

NEET (UG) · CLASS 11 & 12 · FREE E-BOOK

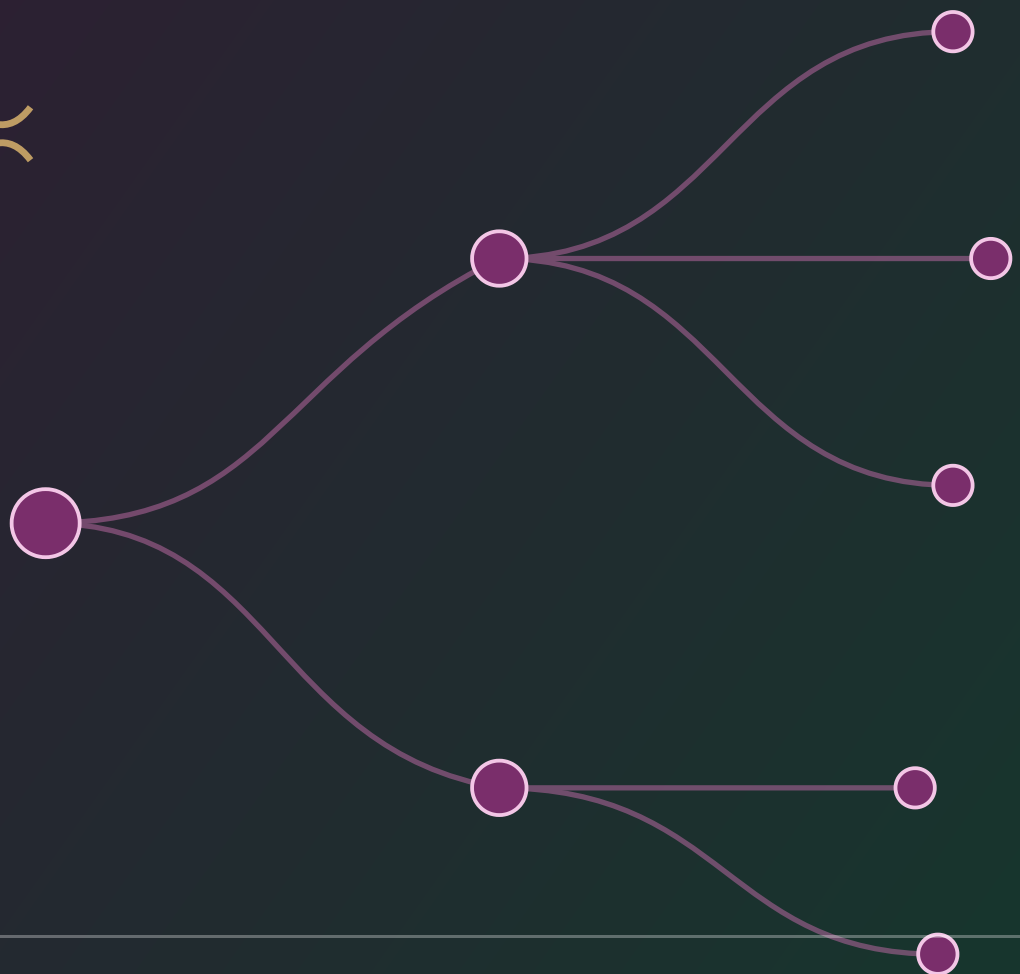
Mind Mapping Biology

One keyword mind map for every NCERT chapter:
the whole syllabus in quick-revision form

32 Chapters

NCERT Sequence

Free E-book



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How to use this book

1. One page, one chapter. The dark pill is the chapter; each card is one branch. Read a card, close your eyes and recall its keywords.

2. Keywords, not paragraphs. Each line is a hook for an NCERT idea. If a keyword does not bring back the idea, re-read that part of NCERT.

3. Use it daily. Revise 3 to 4 chapters a day; the whole syllabus goes round in about 10 days.

4. Red box. One-line facts and traps. Revise this box on the last day before the exam.

Mind Mapping Biology for NEET (UG), Class 11 and 12

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Every fact in this book has been checked against the current NCERT Biology textbooks for Class 11 and 12. Chapter numbering follows the rationalised NCERT syllabus.

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Contents

Part A · Class 11

1	The Living World
2	Biological Classification
3	Plant Kingdom
4	Animal Kingdom
5	Morphology of Flowering Plants
6	Anatomy of Flowering Plants
7	Structural Organisation in Animals
8	Cell: The Unit of Life
9	Biomolecules
10	Cell Cycle and Cell Division
11	Photosynthesis in Higher Plants
12	Respiration in Plants
13	Plant Growth and Development
14	Breathing and Exchange of Gases
15	Body Fluids and Circulation
16	Excretory Products and their Elimination
17	Locomotion and Movement
18	Neural Control and Coordination
19	Chemical Coordination and Integration

Part B · Class 12

1	Sexual Reproduction in Flowering Plants
2	Human Reproduction
3	Reproductive Health
4	Principles of Inheritance and Variation
5	Molecular Basis of Inheritance
6	Evolution
7	Human Health and Disease
8	Microbes in Human Welfare
9	Biotechnology: Principles and Processes
10	Biotechnology and its Applications
11	Organisms and Populations
12	Ecosystem
13	Biodiversity and Conservation



PART A

Class 11

Chapters in NCERT sequence

The Living World

Life, naming and ranking of organisms.

MIND MAP · The Living World

The Living World

What is living?

