a safe level, but it does not necessarily kill tough bacterial spores, unlike sterilization. Common methods involve liquid chemicals (bleach, alcohol) or physical means (heat/pasteurization), crucial in healthcare and water treatment to prevent infection by eliminating pathogens.

II. Fill in the blanks:

a. The life span of RBC is **120 days.**
b. The smallest bone of the body is **Stapes.**
c. **Liver** is the largest gland in the body.
d. Left atrio ventricular valves in the heart is also known as **Mitral** valve.

III. Write short notes for any four of the following:

a. Muscles of face and neck

The muscles of the face and neck control expressions, chewing, and head movement, including facial expression muscles (like Orbicularis Oculi, Zygomaticus, Buccinator) for smiles and blinks, mastication muscles (like Masseter, Temporalis) for jaw movement, and neck muscles (like Sternocleidomastoid, Trapezius, Platysma) for head support and rotation, all working with specific nerves and blood supply.

Facial Muscles (Expressions and Chewing)

- **Scalp/Forehead:** Occipitofrontalis (raises eyebrows, wrinkles forehead).
- **Eyes:** Orbicularis Oculi (blinking, squinting).
- **Nose:** Nasalis, Procerus (flaring nostrils, wrinkling nose).
- **Mouth/Lips:** Orbicularis Oris (closes mouth), Zygomaticus Major/Minor (smiling), Levator Labii Superioris (lifts upper lip), Depressor Anguli Oris/Labii Inferioris (lowers mouth corners/lip), Buccinator (cheek muscle for blowing/sucking), Mentalis (protrudes lower lip).
- **Mastication (chewing):** Masseter, Temporalis, Pterygoids (powerful jaw closing and grinding).

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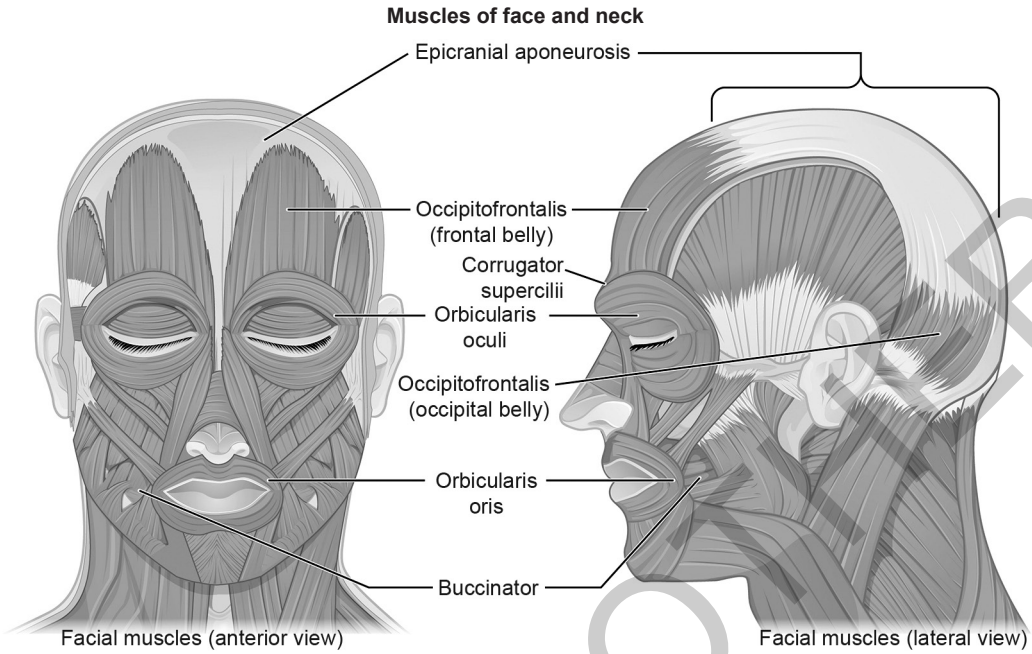


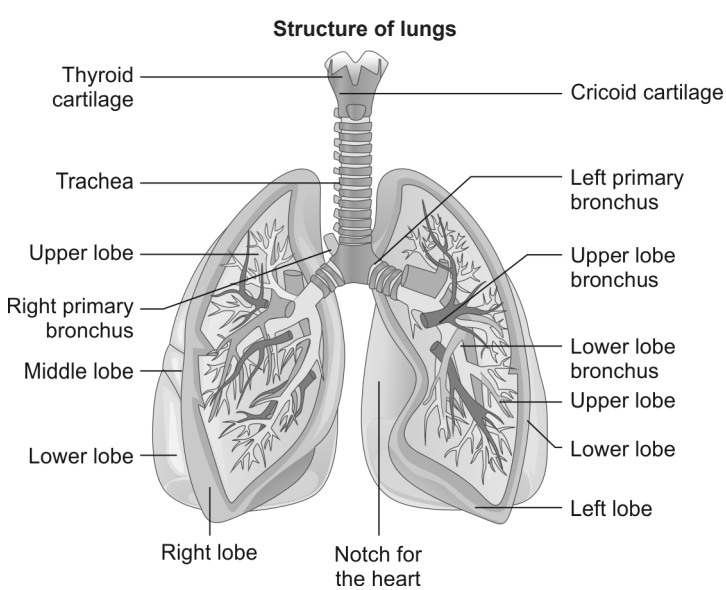
Neck Muscles

Superficial

- **Platysma:** Broad, thin sheet that wrinkles the neck skin, helps lower jaw.
- **Sternocleidomastoid:** Flexes neck, turns head (major neck muscle).
- **Trapezius:** Moves shoulders and head.
- **Deep (suprahyoid and infrahyoid):** Involved in swallowing, vocalization, and hyoid bone movement (e.g., Digastric, Mylohyoid, Sternohyoid).
- **Deep (prevertebral):** Deep muscles for head/neck flexion (e.g., Longus Colli, Rectus Capitis).

Key Functions and Innervation

- Facial expressions are controlled by the Facial Nerve (CN VII), supplying most facial muscles and the platysma.
- Mastication muscles are controlled by the Trigeminal Nerve (CN V).
- Neck muscles have diverse innervations, including cervical spinal nerves and cranial nerves.



b. Structure of lungs

The lungs are spongy, cone-shaped organs with a protective pleural membrane, divided into lobes (right has 3, left has 2) separated by fissures, featuring an apex, base, and surfaces (costal, diaphragmatic, mediastinal). Inside, the trachea branches into bronchi, then bronchioles, ending in tiny air sacs called alveoli where gas exchange (oxygen in, carbon dioxide out) occurs, with the diaphragm muscle below aiding breathing.

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Structures

- **Pleura:** A protective double membrane (visceral and parietal) enclosing the lungs, allowing them to slide smoothly.
- **Hilum:** An indentation on the mediastinal surface where bronchi, vessels, and nerves enter/exit.
- **Trachea (windpipe):** The main airway that splits into two main bronchi.
- **Bronchial tree:** The branching network of bronchi and smaller bronchioles within the lung.
- **Alveoli:** Tiny air sacs at the end of bronchioles, surrounded by capillaries, crucial for gas exchange.
- **Diaphragm:** A muscle below the lungs that contracts and relaxes to facilitate breathing.

