

Cerebrum Biology Academy

Human Physiology Quick Reference Guide For NEET Biology Excellence

Comprehensive guide covering all 9 major human body systems with detailed structures, functions, NEET frequently asked facts, and clinical significance. Perfect for quick revision and exam preparation.

- 9 Major Body Systems
- Key Facts & Structures
- Clinical Significance
- NEET-Focused Content
- Common Disorders

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Digestive System

The digestive system breaks down food into absorbable nutrients through mechanical and chemical processes. It extends from the oral cavity to the rectum, involving the mouth, pharynx, esophagus, stomach, small intestine, large intestine, and accessory organs like the pancreas, liver, and gallbladder.

Key Structures & Organs:

Mouth, Pharynx, Esophagus, Stomach, Small Intestine, Large Intestine, Pancreas, Liver

Structure-Function-Clinical Significance:

Structure	Function	Clinical Significance
Stomach	Churns food; secretes pepsin & HCl	Ulcers from excess acid; GERD
Small Intestine	Main site of nutrient absorption	Malabsorption syndrome
Liver	Produces bile; detoxification	Hepatitis; cirrhosis
Pancreas	Produces digestive enzymes & hormones	Pancreatitis; diabetes

NEET Frequently Asked Facts:

- Digestion of starch begins in mouth via salivary amylase; protein in stomach via pepsin
- Small intestine is 6-7 meters long; large intestine 1.5 meters; most nutrient absorption in small intestine
- Bile emulsifies fats but doesn't digest; pancreatic lipase breaks down fats to fatty acids & glycerol
- HCl secretion by parietal cells creates acidic environment; pepsinogen activated to pepsin at pH 1.5-2
- Vitamin B12 absorption requires intrinsic factor from stomach; deficiency causes pernicious anemia

Common Disorders:

Disorder	Cause	Symptoms
Gastric Ulcer	Helicobacter pylori; stress; NSAIDs	Burning pain; bleeding
GERD	Weak LES; stomach acid reflux	Heartburn; esophageal damage
Malabsorption	Damaged intestinal lining; enzyme deficiency	Weight loss; diarrhea; deficiencies

Respiratory System

The respiratory system facilitates gas exchange between the body and atmosphere. Air enters through nose, travels through pharynx, larynx, trachea, bronchi, and reaches alveoli where oxygen-carbon dioxide exchange occurs. The diaphragm and intercostal muscles control breathing.

Key Structures & Organs:

Nose, Pharynx, Larynx, Trachea, Bronchi, Lungs, Diaphragm, Alveoli

Structure-Function-Clinical Significance:

Structure	Function	Clinical Significance
Trachea	Conducts air to lungs; filters via cilia	Tracheal stenosis; blockage
Alveoli	Site of gas exchange; 300 million in lungs	Emphysema reduces surface area
Diaphragm	Primary breathing muscle; contracts downward	Diaphragmatic paralysis
Intercostal Muscles	Expand/contract ribcage during breathing	Rib fractures affect respiration

NEET Frequently Asked Facts:

- Tidal volume ~500 mL; vital capacity ~4800 mL; residual volume ~1200 mL cannot be expelled
- Hemoglobin carries 98.5% of O₂; remaining 1.5% dissolved in plasma
- CO₂ transported as HCO₃⁻ (70%), carbaminohemoglobin (23%), dissolved in plasma (7%)
- Oxygen diffuses from alveoli to blood due to partial pressure gradient; oxyhemoglobin forms at pO₂ 100 mmHg
- Ventilation-perfusion (V/Q) matching ensures efficient gas exchange; hypoxemia results from V/Q mismatch

Common Disorders:

Disorder	Cause	Symptoms
Asthma	Airway inflammation & bronchoconstriction	Wheezing; breathlessness; tightness
COPD	Smoking; emphysema; chronic bronchitis	Reduced airflow; hypoxemia
Pulmonary Edema	Heart failure; pneumonia; high altitude	Breathlessness; frothy sputum

Circulatory System

The circulatory system transports oxygen, nutrients, hormones, and waste products. The heart pumps blood through arteries, capillaries, and veins. Systemic circulation delivers oxygenated blood to tissues; pulmonary circulation oxygenates blood in lungs.