- Growth (also in crystals; not defining)
- Reproduction (absent in mules; not defining)
- **Metabolism**: defining
- **Consciousness (sensing surroundings)**: defining
- **Cellular organisation**: defining

Naming

- **Binomial nomenclature**: Linnaeus
- Genus (capital) + species (small), italics
- **Codes**: ICBN plants, ICZN animals
- **Example**: *Mangifera indica*, *Homo sapiens*

Taxonomy

- Characterisation → identification → nomenclature → classification
- Systematics adds evolutionary relationships

Hierarchy

- Kingdom → Phylum/Division → Class → Order → Family → Genus → Species
- **Upwards**: fewer common characters
- **Species**: basic unit

NEET Traps & Quick Recall

- Housefly: *Musca domestica*, family Muscidae, order Diptera, class Insecta.
- Man: order Primata, family Hominidae.
- Wheat: family Poaceae, order Poales.
- Lowest category = species; highest = kingdom.

Biological Classification

Five kingdoms, viruses, viroids, prions and lichens.

MIND MAP · Biological Classification

Five Kingdoms (Whittaker 1969)

Monera

- Prokaryotes; peptidoglycan wall
- **Archaeobacteria**: methanogens, halophiles, thermoacidophiles
- **Cyanobacteria**: Nostoc, Anabaena (heterocysts)
- **Mycoplasma**: no wall, smallest cells

Protista

- Single-celled eukaryotes
- Diatoms (silica walls, diatomaceous earth)
- **Dinoflagellates**: red tide (Gonyaulax)
- **Euglenoids**: pellicle; mixotrophic
- **Protozoans**: Amoeba, Trypanosoma, Paramecium, Plasmodium

Fungi

- Chitin wall; heterotrophs
- **Phycomycetes**: Rhizopus, Mucor, Albugo
- **Ascomycetes**: yeast, Penicillium, Neurospora
- **Basidiomycetes**: mushroom, rusts, smuts
- **Deuteromycetes**: Alternaria, Trichoderma (no sexual stage known)

Plantae and Animalia

- **Plantae**: chlorophyll, cellulose wall
- **Animalia**: no wall, holozoic, glycogen store

Non-cellular

- **Virus**: protein coat + DNA or RNA
- **Viroid**: free RNA (potato spindle tuber)
- **Prion**: misfolded protein (mad cow disease)
- **Lichen**: alga + fungus; pollution indicator

NEET Traps & Quick Recall

- TMV: Ivanowsky discovered virus; Beijerinck called it "contagium vivum fluidum".
- Bacteriophages usually have double-stranded DNA.
- Red tide is caused by dinoflagellates.
- Imperfect fungi = deuteromycetes.

Plant Kingdom

Algae to angiosperms and life cycles.

MIND MAP · Plant Kingdom

Plant Kingdom

Algae

- **Green:** Chlamydomonas, Volvox, Spirogyra (starch)
- **Brown:** Laminaria, Sargassum, Fucus (laminarin, mannitol)
- **Red:** Polysiphonia, Gracilaria (floridean starch)
- Agar from Gelidium, Gracilaria

Bryophytes

- Amphibians of plant kingdom
- Gametophyte dominant; no vascular tissue
- **Liverworts:** Marchantia (gemmae)
- **Mosses:** Funaria, Sphagnum (peat)

Pteridophytes

- First vascular land plants
- Sporophyte dominant
- **Selaginella, Salvinia:** heterosporous
- **Ferns:** Dryopteris, Pteris, Adiantum

Gymnosperms

- Naked seeds
- **Cycas:** coralloid roots; Pinus: mycorrhiza
- Endosperm haploid

Angiosperms

- Seeds in fruit; double fertilisation
- Endosperm triploid
- Dicots and monocots

Life cycles

- **Haplontic:** Volvox, Spirogyra
- **Diplontic:** seed plants, Fucus
- **Haplo-diplontic:** bryophytes, pteridophytes, Ectocarpus

NEET Traps & Quick Recall

- Chlorella: protein-rich food supplement, used even by space travellers.
- Mosses with lichens colonise bare rock first.
- Heterospory leads towards seed habit.
- Wolffia: smallest angiosperm.

Animal Kingdom

Basis of classification and phyla from Porifera to Chordata.

MIND MAP · Animal Kingdom

Animal Kingdom

Basis

- **Level:** cellular → tissue → organ → organ system
- **Symmetry:** none, radial, bilateral
- **Germ layers:** diplo- or triploblastic
- **Coelom:** acoelomate, pseudo-, true

Lower phyla

- **Porifera:** canal system, choanocytes
- **Cnidaria:** cnidoblasts, polyp/medusa
- **Ctenophora:** comb plates, bioluminescence
- **Platyhelminthes:** flame cells; Taenia, Fasciola
- **Aschelminthes:** pseudocoelom; Ascaris

Higher non-chordates

- **Annelida:** metamerous, nephridia; earthworm, leech
- **Arthropoda:** largest phylum, jointed legs
- **Mollusca:** mantle, radula; Pila, Octopus
- **Echinodermata:** water vascular system; starfish
- **Hemichordata:** Balanoglossus

Chordata

- Notochord, dorsal hollow nerve cord, gill slits
- **Cyclostomes:** lamprey, hagfish (jawless)
- **Fishes:** cartilaginous (shark) and bony (rohu)
- **Amphibia:** frog, toad, Ichthyophis
- **Reptilia:** snakes, lizards, crocodile (4-chambered heart)
- **Aves:** feathers, air sacs
- **Mammalia:** hair, mammary glands

NEET Traps & Quick Recall

- Metagenesis: Obelia.
- Platypus: egg-laying mammal.
- Water vascular system: only echinoderms.
- Flying fish (Exocoetidae) and sea horse (Hippocampus) are bony fishes.

Morphology of Flowering Plants

Root, stem, leaf, flower, fruit, seed and three families.