Lobes and Differences

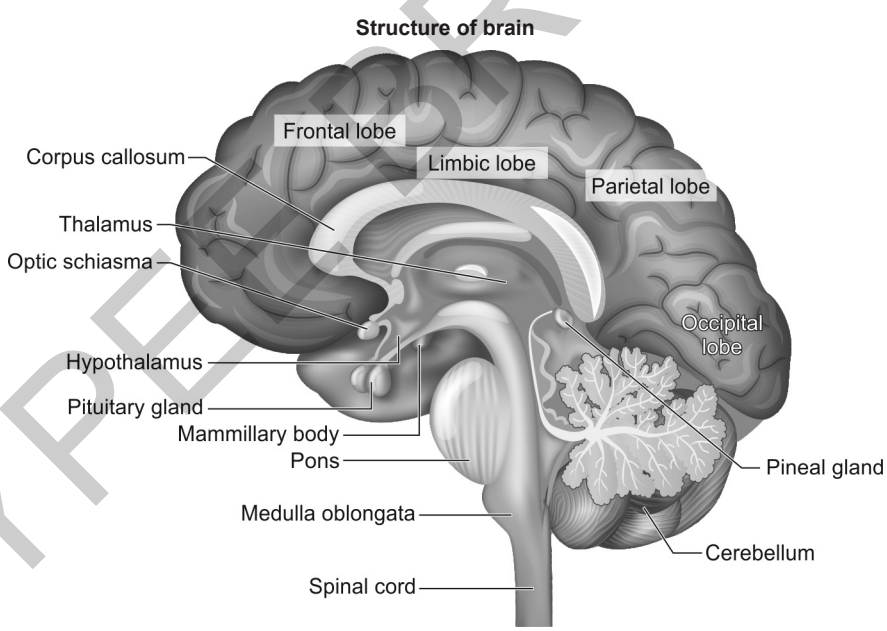
- **Right lung:** Larger, with three lobes (superior, middle, inferior) separated by horizontal and oblique fissures.
- **Left lung:** Smaller to accommodate the heart, with two lobes (superior, inferior) and a cardiac notch (an indentation).

How Air Flows

- **Inhalation:** Air enters through nose/mouth, travels down the trachea.
- **Branching:** Trachea divides into bronchi, then bronchioles.
- **Alveoli:** Air reaches alveoli, oxygen diffuses into blood, carbon dioxide diffuses out.
- **Exhalation:** Carbon dioxide is expelled back up the airways.

c. Structure of brain

The human brain is a complex 3-pound organ that serves as the center of the nervous system. It consists of three primary structural divisions: the cerebrum, the cerebellum, and the brainstem.



Main Structural Divisions

- **Cerebrum:** The largest part of the brain, divided into right and left hemispheres joined by the **corpus callosum**. It handles higher functions like touch, vision, hearing, speech, reasoning, and emotions. Its outer layer is the **cerebral cortex** (gray matter).
- **Cerebellum ("Little Brain"):** Located at the back of the head below the cerebrum. It coordinates voluntary muscle movements, maintains posture, and handles balance and equilibrium.
- **Brainstem:** Connects the cerebrum and cerebellum to the spinal cord. It includes the **midbrain**, **pons**, and **medulla oblongata**. It regulates automatic functions such as breathing, heart rate, and sleep cycles.

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Lobes of the Cerebral Cortex

Each hemisphere is divided into four main lobes with specialized functions:

1. **Frontal lobe:** Responsible for personality, decision-making, executive function, and voluntary movement.
2. **Parietal lobe:** Interprets sensory information like touch, pain, and temperature.
3. **Temporal lobe:** Involved in hearing, language comprehension, and memory storage.
4. **Occipital lobe:** The primary center for visual processing.

Deep Brain Structures

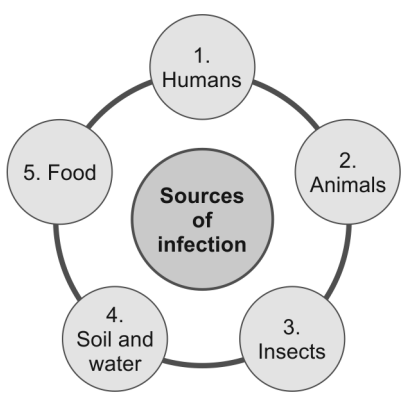
- **Thalamus:** Acts as a relay station for sensory and motor information moving to and from the cortex.
- **Hypothalamus:** Regulates autonomic functions like hunger, thirst, sleep, and body temperature.
- **Limbic system:** Often called the "emotional brain," it includes the **amygdala** (emotions) and **hippocampus** (memory formation).
- **Protective layers:** The brain is protected by the cranium (skull), three layers of membranes called meninges (dura mater, arachnoid mater, and pia mater), and cerebrospinal fluid (CSF), which cushions and nourishes the brain.

d. Sources of infection

Sources of infection are reservoirs where pathogens (germs) live and multiply, including humans (sick or carriers), animals, insects, soil, water, and contaminated food, spreading through contact, air (coughing, sneezing), vectors (mosquitoes, ticks), contaminated surfaces, or direct entry into the body via cuts or ingestion. Key transmission routes involve direct/indirect contact, airborne droplets, vectors, contaminated vehicles (food/water), and bodily fluids, affecting susceptible hosts.

Common Sources and Reservoirs

- **Humans:** Infected individuals or asymptomatic carriers can transmit germs through respiratory secretions (coughing/sneezing), feces, or bodily fluids.
- **Animals:** Pets, wildlife, or livestock can carry diseases (e.g., rabies, *Salmonella*) spread through bites, scratches, or contact with droppings.
- **Insects (vectors):** Mosquitoes (malaria), ticks (Lyme disease), and fleas transmit pathogens.
- **Environment:** Contaminated soil (hookworms), water (*E. coli*, *Giardia*), or even warm water systems (Legionella).
- **Food:** Improperly prepared or contaminated food/water (*Salmonella*, *E. coli*).



Sources of infection

Transmission Routes (How They Spread)

- **Contact:** Direct (touching) or indirect (touching contaminated surfaces like doorknobs).
- **Airborne/droplet:** Inhaling tiny particles from coughs, sneezes, or even talking (e.g., measles, TB).
- **Vehicle:** Through contaminated common items like food, water, or blood.
- **Vector-borne:** Via insect or animal bites/stings.
- **Bodily fluids:** Sexual contact, blood transfusions, or shared needles.

e. Structure of lymph node

A lymph node is a small, bean-shaped secondary lymphoid organ that acts as a biological filter for foreign particles, cancer cells, and pathogens in the lymphatic fluid. An adult has approximately 450 to 800 lymph nodes throughout the body, primarily clustered in the neck, armpits, and groin.

Anatomical Structure

The lymph node is organized into specific layers and compartments that facilitate immune cell interaction:

- **Capsule:** A protective outer shell made of dense connective tissue and collagenous fibers.

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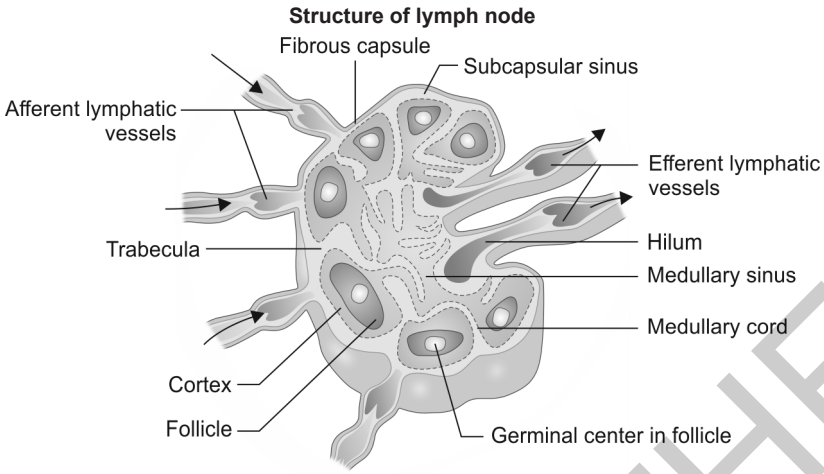

- **Trabeculae:** Connective tissue extensions that project from the capsule into the node, dividing it into smaller compartments and providing structural support.
- **Subcapsular sinus:** A space immediately beneath the capsule where lymph enters the node via multiple afferent lymphatic vessels.
- **Hilum:** An indentation on the concave side where blood vessels enter and leave, and where the single efferent lymphatic vessel exits.