Key Structures & Organs:

Heart, Arteries, Capillaries, Veins, Blood, Lymph Nodes

Structure-Function-Clinical Significance:

Structure	Function	Clinical Significance
Heart (4 Chambers)	Pumps blood; right side to lungs, left to body	Heart failure; arrhythmias
Arteries	Thick walls; high pressure; carry oxygenated blood	Atherosclerosis; aneurysm
Capillaries	One cell thick; exchange site for nutrients & wastes	Edema from capillary leakage
RBCs	Carry oxygen via hemoglobin (Fe ²⁺ center)	Anemia from RBC deficiency

NEET Frequently Asked Facts:

- Heart rate ~72 bpm; cardiac output ~5 L/min; systolic/diastolic BP ~120/80 mmHg
- Blood groups: ABO (A, B, AB, O); Rh factor (positive/negative); compatibility critical for transfusion
- Hemoglobin concentration: males 13.5-17.5 g/dL, females 12-15.5 g/dL; iron deficiency causes anemia
- Blood clotting: intrinsic (12 factors), extrinsic (PT), common (7 factors); prothrombin time ~12 seconds
- Cardiac cycle: atrial systole (0.1 s), ventricular systole (0.3 s), diastole (0.4 s) = 0.8 s total (normal HR)

Common Disorders:

Disorder	Cause	Symptoms
Hypertension	Genetic; lifestyle; hormonal factors	Increased BP >140/90 mmHg
Anemia	Iron deficiency; RBC destruction; low production	Fatigue; pallor; dyspnea
Thrombosis	Blood clot formation; vessel damage; stasis	Stroke; MI; DVT

Excretory System

The excretory system removes metabolic wastes from the body. Kidneys filter blood to produce urine containing urea, uric acid, and excess ions. The nephron is the functional unit; glomerular filtration, tubular reabsorption, and secretion occur sequentially.

Key Structures & Organs:

Kidneys, Ureters, Bladder, Urethra, Nephrons

Structure-Function-Clinical Significance:

Structure	Function	Clinical Significance
Glomerulus	Site of ultrafiltration; Bowman's capsule	Proteinuria in glomerulonephritis
Proximal Tubule	Reabsorbs glucose, amino acids, ions, water	Tubular dysfunction causes losses
Loop of Henle	Creates osmotic gradient; reabsorbs water & salts	Thick ascending segment reabsorbs NaCl
Collecting Duct	Final water reabsorption via ADH	ADH deficiency causes diabetes insipidus

NEET Frequently Asked Facts:

- Glomerular filtration rate ~125 mL/min; daily urine output ~1.5 L; filtration pressure ~10 mmHg
- Reabsorption: 99% of filtered glucose, 85% of ions, 99% of water; 100% selective reabsorption
- Urea: 50-100 g/day excretion from protein metabolism; cleared by kidneys
- Creatinine: constant production ~1-2 g/day from muscle; used to assess GFR
- Countercurrent multiplier in Loop of Henle creates medullary osmotic gradient (1200 mOsm/kg)

Common Disorders:

Disorder	Cause	Symptoms
Glomerulonephritis	Immune complex deposition; infection	Proteinuria; hematuria; HTN
Chronic Kidney Disease	Diabetes; hypertension; chronic glomerulonephritis	Anemia; hyperkalemia
Nephrotic Syndrome	Loss of charge selectivity; massive proteinuria	Proteinuria >3.5 g/day; edema

Nervous System

The nervous system coordinates body functions through electrical and chemical signaling. The CNS (brain, spinal cord) processes information; the PNS (cranial, spinal nerves) carries signals. Neurons transmit signals via synaptic transmission; reflex arcs allow rapid responses without brain involvement.

Key Structures & Organs:

Brain, Spinal Cord, Cranial Nerves, Spinal Nerves, Neurons

Structure-Function-Clinical Significance:

Structure	Function	Clinical Significance
Neuron	Transmits electrical signals via dendrite-axon	Neurodegeneration in Alzheimer's
Synapse	Chemical transmission via neurotransmitters	Synaptic dysfunction in depression
Cerebral Cortex	Sensation, motor control, cognition	Stroke; tumors; seizures
Cerebellum	Balance, coordination, muscle tone	Ataxia; tremor; poor coordination

NEET Frequently Asked Facts:

- Neuron: soma (cell body), dendrites (inputs), axon (output); action potential: resting -70 mV, threshold -55 mV
- Synapse: presynaptic (axon terminal), synaptic cleft (20-40 nm), postsynaptic (receptor sites)
- Neurotransmitters: ACh (NMJ), dopamine (motor), serotonin (mood), GABA (inhibitory), glutamate (excitatory)
- Reflex arc: receptor → sensory neuron → spinal cord → motor neuron → effector (2 neurons, 1 synapse = monosynaptic)
- Brain regions: cerebrum (cognition), cerebellum (coordination), brainstem (vital functions); 12 cranial nerves

Common Disorders:

Disorder	Cause	Symptoms
Parkinson's Disease	Dopamine neuron loss in substantia nigra	Tremor; rigidity; bradykinesia
Alzheimer's Disease	Amyloid-beta plaques; tau tangles	Progressive cognitive decline
Epilepsy	Abnormal neural activity; genetic or acquired	Recurrent seizures

Endocrine System

The endocrine system regulates body functions through hormones secreted by glands. Major glands include pituitary, thyroid, parathyroid, adrenal, pancreas, and reproductive glands. Hormones act on distant target cells via receptor binding, controlling metabolism, growth, and homeostasis.

Key Structures & Organs:

Pituitary Gland, Thyroid, Parathyroid, Adrenal Glands, Pancreas, Gonads

Structure-Function-Clinical Significance:

Structure	Function	Clinical Significance
Pituitary (Anterior)	Growth hormone, TSH, ACTH, FSH, LH secretion	Hyperpituitarism; acromegaly
Thyroid	T3, T4 secretion; metabolic rate control	Hypothyroidism; hyperthyroidism
Pancreas (Beta Cells)	Insulin secretion; blood glucose regulation	Diabetes mellitus types 1 & 2
Adrenal (Cortex)	Cortisol, aldosterone secretion; stress response	Addison's disease; Cushing's

NEET Frequently Asked Facts:

- Pituitary: anterior lobe (6 hormones via releasing hormones), posterior lobe (ADH, oxytocin storage)
- Thyroid: T4 (80%), T3 (20%); negative feedback inhibits TSH; iodine essential cofactor
- Insulin: lowers blood glucose via GLUT4 transporters; insulin resistance = pre-diabetes
- Cortisol: glucocorticoid; increases glucose via gluconeogenesis; diurnal rhythm (high morning, low evening)
- Testosterone: male androgen; FSH/LH control; anabolic effects; 7-8 mg secretion daily

Common Disorders:

Disorder	Cause	Symptoms
Type 1 Diabetes	Autoimmune beta cell destruction	Hyperglycemia; ketosis; polyuria
Thyroid Cancer	Follicular/papillary/medullary/anaplastic types	Nodule; dysphagia; hoarseness
Addison's Disease	Primary adrenal failure; autoimmune	Fatigue; hypotension; hypoglycemia

Musculoskeletal System

The musculoskeletal system provides structure, support, and enables movement. Bones form the skeleton; muscles contract to move joints. Three muscle types: skeletal (voluntary), cardiac (heart), smooth (involuntary). Joints connect bones; ligaments stabilize joints; tendons attach muscles to bones.

Key Structures & Organs:

Skeletal Muscles, Bones, Joints, Tendons, Ligaments, Cartilage

Structure-Function-Clinical Significance:

Structure	Function	Clinical Significance
Skeletal Muscle	Voluntary contraction via motor neurons (myofibrils)	Myasthenia gravis; muscle dystrophy
Long Bone	Diaphysis (shaft), epiphysis (ends); bone ossification	Osteoporosis; fractures
Synovial Joint	Movable joint; synovial fluid lubrication	Osteoarthritis; rheumatoid arthritis
Tendon	Connects muscle to bone; transmits force	Tendinitis; rupture

NEET Frequently Asked Facts:

- Muscle contraction: A band (thick filament), I band (thin filament), Z disk (boundary); sarcomere shortest unit
- Myofilaments: thick (myosin heads pull thin), thin (actin-tropomyosin-troponin); cross-bridge cycle
- ATP role: myosin head power stroke, detachment from actin, calcium pump, excitation-contraction coupling
- 206 bones in adult; compact (dense) and spongy (trabecular) bone; osteocytes maintain bone matrix
- Bone remodeling: osteoblasts (formation), osteoclasts (resorption); balanced in healthy bone