MIND MAP · Morphology of Flowering Plants

Flowering Plant Morphology

Root

- Tap (dicots), fibrous (monocots), adventitious
- Storage:** carrot, turnip, sweet potato
- Prop (banyan), stilt (maize), pneumatophores (Rhizophora)

Stem

- Nodes, internodes, buds
- Tuber (potato), rhizome (ginger), corm (Colocasia)
- Tendrils (grape), thorn (Bougainvillea), phylloclade (Opuntia)
- Runner, stolon, offset, sucker

Leaf

- Venation:** reticulate / parallel
- Simple / compound (pinnate neem, palmate silk cotton)
- Phyllotaxy:** alternate, opposite, whorled
- Tendrils (pea), spine (cactus), pitcher plant

Flower

- Actinomorphic / zygomorphic
- Hypo-, peri-, epigynous
- Aestivation:** valvate, twisted, imbricate, vexillary
- Placentation:** marginal, axile, parietal, free central, basal

Fruit and seed

- Mango, coconut:** drupe
- Maize seed:** endosperm, scutellum, coleoptile

Families

- Fabaceae:** pea flower, diadelphous stamens, legume
- Solanaceae:** swollen placenta, berry
- Liliaceae:** 6 tepals, trilocular ovary

NEET Traps & Quick Recall

- Pea: vexillary aestivation, marginal placentation.
- Mustard: parietal placentation; sunflower: basal.
- Edible part of coconut: endosperm.
- Colchicine comes from Colchicum (Liliaceae).

Anatomy of Flowering Plants

Tissues and internal structure of root, stem and leaf.

MIND MAP · Anatomy of Flowering Plants

Plant Anatomy

Meristems

- **Apical:** length
- **Intercalary:** grasses
- **Lateral:** girth (cambium)

Simple tissues

- **Parenchyma:** living, storage
- **Collenchyma:** corner thickening
- **Sclerenchyma:** dead, lignified

Complex tissues

- **Xylem:** tracheids, vessels, fibres, parenchyma
- **Phloem:** sieve tubes, companion cells
- Endarch (stem) vs exarch (root)

Root

- Radial bundles
- **Dicot:** 2–4 xylem; monocot: polyarch
- Endodermis with Casparian strips

Stem

- **Dicot:** bundles in ring, open
- **Monocot:** scattered, closed, sclerenchymatous sheath

Leaf

- **Dicot:** palisade + spongy
- **Monocot:** undifferentiated mesophyll, bulliform cells

NEET Traps & Quick Recall

- Gymnosperms lack vessels.
- Stomata: bean-shaped (dicot), dumb-bell (grass).
- Lateral roots arise from pericycle.
- Bulliform cells help leaves roll in water stress.

Structural Organisation in Animals

Animal tissues and the frog.

MIND MAP · Structural Organisation in Animals

Animal Tissues and Frog

Epithelium

- **Squamous:** blood vessels, alveoli
- **Cuboidal:** gland ducts, kidney tubules
- **Columnar:** gut lining
- **Ciliated:** bronchioles, Fallopian tube
- **Compound:** skin, mouth

Connective

- Areolar, adipose
- Tendon, ligament
- Cartilage, bone, blood

Muscle

- **Skeletal:** striated, voluntary
- **Smooth:** unstriated, involuntary
- **Cardiac:** striated, involuntary, intercalated discs

Nerve

- Neurons + neuroglia

Frog

- Cold-blooded; hibernation and aestivation
- Skin breathing in water
- 3-chambered heart
- Ureotelic; tadpole stage

NEET Traps & Quick Recall

- Tendon joins muscle to bone; ligament joins bone to bone.
- Gap junctions let ions pass between cells.
- Frog never drinks water; absorbs it through skin.
- Neuroglia make up more than half of neural tissue.

Cell: The Unit of Life

Cell theory, cell types and organelles.

MIND MAP · Cell: The Unit of Life

The Cell

Cell theory

- Schleiden, Schwann
- **Virchow:** cells from pre-existing cells

Prokaryote

- Nucleoid, plasmid, mesosome
- 70S ribosome
- Gram +ve / -ve

Membranes

- **Fluid mosaic:** Singer and Nicolson
- Diffusion, osmosis, active transport

Endomembrane system

- ER (rough, smooth)
- **Golgi:** packaging
- **Lysosome:** digestion
- **Vacuole:** tonoplast

Energy organelles

- **Mitochondria:** respiration; own DNA
- **Chloroplast:** photosynthesis; own DNA
- 80S cytoplasmic ribosomes in eukaryotes

Other parts

- **Cilia/flagella:** 9+2
- **Centriole:** 9 triplets
- **Nucleus:** nucleolus, chromatin
- **Chromosomes:** metacentric to telocentric

NEET Traps & Quick Recall

- Mycoplasma: smallest cell (0.3 μm).
- Ostrich egg: largest single cell.
- Centrioles absent in higher plants.
- Mitochondria and chloroplasts are semi-autonomous.

Biomolecules

Small molecules, macromolecules and enzymes.

MIND MAP · Biomolecules

Biomolecules

Analysis

- **Acid-soluble pool:** small molecules
- **Acid-insoluble:** proteins, nucleic acids, polysaccharides, lipids

Small molecules

- **Amino acids:** 20; zwitterion
- Fatty acids, glycerol, phospholipids (lecithin)
- Nucleotide = base + sugar + phosphate

Proteins

- Peptide bonds
- Primary → secondary → tertiary → quaternary
- **Collagen:** most abundant in animals
- **RuBisCO:** most abundant on earth

Polysaccharides

- **Starch:** helix, blue with iodine
- **Cellulose:** no blue colour
- Glycogen (animals), inulin (fructose), chitin

Enzymes

- Active site; lower activation energy
- Optimum temperature and pH
- **Competitive inhibition:** malonate vs succinate
- **Cofactors:** prosthetic group, coenzyme, metal ion
- **Six classes:** oxidoreductase, transferase, hydrolase, lyase, isomerase, ligase

NEET Traps & Quick Recall

- Ribozymes: RNA enzymes.
- Lipids are not strictly macromolecules (small, form vesicles).
- Haem is the prosthetic group of peroxidase and catalase.
- Zinc is a cofactor of carboxypeptidase.