Internal Histological Regions

Each lymph node is divided into three main cellular zones:

Region	*Primary immune cells*	*Key features*
Outer Cortex	B cells	Contains **lymphoid follicles**. Primary follicles have inactive B cells; secondary follicles develop **germinal centers** for active B-cell proliferation and antibody production.
Paracortex	**T cells** and Dendritic cells	The site for T-cell activation. It contains **High Endothelial Venules (HEVs)**, specialized blood vessels that allow lymphocytes to enter from the bloodstream.
Medulla	Plasma cells, Macrophages	The innermost layer consisting of **medullary cords** (antibody-secreting cell clusters) and **medullary sinuses** that drain filtered lymph toward the hilum.

Flow of Lymph

Lymph flows unidirectionally through the node to maximize exposure to immune cells:

- **Entry:** Enters via **afferent vessels** on the convex side.
- **Filtration:** Moves from the **subcapsular sinus** through **cortical/trabecular sinuses** and into **medullary sinuses**, where macrophages trap foreign matter.
- **Exit:** Exits through the **efferent vessel** at the hilum.

IV. Answer the following:

a. List the endocrine glands

The main endocrine glands are the hypothalamus, pituitary, pineal, thyroid, parathyroid, thymus, adrenal glands, pancreas, ovaries (female), and testes (male), which work together to produce hormones regulating growth, metabolism, reproduction, mood, and more, releasing them directly into the bloodstream.

- **Hypothalamus:** In the brain; controls the pituitary.
- **Pituitary gland:** Base of the brain; the "master gland" controlling others.
- **Pineal gland:** In the brain; produces melatonin (sleep).
- **Thyroid gland:** Neck; regulates metabolism.

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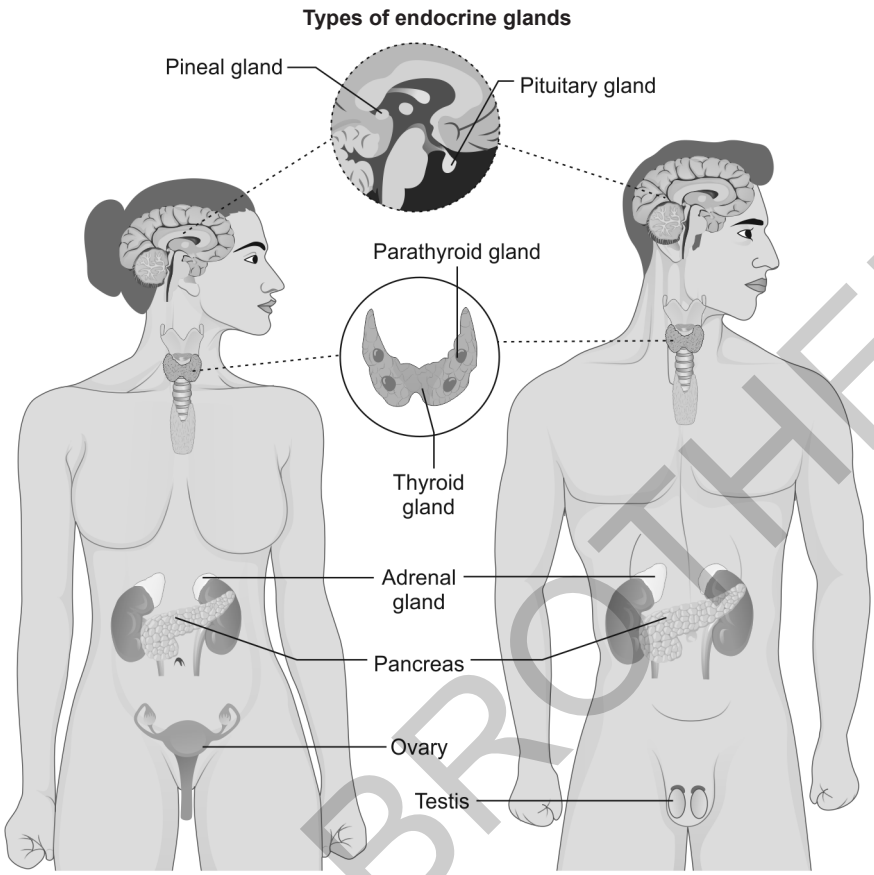
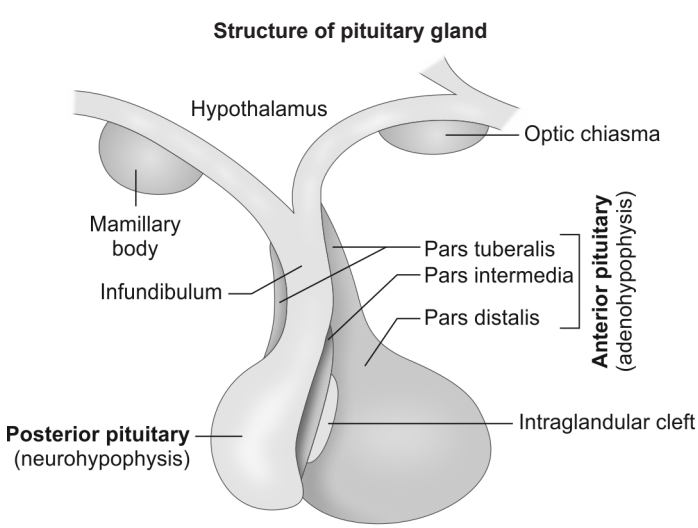


- **Parathyroid glands:** Behind the thyroid; control calcium.
- **Thymus:** Upper chest; immune function.
- **Adrenal glands:** On top of kidneys; stress response, metabolism.
- **Pancreas:** Behind the stomach; blood sugar regulation (insulin, glucagon).
- **Ovaries:** Female gonads; produce estrogen, progesterone.
- **Testes:** Male gonads; produce testosterone.

b. Explain the structure of pituitary gland and its hormones

The pituitary gland is a pea-sized "master gland" at the brain's base, connected to the hypothalamus, with two lobes: the Anterior Pituitary (glandular) making Growth Hormone (GH), TSH, ACTH, FSH, LH, and Prolactin, regulating growth, metabolism, and reproduction; and the Posterior Pituitary (neural), storing and releasing Oxytocin (childbirth/lactation) and Vasopressin (ADH) (water balance) made by the hypothalamus.

- **Location:** Base of the brain, within a bony structure called the sella turcica, attached to the hypothalamus by the pituitary stalk (infundibulum).
- **Anterior pituitary (adenohypophysis):** The larger, glandular part, responsible for synthesizing and secreting its own hormones.



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- **Posterior pituitary (neurohypophysis):** Neural tissue that stores and releases hormones produced by the hypothalamus.
- **Intermediate lobe:** A thin layer between the lobes, producing MSH (Melanocyte-Stimulating Hormone), though often part of the anterior pituitary in adults.