Common Disorders:

Disorder	Cause	Symptoms
Osteoporosis	Bone density loss; estrogen deficiency; Calcium deficiency	Fractures; height loss
Rheumatoid Arthritis	Autoimmune synovial inflammation	Joint pain; swelling; deformity
Muscular Dystrophy	Genetic protein deficiency (dystrophin)	Progressive muscle weakness

Reproductive System

The reproductive system produces gametes and enables sexual reproduction. Males: testes produce sperm in seminiferous tubules; prostate, seminal vesicles, bulbourethral glands add secretions. Females: ovaries produce eggs; fallopian tubes transport ovum; uterus supports embryo; vagina is birth canal.

Key Structures & Organs:

Testes, Prostate, Seminal Vesicles, Ovaries, Fallopian Tubes, Uterus, Vagina

Structure-Function-Clinical Significance:

Structure	Function	Clinical Significance
Testes	Sperm production (spermatogenesis); testosterone secretion	Infertility, testicular cancer
Ovaries	Oocyte maturation; estrogen & progesterone secretion	Ovarian cysts; PCOS
Fallopian Tube	Transports ovum; site of fertilization	Ectopic pregnancy; blockage
Uterus	Implantation site; fetal development; contractions during labor	Fibroids, cancer

NEET Frequently Asked Facts:

- Spermatogenesis: 74 days in seminiferous tubules; diploid (2n) → haploid (n) spermatozoa; 200-300 million/day
- Oogenesis: 20 years puberty to menopause; primary oocyte (arrested prophase I) → secondary oocyte (arrests metaphase II)
- Menstrual cycle: follicular phase (0-14 days, estrogen rise), ovulation (day 14, LH surge), luteal phase (14-28 days, progesterone)
- Fertilization: cortical reaction prevents polyspermy; sperm nucleus fuses with egg nucleus in metaphase II
- Implantation: blastocyst (day 5-6) embeds in endometrium; trophoblast forms placenta; pregnancy maintained by hCG

Common Disorders:

Disorder	Cause	Symptoms
Infertility	Low sperm count; ovulation failure; blocked tubules	Inability to conceive after 1 year
Endometriosis	Ectopic endometrial tissue	Pelvic pain; heavy bleeding
Prostate Cancer	Malignant epithelial cells	Urinary symptoms; PSA elevation

Immune System

The immune system defends against pathogens through innate and adaptive immunity. Innate immunity: physical barriers, phagocytes, complement. Adaptive immunity: T cells (cell-mediated), B cells (antibody-mediated). Lymph nodes, spleen, thymus, bone marrow are lymphoid organs.

Key Structures & Organs:

Lymph Nodes, Spleen, Thymus, Bone Marrow, Lymphocytes

Structure-Function-Clinical Significance:

Structure	Function	Clinical Significance
Neutrophil	Innate; first responder; phagocytosis of bacteria	Leukocyte deficiency if low
T Cell	Adaptive; cell-mediated; cytotoxic and helper types	Leukemia; T cell lymphoma
B Cell	Adaptive; antibody production; memory formation	Leukemia; hypogammaglobulinemia
Antibody (IgG)	Opsonization; neutralization; complement activation	Autoimmune disease

NEET Frequently Asked Facts:

- Innate immunity: non-specific; includes physical barriers (skin), chemical (acid, lysozyme), cellular (macrophages, neutrophils)
- Adaptive immunity: specific antigen recognition; lag time 3-5 days; memory response faster on re-exposure
- T cells: CD4+ (helper, IL-2 secretion), CD8+ (cytotoxic, perforin/granzyme), regulatory T cells (immune tolerance)
- Antibodies: 5 classes (IgA-gut, IgD-B cell marker, IgE-allergy, IgG-circulation, IgM-first responder); Y-shaped; Fab-variable, Fc-constant
- Complement: 9 main proteins; cascade activation; opsonization (C3b), cytolysis (C5-9 membrane attack complex)

Common Disorders:

Disorder	Cause	Symptoms
HIV/AIDS	Retrovirus destroys CD4+ T cells	Opportunistic infections; immunodeficiency
Autoimmune Lupus	Antibodies to nuclear antigens	Rash; arthritis; kidney involvement
Anaphylaxis	IgE-mediated mast cell/basophil degranulation	Severe allergic reaction; shock

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