Cell Cycle and Cell Division

Interphase, mitosis and meiosis.

MIND MAP · Cell Cycle and Cell Division

Cell Cycle

Interphase

- **G₁**: growth
- **S**: DNA doubles (2C → 4C)
- **G₂**: prepares for division
- **G₀**: quiescent

Mitosis

- **Prophase**: condensation
- **Metaphase**: plate; best to count chromosomes
- **Anaphase**: chromatids separate
- **Telophase**: nuclei reform
- **Cytokinesis**: furrow (animal), cell plate (plant)

Meiosis I

- Leptotene → zygotene (synapsis) → pachytene (crossing over) → diplotene (chiasmata) → diakinesis
- Homologues separate

Meiosis II

- Like mitosis
- Four haploid cells

Significance

- **Mitosis**: growth, repair, same genes
- **Meiosis**: halves number, variation

NEET Traps & Quick Recall

- Human cell cycle ≈ 24 h; yeast ≈ 90 min.
- Coconut liquid endosperm: free nuclear (syncytium).
- Crossing over needs recombinase, at pachytene.
- Diplotene can last months or years in oocytes.

Photosynthesis in Higher Plants

Light reaction, Calvin cycle, C_4 and photorespiration.

MIND MAP · Photosynthesis

Photosynthesis

History

- **Priestley**: plants restore air
- **Ingenhousz**: needs sunlight
- **Sachs**: glucose, starch
- **Engelmann**: action spectrum (Cladophora)
- **Van Niel**: O_2 comes from water

Pigments

- **Chlorophyll a**: main
- **Chlorophyll b, xanthophylls, carotenoids**: accessory

Light reaction

- PS II (P680), PS I (P700)
- Water splits at PS II
- **Z-scheme**: ATP + NADPH
- **Cyclic**: only ATP
- **Chemiosmosis**: ATP synthase

Calvin cycle

- Carboxylation (RuBisCO) → reduction → regeneration
- First product 3-PGA
- 18 ATP + 12 NADPH per glucose

C_4 plants

- Hatch–Slack; first product OAA
- Kranz anatomy
- Maize, sugarcane, sorghum

Photorespiration and factors

- RuBisCO binds O_2 in C_3 plants
- No ATP made; wasteful
- **Blackman**: law of limiting factors
- **CO_2** : major limiting factor

NEET Traps & Quick Recall

- C_4 plants lack photorespiration.
- PEPcase is the CO_2 fixer in C_4 mesophyll.
- Light saturation at about 10% of full sunlight.
- Light reaction in grana; dark reaction in stroma.

Respiration in Plants

Glycolysis, fermentation, Krebs cycle and ETS.

MIND MAP · Respiration in Plants

Respiration

Glycolysis

- Cytoplasm; EMP pathway
- Glucose → 2 pyruvate
- Net 2 ATP + 2 NADH

Fermentation

- **Yeast:** ethanol + CO₂
- **Muscle:** lactic acid
- Yeast dies at ~13% alcohol

Link reaction

- Pyruvate → acetyl CoA
- Pyruvate dehydrogenase

Krebs cycle

- Mitochondrial matrix
- Citric acid first product
- **Per turn:** 3 NADH, 1 FADH₂, 1 GTP

ETS

- Inner mitochondrial membrane
- Complex I-IV; ATP synthase (V)
- **O₂:** final acceptor
- NADH = 3 ATP; FADH₂ = 2 ATP

RQ

- Carbohydrate 1; fat ~0.7; protein ~0.9
- **Anaerobic:** infinite

NEET Traps & Quick Recall

- Net 38 ATP per glucose (theoretical).
- Respiration is amphibolic (breakdown and synthesis).
- Hexokinase: first enzyme of glycolysis.
- Cytochrome c oxidase has copper centres.

Plant Growth and Development

Growth, differentiation and plant hormones.

MIND MAP · Plant Growth and Development

Plant Growth

Growth

- Open, indeterminate
- Phases:** meristematic, elongation, maturation
- Arithmetic (linear) and geometric (sigmoid) growth

Differentiation

- Dedifferentiation → redifferentiation
- Plasticity:** heterophylly (cotton, buttercup)

Auxins

- IAA, NAA, 2,4-D
- Rooting, apical dominance, parthenocarpy

Gibberellins

- Bakanae disease (rice)
- Stem elongation, bolting, malting

Cytokinins

- Kinetin, zeatin
- Cell division, delay senescence

Ethylene

- Gas; fruit ripening
- Ethephon

ABA

- Stress hormone
- Stomatal closure, dormancy

NEET Traps & Quick Recall

- 2,4-D: weedicide for dicot weeds.
- GA increases sugarcane yield.
- Decapitation breaks apical dominance (tea, hedges).
- ABA antagonises GA.

Breathing and Exchange of Gases

Respiratory system, volumes, gas transport and control.

MIND MAP · Breathing and Exchange of Gases

Breathing

Pathway

- Nostrils → pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- Epiglottis guards larynx
- Pleura around lungs

Mechanism

- **Inspiration:** diaphragm and external intercostals contract
- **Expiration:** muscles relax
- 12–16 breaths/min

Volumes

- TV 500 mL
- IRV 2500–3000 mL
- ERV 1000–1100 mL
- RV 1100–1200 mL
- $VC = TV + IRV + ERV$

Exchange

- Alveolar pO_2 104, pCO_2 40 mm Hg
- Diffusion membrane < 1 mm
- CO_2 20–25× more soluble than O_2

Transport

- O_2 : 97% as oxyhaemoglobin
- CO_2 : 70% bicarbonate, 20–25% carbamino
- Carbonic anhydrase

Control and disorders

- **Rhythm centre:** medulla; pneumotaxic: pons
- Asthma, emphysema, occupational dust

NEET Traps & Quick Recall

- O_2 dissociation curve is sigmoid.
- Residual volume is not measured by spirometer.
- Low pCO_2 and H^+ favour oxyhaemoglobin formation.
- Smoking is a major cause of emphysema.