Anatomical Structure

The gland is composed of two main lobes with distinct embryological origins and functions:

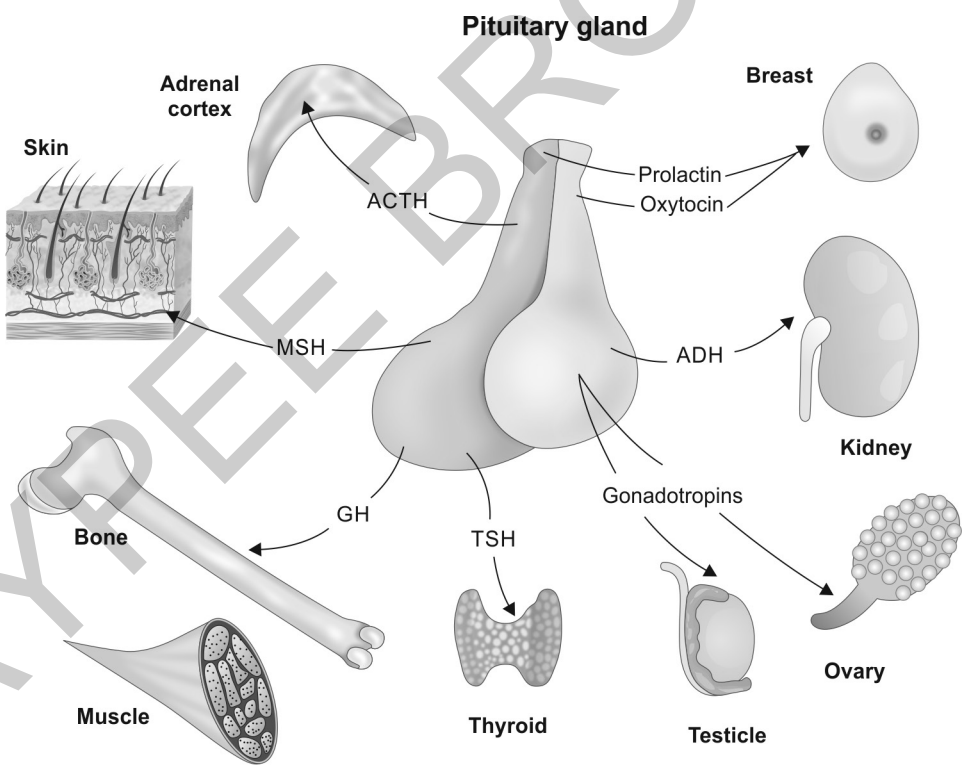
Structure	*Composition*	*Regulation*
Anterior pituitary (Adenohypophysis)	Glandular epithelial tissue	Controlled by hypothalamic releasing and inhibiting hormones via the hypophyseal portal system (blood vessel network)
Posterior pituitary (Neurohypophysis)	Neural tissue (axons from hypothalamic neurons)	Stores and releases hormones synthesized in the hypothalamus. Regulated by **nerve impulses**
Intermediate lobe (Pars intermedia)	A thin layer of cells between the two lobes	In adult humans, it is rudimentary and often considered part of the anterior lobe.

Pituitary Hormones and Functions

Anterior Pituitary Hormones

The anterior lobe synthesizes and secretes several vital hormones:

- **Growth Hormone (GH):** Stimulates growth of bone, muscle, and body tissues.



Types of Pituitary Hormones

- **Thyroid-stimulating hormone (TSH):** Triggers the thyroid gland to release thyroid hormones.
- **Adrenocorticotropic hormone (ACTH):** Stimulates the adrenal cortex to produce cortisol (the stress hormone).
- **Follicle-stimulating hormone (FSH):** Regulates egg development in ovaries and sperm production in testes.
- **Luteinizing hormone (LH):** Stimulates ovulation in females and testosterone production in males.
- **Prolactin (PRL):** Promotes breast milk production (lactation) after childbirth.

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Posterior Pituitary Hormones

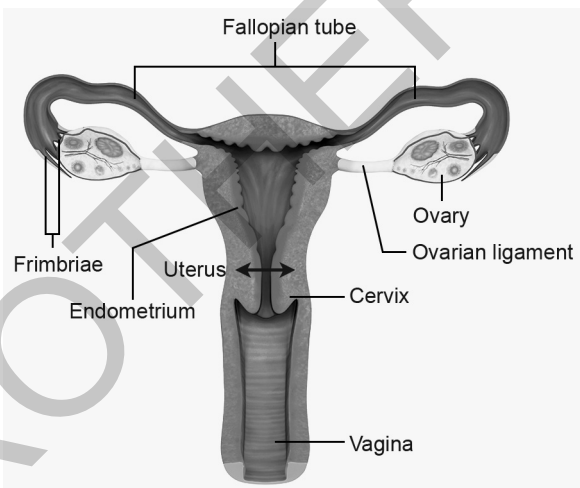
This lobe does not produce its own hormones; it **stores** and **releases** two hormones made in the hypothalamus:

- **Antidiuretic hormone (ADH/Vasopressin):** Controls water balance by causing the kidneys to reabsorb water.
- **Oxytocin:** Stimulates uterine contractions during labor and triggers milk ejection during breastfeeding.

Intermediate Lobe Hormone

Melanocyte-stimulating hormone (MSH): Stimulates the production of melanin, the pigment responsible for skin and hair color.

Organs of female reproductive system



c. List the organ of female reproductive system

The female reproductive system includes both internal and external organs, with internal parts like the ovaries, fallopian tubes, uterus, and cervix, and external parts (vulva) such as the mons pubis, labia, clitoris, and vaginal opening, all working to produce eggs, facilitate fertilization, and support pregnancy.

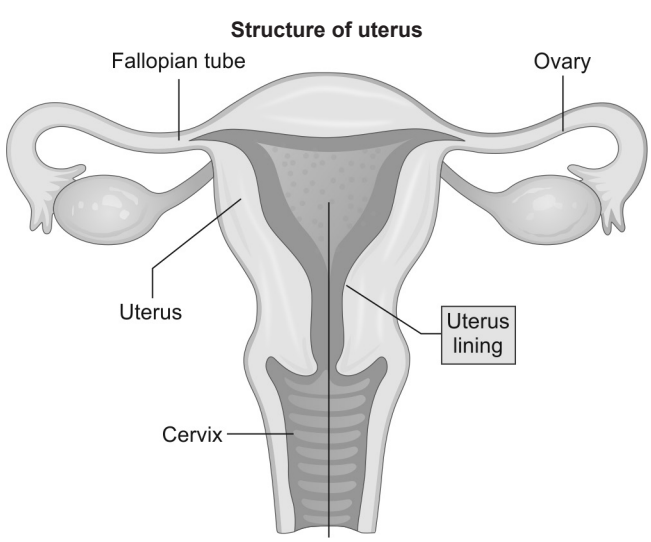
Internal Organs

- **Ovaries:** Produce eggs (ova) and hormones like estrogen and progesterone.
- **Fallopian tubes (uterine tubes):** Tubes connecting ovaries to the uterus, where fertilization typically occurs.
- **Uterus:** A hollow, muscular organ that holds and nourishes a developing fetus.
- **Cervix:** The lower, narrow part of the uterus that opens into the vagina.
- **Vagina:** A muscular canal connecting the uterus to the outside of the body.

External Organs (Vulva)

- **Mons pubis:** A fleshy pad covering the pubic bone.
- **Labia majora and labia minora:** Folds of skin protecting the vaginal opening.
- **Clitoris:** A small, sensitive organ for sexual pleasure.
- **Vestibule:** The area containing the urethral and vaginal openings.
- **Hymen:** A thin membrane that may partially cover the vaginal opening.
- **Bartholin's glands:** Glands that secrete mucus for lubrication.

Structure of uterus



d. Explain the structure of uterus

The uterus (or womb) is a hollow, pear-shaped muscular organ of the female reproductive system located in the pelvic cavity between the urinary bladder (anteriorly) and the rectum (posteriorly). In a non-pregnant state, it is approximately 7–8 cm long and 5 cm wide.

Anatomical Regions

The uterus is divided into four primary regions:

1. **Fundus:** The broad, dome-shaped uppermost portion above the entry points of the fallopian tubes.