Body Fluids and Circulation

Blood, lymph, heart, cardiac cycle and ECG.

MIND MAP · Body Fluids and Circulation

Circulation

Blood

- Plasma 55%
- RBC**: 5–5.5 million/mm³; 120 days
- WBC**: neutrophils most, basophils least
- Platelets**: clotting

Groups

- ABO**: O donor, AB recipient
- Rh**: erythroblastosis foetalis

Clotting

- Thrombokinas → thrombin → fibrin
- Ca²⁺ needed

Heart

- 4 chambers
- Tricuspid (right), bicuspid (left)
- SAN pacemaker → AVN → bundle of His → Purkinje

Cardiac cycle

- 0.8 s; 72 beats/min
- Stroke volume 70 mL; output 5 L/min
- Lub (AV valves close), dub (semilunar valves close)

ECG and disorders

- P**: atrial depolarisation; QRS: ventricular; T: repolarisation
- Hypertension ≥ 140/90
- Angina, heart failure, atherosclerosis

NEET Traps & Quick Recall

- Lymph has no RBCs.
- Double circulation: pulmonary + systemic.
- Hepatic portal vein carries blood from intestine to liver.
- Spleen: graveyard of RBCs.

Excretory Products and their Elimination

Nitrogen wastes, nephron, urine formation and regulation.

MIND MAP · Excretion

Excretion

Wastes

- **Ammonotelic:** bony fish
- **Ureotelic:** mammals
- **Uricotelic:** birds, reptiles, insects

Organs in animals

- **Flame cells:** flatworms
- **Nephridia:** earthworm
- **Malpighian tubules:** insects
- **Green glands:** prawn

Nephron

- Glomerulus + Bowman's capsule
- PCT → loop of Henle → DCT → collecting duct
- Cortical vs juxtamedullary

Urine formation

- **Filtration:** GFR 125 mL/min (180 L/day)
- **Reabsorption:** 99%
- **Secretion:** H^+ , K^+ , NH_3

Concentration

- **Counter-current:** loop of Henle + vasa recta
- Medulla up to 1200 mOsm/L

Regulation

- **ADH:** water reabsorption
- **RAAS:** renin → angiotensin II → aldosterone
- **ANF:** opposes RAAS

NEET Traps & Quick Recall

- Descending limb: permeable to water; ascending limb: impermeable.
- Uremia → haemodialysis.
- Glycosuria and ketonuria: diabetes mellitus.
- Lungs, liver and skin also excrete.

Locomotion and Movement

Movement, muscle contraction, skeleton and joints.

MIND MAP · Locomotion and Movement

Locomotion

Movement types

- Amoeboid, ciliary, muscular

Muscle

- Sarcomere:** Z-line to Z-line
- A-band (myosin), I-band (actin)
- Ca^{2+} binds troponin
- Sliding filament:** I-band shortens, A-band same

Skeleton

- 206 bones
- Axial 80, appendicular 126
- Vertebrae:** 7 cervical, 12 thoracic, 5 lumbar, sacrum, coccyx
- Ribs:** 12 pairs; true 7, false 3, floating 2

Joints

- Fibrous:** skull sutures
- Cartilaginous:** vertebrae
- Synovial:** ball-and-socket, hinge, pivot, gliding, saddle

Disorders

- Myasthenia gravis:** autoimmune
- Muscular dystrophy
- Tetany:** low Ca^{2+}
- Arthritis, gout, osteoporosis

NEET Traps & Quick Recall

- Atlas-axis: pivot joint; knee: hinge; thumb: saddle.
- Red muscle fibres: myoglobin, aerobic.
- Femur: longest bone; stapes: smallest.
- Myosin head has ATPase activity.

Neural Control and Coordination

Neuron, impulse, synapse and brain.

MIND MAP · Neural Control and Coordination

Neural Control

Neuron

- Cyton (Nissl's granules), dendrites, axon
- Multipolar, bipolar, unipolar
- **Myelinated**: nodes of Ranvier

System

- **CNS**: brain + spinal cord
- **PNS**: somatic + autonomic
- **Autonomic**: sympathetic + parasympathetic

Impulse

- **Resting**: inside negative
- **Na⁺ in**: depolarisation
- **K⁺ out**: repolarisation
- **Na⁺/K⁺ pump**: 3 out, 2 in

Synapse

- **Electrical**: fast, rare
- **Chemical**: neurotransmitter (acetylcholine)

Brain

- **Forebrain**: cerebrum, thalamus, hypothalamus
- **Midbrain**: corpora quadrigemina
- **Hindbrain**: pons, cerebellum, medulla
- Corpus callosum joins hemispheres

NEET Traps & Quick Recall

- Medulla: breathing, heart reflexes.
- Cerebellum: balance.
- Hypothalamus: temperature, hunger, thirst.
- Limbic system: emotions.

MIND MAP · Chemical Coordination

Hormones

Hypothalamus

- GnRH, somatostatin
- Controls pituitary

Pituitary

- **Anterior:** GH, PRL, TSH, ACTH, LH, FSH
- **Posterior:** oxytocin, ADH (made in hypothalamus)

Pineal and thyroid

- **Pineal:** melatonin (sleep–wake)
- **Thyroid:** T_3 , T_4 (BMR); calcitonin

Parathyroid and thymus

- **PTH:** raises blood Ca^{2+}
- **Thymus:** thymosins; T-cells

Adrenal

- **Medulla:** adrenaline (fight or flight)
- **Cortex:** cortisol, aldosterone

Pancreas

- **α :** glucagon (raises sugar)
- **β :** insulin (lowers sugar)

Gonads and others

- **Testis:** testosterone
- **Ovary:** oestrogen, progesterone
- **Heart:** ANF; kidney: erythropoietin
- **Gut:** gastrin, secretin, CCK, GIP

NEET Traps & Quick Recall

- Excess GH: gigantism (child), acromegaly (adult).
- Low ADH: diabetes insipidus.
- Iodine deficiency: goitre; Graves' disease: exophthalmic goitre.
- Steroid hormones act on intracellular receptors.



PART B

Class 12

Chapters in NCERT sequence

Sexual Reproduction in Flowering Plants

Flower, gametophytes, pollination and double fertilisation.

MIND MAP · Sexual Reproduction in Flowering Plants

Plant Reproduction

Male side

- **Anther:** 4 microsporangia
- **Wall:** epidermis, endothecium, middle layers, tapetum
- **Pollen:** exine (sporopollenin), intine, germ pores
- Vegetative cell + generative cell

Female side

- **Ovule:** funicle, integuments, micropyle, nucellus
- Megaspore mother cell → 4 megaspores, 1 survives
- **Embryo sac:** 7 cells, 8 nuclei
- **Egg apparatus:** egg + 2 synergids

Pollination

- Autogamy, geitonogamy, xenogamy
- **Cleistogamy:** Viola, Oxalis, Commelina
- **Wind:** maize; water: Vallisneria; insects: most

Outbreeding devices

- Timing difference
- Position difference
- Self-incompatibility
- Unisexual flowers

Double fertilisation

- **Syngamy:** zygote ($2n$)
- **Triple fusion:** PEN ($3n$)

After fertilisation

- Endosperm before embryo
- Ovule → seed; ovary → fruit
- Apomixis, polyembryony, parthenocarpy

NEET Traps & Quick Recall

- Sporopollenin: most resistant organic material.
- Filiform apparatus guides the pollen tube.
- Coconut water: free-nuclear endosperm.
- False fruit: apple, strawberry, cashew.

Human Reproduction

Reproductive systems, gametogenesis, cycle and pregnancy.

MIND MAP · Human Reproduction

Human Reproduction

Male

- Testes in scrotum (2–2.5 °C cooler)
- **Seminiferous tubules:** sperm + Sertoli cells
- **Leydig cells:** testosterone
- Epididymis → vas deferens → urethra
- Seminal vesicles, prostate, bulbourethral glands

Female

- Ovaries
- **Oviduct:** infundibulum, ampulla, isthmus
- **Uterus:** endometrium, myometrium, perimetrium
- Cervix, vagina

Gametogenesis

- **Sperm:** puberty onwards, 4 per cell
- **Ovum:** begins before birth, 1 per cell
- **Ovulation:** secondary oocyte

Menstrual cycle

- Menstrual → follicular → ovulation (day 14, LH surge) → luteal
- **Corpus luteum:** progesterone

Fertilisation

- In ampulla
- Morula → blastocyst → implantation

Pregnancy and birth

- **Placenta:** hCG, hPL, progesterone
- **Oxytocin:** labour
- **Colostrum:** IgA

NEET Traps & Quick Recall

- Sperm head has acrosome; middle piece has mitochondria.
- Father's sperm decides sex of baby.
- Heart forms after one month of pregnancy.
- Menopause around 50 years.

Reproductive Health

Population, contraception, MTP, STIs and ART.

MIND MAP · Reproductive Health

Reproductive Health

Programmes

- Family planning 1951 (India first)
- RCH programme
- Amniocentesis ban for sex test

Natural methods

- Periodic abstinence (days 10–17)
- Withdrawal
- Lactational amenorrhoea (6 months)

Barriers and IUDs

- Condoms, diaphragms, cervical caps
- CuT, Cu7, Multiload 375
- Progestasert, LNG-20

Hormonal and surgical

- Pills; Saheli (weekly)
- Injections, implants
- **Emergency:** within 72 h
- Vasectomy, tubectomy

MTP and STIs

- MTP legal 1971, amended 2017
- Safe in first trimester
- **STIs:** gonorrhoea, syphilis, herpes, HIV, hepatitis B

Infertility help

- IVF-ET (test tube baby)
- ZIFT (≤ 8 blastomeres), IUT (> 8)
- GIFT, ICSI, IUI

NEET Traps & Quick Recall

- Copper ions reduce sperm motility.
- Hepatitis B, herpes and HIV are not fully curable.
- Saheli: CDRI Lucknow.
- STIs are common in 15–24 year age group.

Principles of Inheritance and Variation

Mendel, deviations, linkage, sex determination and disorders.

MIND MAP · Principles of Inheritance and Variation

Inheritance

Mendel

- Pea; 7 traits
- Monohybrid 3:1 (1:2:1)
- Dihybrid 9:3:3:1
- Test cross 1:1

Laws

- Dominance
- Segregation
- Independent assortment

Deviations

- **Incomplete dominance:** snapdragon 1:2:1
- **Codominance:** ABO
- **Multiple alleles:** I^A , I^B , i
- **Pleiotropy:** phenylketonuria
- **Polygenic:** skin colour

Chromosome theory

- Sutton and Boveri
- **Morgan:** Drosophila, linkage
- **Sturtevant:** gene maps

Sex determination

- **XO:** grasshopper
- **XY:** humans
- **ZW:** birds (female ZW)
- **Bees:** haplodiploid

Disorders

- **Haemophilia, colour blindness:** X-linked recessive
- **Sickle-cell:** Glu → Val
- Down (21 trisomy), Klinefelter (XXY), Turner (XO)

NEET Traps & Quick Recall

- Colour blindness: 8% males, 0.4% females.
- Thalassaemia: quantitative; sickle-cell: qualitative.
- Mendel's work rediscovered in 1900.
- Punnett square: Reginald Punnett.