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2. **Corpus (body):** The largest central region where embryo implantation typically occurs. It narrows inferiorly toward the cervix.
3. **Isthmus:** A narrow, transitional segment between the corpus and the cervix.
4. **Cervix:** The lower, cylindrical neck that protrudes into the vagina. It contains the **cervical canal**, which connects the uterine cavity to the vagina via the internal and external os.

Layers of the Uterine Wall

The uterine wall consists of three distinct tissue layers:

1. **Endometrium (inner layer):** A highly vascularized mucosal lining. It has two zones: the **stratum functionalis** (shed monthly during menstruation) and the **stratum basalis** (the permanent layer that regenerates the functionalis each cycle).
2. **Myometrium (middle layer):** The thickest layer (approx. 90% of the wall), composed of smooth muscle fibers. These muscles contract during labor to expel the fetus and during menstruation to shed the lining.
3. **Perimetrium (outer layer):** A thin, serous membrane (visceral peritoneum) that covers the exterior of the uterus, providing protection and reducing friction with surrounding organs.

Support Structures (Ligaments)

Several paired ligaments stabilize the uterus within the pelvis, including the broad, round, cardinal, and uterosacral ligaments.

Position and Orientation

The uterus is commonly positioned in an anteverted and anteflexed orientation, tilted and bent forward. Other positions, such as retroverted or retroflexed, are also possible.

Blood Supply and Innervation

- **Blood supply:** The primary blood supply comes from the uterine arteries, with contributions from the ovarian arteries. These vessels form an extensive network within the uterine wall.
- **Innervation:** The uterus receives innervation from the autonomic nervous system via the inferior hypogastric plexus.

V. State whether the following statements is ture or false:

a. The optic nerve transmits the nerve impulses of smell: **False**
b. Veins carry oxygenated blood away from the heart: **False**
c. Neuron is the functional unit of kidney: **False**
d. Rabies is a zoonotic disease: **True**

VI. Write short notes for any three of the following:

a. Physiology of vision

The physiology of vision is the complex process by which the visual system captures light and converts it into perceived images. This biological journey occurs in four primary stages: image formation, phototransduction, transmission, and brain processing.

Image Formation (the Optical System)

Light enters the eye and is manipulated to focus a sharp, inverted image onto the retina.

- **Refraction:** The **cornea** provides about 75% of the eye's focusing power by bending light as it enters.
- **Aperture Control:** The **iris** adjusts the size of the **pupil** to regulate the amount of light entering, contracting in bright light and dilating in dim light.
- **Accommodation:** The **crystalline lens** changes its curvature via the ciliary muscles to focus on objects at varying distances.
- **Convergence:** Both eyes move medially to focus on a single object, enabling binocular vision and depth perception.

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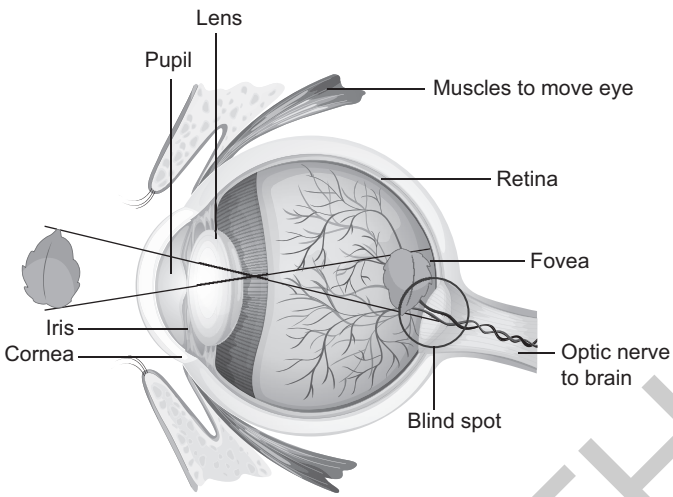

Physiology of vision

Phototransduction (the Neural Stage)

In the retina, light energy is converted into electrical signals by specialized photoreceptor cells.

- **Photoreceptors:**
  - *Rods:* Highly sensitive to low light levels; responsible for night (scotopic) vision and peripheral motion, but do not detect color.
  - *Cones:* Concentrated in the **fovea**; responsible for sharp central vision and color (photopic) vision. There are three types sensitive to red, green, and blue wavelengths.
- **Photochemical reaction:** Light hits the pigment **rhodopsin** (in rods) or photopsins (in cones), causing the 11-cis-retinal molecule to isomerize into all-trans-retinal.
- **Electrical signal:** This reaction triggers a biochemical cascade that closes sodium channels, leading to **hyperpolarization** of the cell and a change in neurotransmitter release.

Transmission (The Visual Pathway)

Retinal signals are refined and sent to the brain for interpretation.

- **Retinal processing:** Signals pass from photoreceptors to **bipolar cells** and then to **ganglion cells**.
- **Optic nerve and chiasm:** Axons from ganglion cells form the **optic nerve**. At the **optic chiasm**, fibers from the nasal half of each retina cross to the opposite side, ensuring each hemisphere of the brain receives information from both eyes.
- **Relay station:** Most fibers synapse in the **Lateral Geniculate Nucleus (LGN)** of the thalamus, which organizes information before sending it to the cortex.

Brain Processing (Perception)

- **Primary visual cortex (V1):** Located in the occipital lobe, it handles basic features like edge detection, orientation, and spatial organization.
- **Visual streams:** Processing continues along two main pathways:
  1. *Ventral stream ("What" pathway):* Projects to the temporal lobe for object and face recognition.
  2. *Dorsal stream ("Where/How" pathway):* Projects to the parietal lobe to process motion and spatial location.

b. Cardiac cycle

The cardiac cycle is the sequence of electrical and mechanical events that occur from the beginning of one heartbeat to the beginning of the next. In a healthy adult at rest, a complete cycle lasts approximately 0.8 seconds (at a rate of ~75 beats per minute) and involves both contraction (systole) and relaxation (diastole) of the heart's four chambers.

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Phases of the Cardiac Cycle

The cycle is often divided into two primary phases, further broken down into specific stages based on pressure and volume changes.

Diastole (Relaxation and Filling)

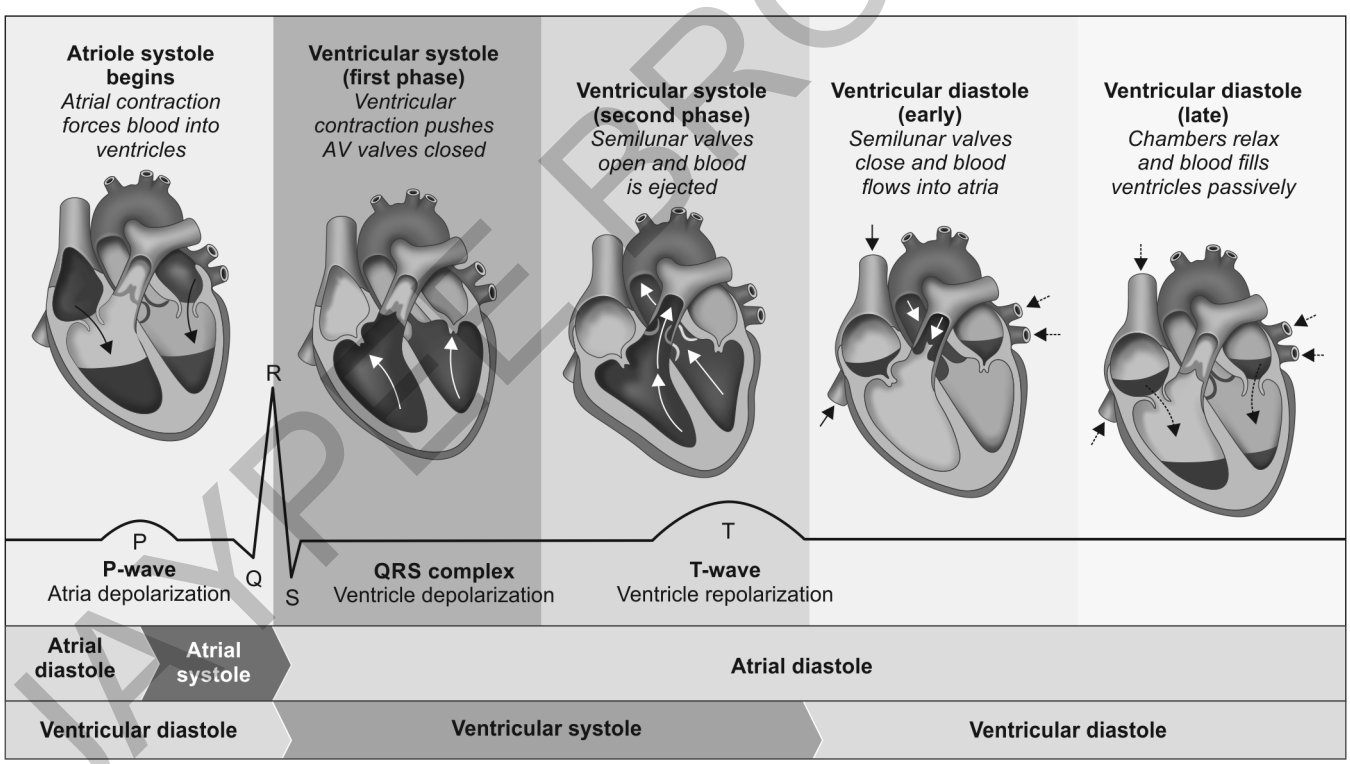
During this phase, the heart chambers relax and refill with blood.