Molecular Basis of Inheritance

DNA, replication, transcription, code, translation and genome.

MIND MAP · Molecular Basis of Inheritance

DNA and Gene Expression

DNA

- Watson–Crick 1953
- A = T, G = C (Chargaff)
- 3.4 nm pitch; 10 bp per turn
- **Nucleosome**: histone octamer + 200 bp

Proof

- **Griffith**: transformation
- **Avery et al.**: DNA is the principle
- **Hershey–Chase**: ^{32}P DNA enters bacteria

Replication

- **Semi-conservative**: Meselson–Stahl (^{15}N)
- 5' → 3' only
- Okazaki fragments; ligase

Transcription

- Template 3' → 5'
- **Bacteria**: σ start, ρ stop
- **Eukaryotes**: splicing, capping, tailing

Code and translation

- Triplet; 61 sense, 3 stop
- AUG start; degenerate, universal
- tRNA adapter; ribozyme peptidyl transferase

Regulation and genome

- **Lac operon**: z, y, a; lactose inducer
- HGP 1990–2003
- **DNA fingerprinting**: VNTR

NEET Traps & Quick Recall

- RNA was the first genetic material.
- Stop codons: UAA, UAG, UGA.
- Human haploid DNA $\approx 3.3 \times 10^9$ bp, length ≈ 2.2 m.
- Lac operon is under negative regulation.

Evolution

Origin of life, evidences, theories and human evolution.

MIND MAP · Evolution

Evolution

Origin

- **Oparin-Haldane:** chemical evolution
- **Miller:** amino acids from CH_4 , NH_3 , H_2 , water vapour

Evidences

- Fossils
- **Homologous:** divergent (forelimbs)
- **Analogous:** convergent (wings)
- **Peppered moth:** industrial melanism
- Antibiotic and pesticide resistance

Adaptive radiation

- Darwin's finches
- Australian marsupials

Theories

- **Lamarck:** use and disuse
- **Darwin:** natural selection
- **de Vries:** mutation (evening primrose)

Hardy-Weinberg

- $p^2 + 2pq + q^2 = 1$
- Changed by gene flow, drift, mutation, recombination, selection
- **Selection:** stabilising, directional, disruptive

Human evolution

- Dryopithecus, Ramapithecus
- Australopithecus
- Homo habilis (650–800 cc)
- Homo erectus (900 cc)
- Neanderthal (1400 cc)
- Homo sapiens (Africa)

NEET Traps & Quick Recall

- Thorn of Bougainvillea and tendril of Cucurbita: homologous.
- Eyes of octopus and mammals: analogous.
- Founder effect is a kind of genetic drift.
- Coelacanth: lobefin fish found in 1938.

Human Health and Disease

Diseases, immunity, AIDS, cancer and drugs.

MIND MAP · Human Health and Disease

Health and Disease

Diseases

- **Typhoid:** Salmonella typhi, Widal test
- **Pneumonia:** Streptococcus, Haemophilus
- **Common cold:** rhinovirus
- **Malaria:** Plasmodium, female Anopheles
- **Amoebiasis:** Entamoeba
- Ascariasis, filariasis (Wuchereria)
- **Ringworm:** Microsporum, Trichophyton, Epidermophyton

Innate immunity

- Physical, physiological, cellular, cytokine barriers
- Interferons

Acquired immunity

- **B-cells:** antibodies (humoral)
- **T-cells:** cell-mediated
- **Antibody:** H₂L₂
- Active vs passive

Immune problems

- **Allergy:** IgE, histamine
- **Autoimmunity:** rheumatoid arthritis
- **Lymphoid organs:** primary (bone marrow, thymus), secondary

AIDS and cancer

- **HIV:** retrovirus; kills helper T-cells; ELISA
- **Cancer:** lost contact inhibition; metastasis
- **Treatment:** surgery, radiation, chemotherapy, α-interferon

Drugs

- **Opioids:** heroin
- **Cannabinoids:** marijuana
- **Coca:** cocaine
- **Tobacco:** nicotine

NEET Traps & Quick Recall

- Haemozoin causes malarial fever.
- Gambusia fish eats mosquito larvae.
- Colostrum: IgA; placenta: IgG.
- World AIDS Day: 1 December.

Microbes in Human Welfare

Household, industrial, sewage, biogas, biocontrol and biofertiliser uses.

MIND MAP · Microbes in Human Welfare

Useful Microbes

Household

- **Lactobacillus**: curd, vitamin B₁₂
- **Yeast**: bread
- **Propionibacterium**: Swiss cheese holes

Industry

- **Saccharomyces**: ethanol, beer, wine
- **Penicillin**: Fleming
- **Citric acid**: Aspergillus niger
- **Acetic acid**: Acetobacter aceti

Medicines

- **Streptokinase**: clot buster
- **Cyclosporin A**: transplant (Trichoderma)
- **Statins**: cholesterol (Monascus)

Sewage

- **Primary**: physical
- **Secondary**: flocs, BOD falls
- **Sludge digester**: biogas

Biogas

- Methanogens (Methanobacterium)
- Gobar gas; IARI, KVIC

Farming

- **Bt**: caterpillars
- **Trichoderma**: fungal biocontrol
- **Baculoviruses**: species-specific
- Rhizobium, Azotobacter, Azospirillum
- Mycorrhiza (Glomus), cyanobacteria

NEET Traps & Quick Recall

- High BOD = high pollution.
- Lipases in detergents remove oily stains.
- Pectinases clarify fruit juices.
- Ladybird controls aphids.

Biotechnology: Principles and Processes

Tools and steps of recombinant DNA technology.