- **Isovolumetric relaxation:** Both atrioventricular (AV) and semilunar valves are closed. Ventricular pressure drops rapidly while volume remains constant.
- **Rapid filling:** Ventricular pressure falls below atrial pressure, causing AV valves to open. Blood flows passively and quickly into the ventricles (about 70–80% of filling).
- **Diastasis (slow filling):** A period of slower, passive blood flow into the ventricles as the pressure gradient levels off.
- **Atrial systole:** The atria contract (triggered by the **P wave** on an ECG) to pump the remaining 20–30% of blood into the ventricles. This is known as the "atrial kick".

Systole (Contraction and Ejection)

During this phase, the ventricles contract to pump blood into circulation.

- **Isovolumetric contraction:** Initiated by ventricular depolarization (**QRS complex**). Ventricles contract and pressure rises, causing the AV valves to snap shut (creating the **S1 "lub"** sound). All valves are closed, so pressure builds without a change in volume.



Phases of cardiac cycle

- **Ventricular ejection:** Ventricular pressure exceeds arterial pressure (aorta and pulmonary artery), forcing semilunar valves open. Blood is rapidly ejected.
- **End of systole:** Ventricular pressure begins to fall. As it drops below arterial pressure, the semilunar valves close to prevent backflow (creating the **S2 "dub"** sound).

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Summary of Duration (0.8s Total)

Phase	*Duration (approx.)*	*Key event*
Atrial systole	0.1 s	Final 20–30% of ventricular filling
Ventricular systole	0.3 s	Blood ejected to lungs and body
Ventricular diastole	0.5 s	Ventricles relax and fill passively

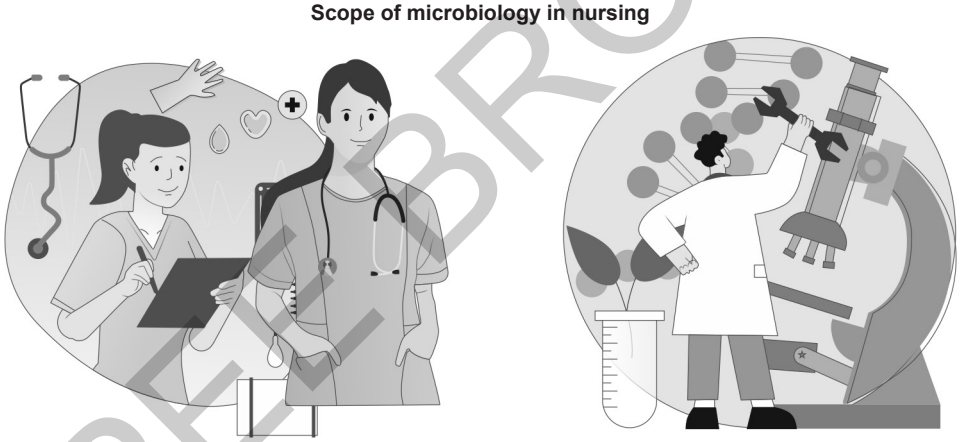
Key Clinical Indicators

- **Stroke volume (SV):** The amount of blood pumped by a ventricle in one cycle (SV = end diastolic volume – end systolic volume).
- **Ejection fraction (EF):** The percentage of blood ejected from the ventricle during systole (normally ~60%).
- **Heart sounds:** The "lub-dub" sounds are produced by the closure of heart valves: S1 (mitral/tricuspid) and S2 (aortic/pulmonary).

d. Scope of microbiology in nursing

The scope of microbiology in nursing involves using knowledge of microbes (bacteria, viruses, fungi) for infection control, understanding disease transmission, promoting sterilization and hygiene, assisting in diagnosis and treatment (like antibiotic stewardship), educating patients, and performing tasks such as specimen collection, all crucial for safe patient care, preventing hospital-acquired infections, and managing infectious outbreaks in various settings like operating rooms and public health.

Scope of microbiology in nursing



Areas of Microbiology in Nursing

- **Infection prevention and control:** Applying principles of asepsis, sterilization, and disinfection to maintain sterile environments (like ORs) and prevent healthcare-associated infections (HAIs).
- **Disease understanding:** Knowing how microbes cause illness (pathogenesis), how they spread (transmission), and recognizing signs of infection early for prompt intervention
- **Antibiotic stewardship:** Understanding antibiotic mechanisms, appropriate use, and the critical issue of antibiotic resistance to combat infections effectively.
- **Specimen handling:** Collecting and managing samples (blood, urine, swabs) for lab testing, ensuring their integrity for accurate diagnosis.
- **Patient and family education:** Teaching proper hygiene, vaccination importance, and infection prevention at home.
- **Wound care management:** Applying knowledge of microbes to manage wound infections and promote healing.
- **Public health and epidemiology:** Contributing to community health by understanding infectious disease outbreaks and immunization programs.
- **Personal safety:** Protecting themselves and others by understanding how microbes can be transmitted in clinical settings.

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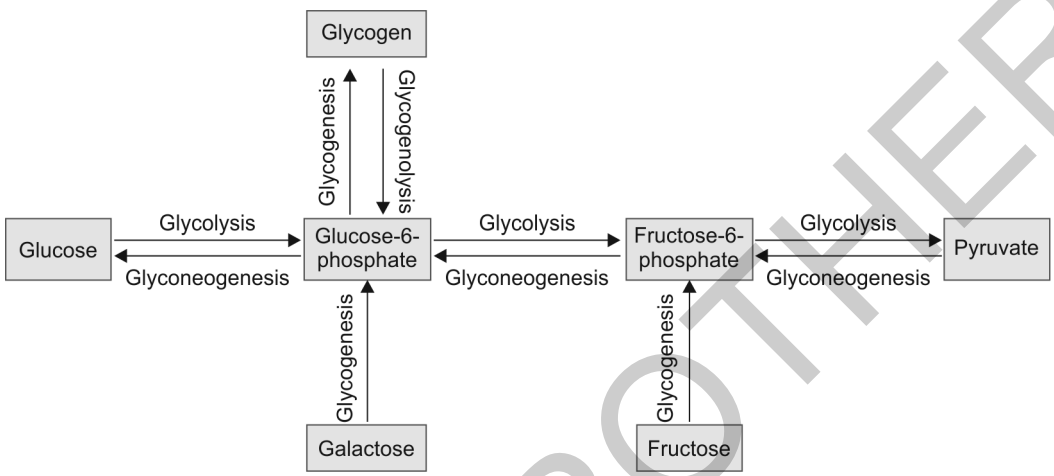
d. Metabolism of carbohydrates

Carbohydrate metabolism is the process where organisms break down, synthesize, and convert carbs for energy and building blocks, primarily using glucose, starting with digestion into monosaccharides. Key pathways include glycolysis (glucose to pyruvate), the Krebs cycle (further breakdown for ATP), and gluconeogenesis (making glucose from non-carb sources). Energy is stored as glycogen in the liver and muscles or converted to fat, with tight regulation ensuring energy supply for tissues like the brain.



Carbohydrate metabolism

Processes in Carbohydrate Metabolism

- **Digestion and absorption:** Dietary carbs are broken down into simple sugars (monosaccharides like glucose) and absorbed into the bloodstream.
- **Glycolysis:** Glucose is split into pyruvate in the cytoplasm, generating a small amount of ATP (energy).
- **Krebs cycle (citric acid cycle):** Pyruvate enters mitochondria, is further oxidized, producing more ATP, NADH, and FADH2.
- **Oxidative phosphorylation:** The main ATP-producing step, using products from the Krebs cycle.
- **Glycogenesis:** Synthesis of glycogen (stored glucose) in liver/muscles when energy is abundant.
- **Glycogenolysis:** Breakdown of stored glycogen into glucose when needed.
- **Gluconeogenesis:** Creating new glucose from non-carbohydrate sources (like amino acids, lactate) during fasting or starvation, vital for the brain.
- **Lipogenesis:** Excess glucose is converted to triglycerides (fat) and stored in adipocytes (fat cells).

Importance

- **Energy source:** Provides immediate energy (ATP) for all cellular functions.
- **Fuel for the brain:** Glucose is the essential fuel for the brain and red blood cells.
- **Building blocks:** Intermediates are used for synthesizing other molecules like nucleotides, glycoproteins, and lipids.
- **Regulation:** Tightly controlled by hormones (like insulin) to match energy supply with demand, preventing excess storage or energy depletion.

Pathways for Different Needs

- **Anaerobic (no oxygen):** Glycolysis produces lactate.
- **Aerobic (with oxygen):** Glycolysis → Krebs Cycle → Oxidative Phosphorylation for maximum ATP.
- **Pentose phosphate pathways:** Produces NADPH and precursor molecules for nucleotide synthesis.

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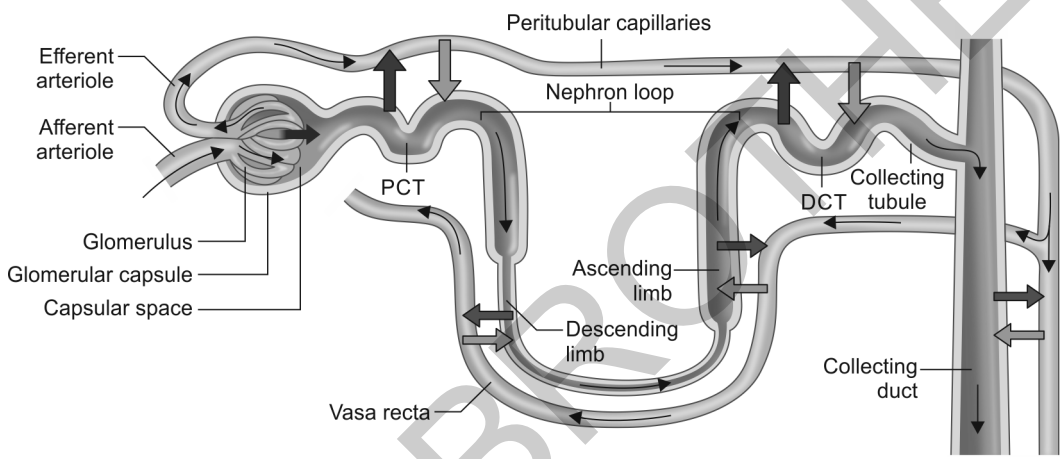
e. Process of urine formation

Urine formation in the kidneys occurs in three main steps within the nephron: glomerular filtration (filtering blood in the glomerulus), tubular reabsorption (reclaiming useful substances like glucose, amino acids, and water back into the blood), and tubular secretion (actively adding wastes and excess ions from the blood into the filtrate). This process creates urine, which is about 95% water and 5% waste (like urea) and is collected for excretion.

Urine formation process

Glomerular filtration	Tubular reabsorption	Tubular secretion
The movement of substances from the blood within the glomerulus into the capsular space	The movement of substances from the tubular fluid back into the blood	The movement of substances from the blood into the tubular fluid



Glomerular Filtration

- Blood pressure forces water and small solutes (wastes, ions, glucose, amino acids) from the blood in the glomerulus (a tuft of capillaries) into Bowman's capsule.
- Larger molecules like proteins and blood cells are too big to pass through and remain in the blood.

Tubular Reabsorption

- As the filtered fluid (glomerular filtrate) moves through the renal tubules (proximal convoluted tubule, Loop of Henle, distal convoluted tubule), most useful substances are transported back into the bloodstream.
- This active process reclaims glucose, amino acids, salts, and most water, which are vital for the body.

Tubular Secretion

- Waste products (like creatinine, hydrogen ions, potassium ions) and excess substances are actively transported from the blood in the peritubular capillaries into the filtrate.
- This fine-tunes the urine's composition and helps maintain the body's pH balance.

Excretion: The final fluid, now urine, moves from the collecting ducts to the renal pelvis, down the ureters, to the bladder, and is eventually expelled from the body.

VII. Answer the following:

a. Define immunity

Immunity is body's natural defense system that protects it from harmful germs like bacteria, viruses, and other foreign invaders, allowing you to fight off disease and stay healthy, primarily through innate (born with) and acquired (developed) systems. It involves barriers (skin, mucous), specialized cells, and antibodies that recognize and neutralize threats, either generally (innate) or specifically (acquired), and can be boosted by vaccines

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b. Explain the types of immunity

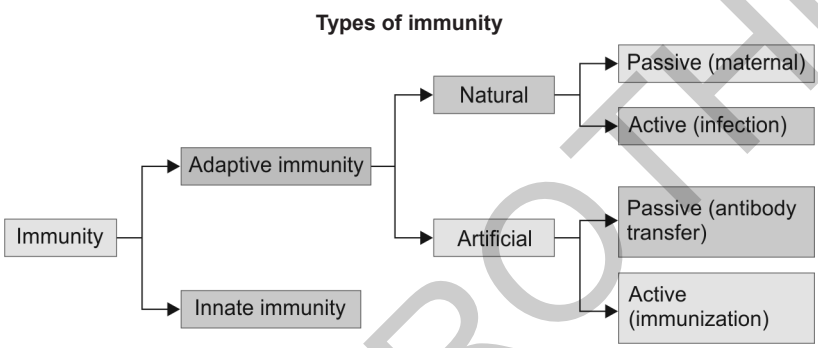
Immunity involves two main systems: Innate Immunity (general, present from birth) and Adaptive (Acquired) Immunity (specific, develops over time). Adaptive immunity further splits into Active (body makes its own antibodies, long-lasting, e.g., after infection/vaccine) and Passive (receives ready-made antibodies, temporary, e.g., mother to baby). These work with innate defenses to protect the body from pathogens.

Innate Immunity (Natural or Non-specific)

This is the general defines system you are born with. It provides an immediate but non-specific response to any foreign invader.