MIND MAP · Biotechnology: Principles and Processes

rDNA Technology

Founders

- Cohen and Boyer, 1972

Restriction enzymes

- Cut at palindromes
- **EcoRI**: GAATTC
- Sticky ends; ligase joins

Gel electrophoresis

- DNA to anode
- Small fragments go farther
- Ethidium bromide + UV

Vectors

- ori, selectable marker, cloning site
- **pBR322**: amp^R, tet^R
- Blue-white screening (lacZ)
- Ti plasmid, retroviruses

Getting DNA in

- CaCl₂ + heat shock
- Micro-injection
- Gene gun

Steps

- Isolate DNA → cut → PCR → ligate → transform → culture → extract
- **PCR**: denature, anneal, extend (Taq)
- Bioreactor; downstream processing

NEET Traps & Quick Recall

- Molecular scissors = restriction enzymes.
- Insertional inactivation identifies recombinants.
- Lysozyme, cellulase, chitinase break cell walls.
- DNA precipitates with chilled ethanol.

Biotechnology and its Applications

Bt crops, RNAi, insulin, gene therapy, diagnosis and ethics.

MIND MAP · Biotechnology and its Applications

Biotech Uses

Agriculture

- GM crops
- **Bt cotton**: cry genes
- **Golden rice**: vitamin A

RNAi

- dsRNA silences mRNA
- Tobacco protected from nematode

Medicine

- **Human insulin**: Eli Lilly 1983
- A and B chains joined by disulphide bonds

Gene therapy

- ADA deficiency, 1990
- Lymphocytes + functional gene

Diagnosis

- PCR, ELISA, probes

Transgenic animals

- Mostly mice
- **Rosie**: human α -lactalbumin milk

Ethics

- GEAC
- Biopiracy; basmati patent

NEET Traps & Quick Recall

- Bt toxin is an inactive protoxin until alkaline insect gut.
- cryIAc, cryIAb: cotton bollworm; cryIAb: corn borer.
- Over 95% of transgenic animals are mice.
- RNAi is a natural defence in eukaryotes.

Organisms and Populations

Population attributes, growth and interactions.

MIND MAP · Organisms and Populations

Populations

Attributes

- Birth rate, death rate
- Sex ratio
- Age pyramids:** expanding, stable, declining
- Density:** counts, pug marks, faecal pellets

Growth

- $N_{t+1} = N_t + [(B + I) - (D + E)]$
- Exponential:** J-curve, $dN/dt = rN$
- Logistic:** S-curve, carrying capacity K

Life history

- Breed once:** Pacific salmon, bamboo
- Many small vs few large offspring

Predation

- Cactus moth controlled prickly pear (Australia)
- Defences:** camouflage, poison, thorns
- Monarch butterfly tastes bad

Competition

- Gause's exclusion principle
- Balanus vs Chthamalus
- Resource partitioning:** MacArthur's warblers

Parasitism and others

- Brood parasitism:** koel
- Commensalism:** orchid on mango; egret and cattle
- Mutualism:** lichen, mycorrhiza, fig-wasp
- Sexual deceit:** Ophrys orchid

NEET Traps & Quick Recall

- Mutualism +/+; competition -/-; predation and parasitism +/-.
- Commensalism +/0; amensalism -/0.
- Logistic growth is more realistic.
- Abingdon tortoise died out after goats arrived.

MIND MAP · Ecosystem

Ecosystem

Structure

- Biotic + abiotic
- Stratification
- **Pond**: simple example

Productivity

- $GPP - \text{respiration} = NPP$
- **Secondary productivity**: consumers
- Biosphere NPP ~170 billion t/yr

Decomposition

- Fragmentation → leaching → catabolism → humification → mineralisation
- **Fast**: warm, moist, N-rich
- **Slow**: lignin, chitin, cold

Energy flow

- Plants catch 2–10% of PAR
- One-way flow
- 10% law (Lindeman)
- Grazing and detritus food chains

Pyramids

- Number, biomass, energy
- **Energy**: always upright
- **Biomass in sea**: inverted
- **Number on a tree**: inverted

NEET Traps & Quick Recall

- PAR is about half of incident sunlight.
- Humus is resistant and colloidal.
- Standing crop = mass at a trophic level.
- Earthworm: detritivore (fragmentation).

Biodiversity and Conservation

Patterns, loss and conservation of biodiversity.

MIND MAP · Biodiversity and Conservation

Biodiversity

Levels

- Genetic, species, ecological

Numbers

- > 1.5 million described
- ~7 million estimated (May)
- Insects:** 70% of animals
- India:** 2.4% land, 8.1% species; mega-diverse

Patterns

- More species near equator
- Species-area:** $\log S = \log C + Z \log A$
- Z:** 0.1–0.2 (regions), 0.6–1.2 (continents)

Why it matters

- Rivet popper hypothesis (Ehrlich)
- Tilman:** diverse plots more stable

Loss: evil quartet

- Habitat loss (main cause)
- Over-exploitation
- Alien species:** Nile perch, Parthenium, Lantana, water hyacinth
- Co-extinction

Conservation

- In situ:** hotspots (34; 3 in India), national parks, sanctuaries, biosphere reserves, sacred groves
- Ex situ:** zoos, botanical gardens, seed banks, cryopreservation
- Rio 1992; Johannesburg 2002

NEET Traps & Quick Recall

- Recent extinctions: dodo, quagga, thylacine, Steller's sea cow.
- Amazon: "lungs of the planet".
- Hotspots: < 2% of land, very high endemism.
- Sacred groves: Khasi and Jaintia hills, Aravalli, Western Ghats.

All the best for NEET!

Want more than keywords? **Road Maps in Biology for NEET (UG) and Class 11 and 12** by MTA Team covers the same 32 chapters with full road maps, process flowcharts, comparison tables and NEET traps:
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