Anatomical and Physical Barriers

The first line of defense, including the skin and mucous membranes that trap germs.



Physiological Barriers

Substances like stomach acid, enzymes in tears, and fever that inhibit microbial growth.

Active vs. Passive Immunity

Adaptive immunity is further classified by how it is acquired:

Type	*How it works*	*Duration*
Active	The body produces its own antibodies after exposure to a pathogen or vaccine.	Long-lasting (often years or life).
Passive	Ready-made antibodies are transferred from another source (e.g., mother to baby via the placenta or breast milk).	Short-lived (weeks to months).

Cellular barriers

White blood cells like neutrophils, macrophages, and Natural Killer (NK) cells that engulf and destroy pathogens.

Adaptive Immunity (Acquired or Specific)

This system develops over your lifetime as you are exposed to specific diseases or receive vaccines. It is highly specific and creates **immunological memory**.

- **Humoral immunity:** Mediated by B cells, which produce antibodies that circulate in body fluids to neutralize pathogens.
- **Cell-mediated immunity:** Mediated by T cells (Helper and Cytotoxic), which directly attack infected or cancerous cells.

c. List the types of tissues

Epithelial Tissue

This tissue forms the body's protective covering, lining internal organs and cavities, and making up glands. It is classified by cell shape and the number of layers:

- **Cell shapes:** Squamous (flat), Cuboidal (cube-shaped), and Columnar (tall/rectangular).

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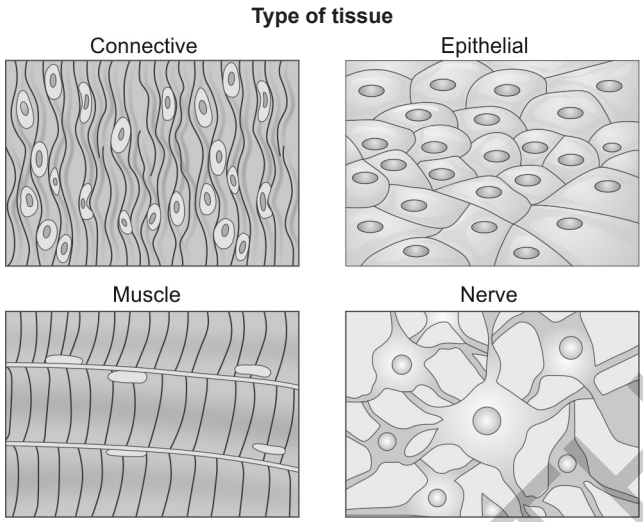

Layer Types

- **Simple:** A single layer of cells for absorption and filtration.
- **Stratified:** Multiple layers for protection (e.g., skin).
- **Pseudostratified:** A single layer that appears to be multiple layers.
- **Transitional:** Specialized to stretch (found in the bladder).

Connective Tissue

The most abundant and diverse tissue type, it binds, supports, and protects body structures. It typically consists of cells embedded in an extracellular matrix.

- **Connective tissue proper:** Includes loose (areolar, adipose, reticular) and dense (tendons, ligaments) tissues.
- **Specialized connective tissues:**
  - *Bone:* Rigid and mineralized for structural support.
  - *Cartilage:* Flexible and strong (hyaline, elastic, and fibrocartilage).
  - *Fluid connective tissues:* Blood and lymph.

Muscle Tissue

This tissue is specialized for contraction and movement. There are three types:

1. **Skeletal muscle:** Voluntary and striated, attached to bones for body movement.
2. **Cardiac muscle:** Involuntary and striated, found only in the heart to pump blood.
3. **Smooth muscle:** Involuntary and non-striated, found in the walls of hollow organs like the stomach and blood vessels.

Nervous Tissue

Nervous tissue is responsible for communicating electrical and chemical signals between body parts.

- **Neurons:** Conduct nerve impulses.
- **Neuroglia (Glial cells):** Support and protect neurons.

d. Explain the functions of epithelial tissue

Epithelial tissue, or **epithelium**, serves several critical roles depending on its location in the body. Primarily, it acts as a gatekeeper, forming a barrier that controls the movement of substances between internal and external environments.

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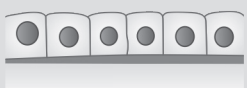
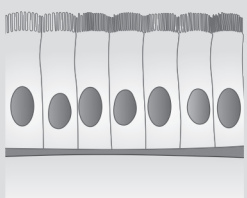
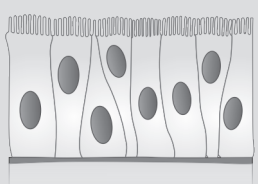
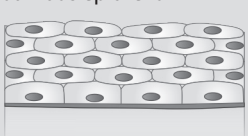
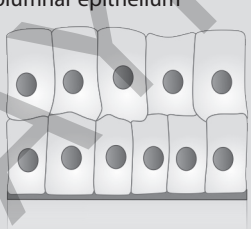
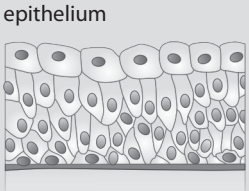
Functions of epithelial tissues

Cells	*Location*	*Function*
Simple squamous epithelium 	Air sacs of lungs and the lining of the heart, blood vessels, and lymphatic vessels	Allows materials to pass through by diffusion and filtration, and secretes lubricating substance
Simple cuboidal epithelium 	In ducts and secretory portions of small glands and in kidney tubules	Secretes and absorbs
Simple columnar epithelium 	Ciliated tissues are in bronchi, uterine tubes, and uterus; smooth (nonciliated tissues) are in the digestive tract, bladder	Absorbs; it also secretes mucous and enzymes
Pseudostratified columnar epithelium 	Ciliated tissue lines the trachea and much of the upper respiratory tract	Secretes mucus; ciliated tissue moves mucus
Stratified squamous epithelium 	Lines the esophagus, mouth, and vagina	Protects against abrasion
Stratified cuboidal epithelium 	Sweat glands, salivary glands, and the mammary glands	Protective tissue
Stratified columnar epithelium 	The male urethra and the ducts of some glands	Secretes and protects
Transitional epithelium 	Lines the bladder, urethra, and the ureters	Allows the urinary organs to expand and stretch

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Primary Functions

- **Protection:** It forms the body's first line of defense against physical trauma, chemical toxins, radiation, and biological invasion by microorganisms. For example, the skin's epidermis protects underlying organs from injury and infection.
- **Secretion:** Glandular epithelial cells produce and release substances like hormones, enzymes, mucus, sweat, and digestive juices. These can be released into ducts (exocrine glands) or directly into the bloodstream (endocrine glands).
- **Absorption:** Epithelial cells in the digestive tract, particularly those with finger-like projections called **microvilli**, are specialized to absorb nutrients and water into the body.
- **Filtration and diffusion:** Simple (single-layer) squamous epithelium is thin enough to allow for the rapid exchange of gases (like oxygen and CO_2 in the lungs) and the filtration of waste (in the kidneys).
- **Sensory reception:** Specialized epithelial cells contain sensory nerve endings that can detect stimuli for smell, taste, hearing, and vision.
- **Excretion:** It aids in the removal of waste products from the body, such as sweat through the skin or urine through the kidney tubules.

Specialized Structural Functions

- **Movement of materials:** Ciliated epithelial cells have hair-like **cilia** that beat in unison to move substances across their surface. For example, they sweep mucus and trapped particles out of the respiratory tract and move eggs through the fallopian tubes.
- **Barrier maintenance:** Tight junctions between cells create an impermeable seal that prevents fluids or pathogens from leaking between tissues.
- **Flexibility and stretch: Transitional epithelium** (urothelium) in the urinary bladder allows the organ to expand and contract as it fills with urine without tearing.

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