LEP: 11TH BIOLOGY
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INDEX

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The Living World

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├── Characteristics of Living Organisms

| ├─ Growth

| ├─ Reproduction

| ├─ Metabolism

| ├─ Cellular organisation

| └─ Response to stimuli

|

├── Diversity of Life

| ├─ Need for classification

| ├─ Taxonomy → Classification + Nomenclature + Identification

| └─ Systematics → Relationships & Evolution

|

├── Nomenclature

| ├─ Binomial system (Genus + Species) – Carolus Linnaeus

| ├─ Rules → Italicised, Genus capitalised, Species small

| └─ Example: Homo sapiens

|

- Taxonomic Categories
  - Kingdom
  - Phylum / Division
  - Class
  - Order
  - Family
  - Genus
  - Species
- Tools for Study of Taxonomy
  - Herbarium
  - Botanical gardens
  - Museum
  - Zoological parks
  - Keys (dichotomous key)

Biological Classification

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├── Early Systems

| ├─ 2-Kingdom → Plantae, Animalia (Linnaeus)

| └─ Limitations → No distinction of prokaryotes/eukaryotes, unicellular/multicellular

|

├── 5-Kingdom System (Whittaker, 1969)

| ├─ Monera

| | ├─ Prokaryotes → Bacteria, Blue-green algae (cyanobacteria)

| | ├─ Cell wall with peptidoglycan

| | ├─ Modes → Autotrophs, Heterotrophs

| | └─ Archaebacteria (extremophiles)

| | ├─ Halophiles → salty areas

| | ├─ Thermoacidophiles → hot, acidic springs

| | └─ Methanogens → anaerobic swamps

| ├─ Protista

| | ├─ Unicellular, eukaryotic

| | ├─ Modes → Autotrophs (algae), Heterotrophs (protozoa)

| | └─ Examples → Amoeba, Paramecium, Euglena

| |

| ├─ Fungi

| | ├─ Heterotrophic → Saprophytes, parasites

| | ├─ Cell wall → Chitin

| | ├─ Reproduction → Asexual (spores), Sexual

| | └─ Examples → Yeast, Mushroom, Rhizopus

| |

| ├─ Plantae

| | ├─ Multicellular, autotrophic

| | ├─ Cell wall → Cellulose

| | └─ Photosynthesis


| └─ Animalia

| ├─ Multicellular, heterotrophic

| ├─ No cell wall

| └─ Locomotion & nervous system

|

├── 3-Domain System (Woese)

| ├─ Archaea

| ├─ Bacteria

| └─ Eukarya

|

└── Acellular Organisms

├─ Viruses → DNA/RNA inside protein coat

├─ Viroids → Infectious RNA without protein

└─ Prions → Infectious proteins (e.g., mad cow disease)

Plant Kingdom

|

├── Basis of Classification

| ├─ Thallus organisation

| ├─ Vascular tissue (xylem, phloem) presence

| ├─ Reproduction → Spore/Seed

| └─ Seed type → Naked (gymnosperm) / Covered (angiosperm), Mono/Dicot

|

├── Algae

| ├─ Characteristics → Simple thallus, chlorophyll, aquatic

| ├─ Classes

| | ├─ Chlorophyceae (Green algae) → Chlamydomonas, Spirogyra

| | ├─ Phaeophyceae (Brown algae) → Laminaria, Fucus

| | └─ Rhodophyceae (Red algae) → Polysiphonia, Gracilaria

| └─ Economic importance → Agar, food, oxygen

├── Bryophytes (Amphibians of plant kingdom)

│ ├─ No vascular tissues

│ ├─ Dominant gametophyte, dependent sporophyte

│ ├─ Liverworts → Marchantia

│ └─ Mosses → Funaria, Sphagnum

│

├── Pteridophytes

│ ├─ First vascular cryptogams

│ ├─ Roots, stems, leaves, vascular tissues present

│ ├─ Dominant sporophyte, independent gametophyte

│ └─ Examples → Fern (Dryopteris), Equisetum, Lycopodium

│

├── Gymnosperms

│ ├─ Naked seeds (not enclosed in fruit)

│ ├─ Woody trees, tap root system

│ ├─ Examples → Cycas, Pinus, Ephedra

│

└── Angiosperms (Flowering plants)

├─ Seeds enclosed in fruits

├─ Double fertilisation (unique feature)

├─ Classification

│ ├─ Monocots → One cotyledon, fibrous root, parallel venation

│ └─ Dicots → Two cotyledons, tap root, reticulate venation

└─ Examples → Mango, Pea, Wheat, Maize

Animal Kingdom

|

├── Basis of Classification

| ├─ Levels of organisation → Cellular, Tissue, Organ, Organ system

| ├─ Body symmetry → Asymmetry, Radial, Bilateral

| ├─ Germ layers → Diploblastic, Triploblastic

| ├─ Coelom → Acoelomate, Pseudocoelomate, Coelomate

| ├─ Segmentation → Absent / Present

| └─ Notochord → Non-chordates / Chordates

|

├── Non-Chordates

| ├─ Porifera (Sponges)

| | ├─ Cellular level, pores → canal system

| | └─ Example: Sycon

| ├─ Coelenterata (Cnidaria)

| | ├─ Tissue level, radial symmetry

| | ├─ Cnidoblasts (stinging cells)

| | └─ Example: Hydra, Jellyfish

| |

| ├─ Platyhelminthes

| | ├─ Flatworms, triploblastic, acoelomate

| | └─ Example: Taenia (tapeworm)

| |

| ├─ Nematoda

| | ├─ Roundworms, pseudocoelom

| | └─ Example: Ascaris

| |

| ├─ Annelida

| | ├─ True coelom, segmented body

| | └─ Example: Earthworm, Leech

| |

| ├─ Arthropoda (largest phylum)

| | ├─ Jointed appendages, exoskeleton

| | └─ Example: Cockroach, Prawn, Insects

| ├─ Mollusca

| | ├─ Soft body, calcareous shell

| | └─ Example: Snail, Octopus

| |

| └─ Echinodermata

| ├─ Spiny skin, water vascular system

| └─ Example: Starfish, Sea urchin

|

└── Chordates

├─ Features → Notochord, Dorsal nerve cord, Pharyngeal gill slits, Post-anal tail

├─ Subphylum Urochordata & Cephalochordata (Protochordates)

| ├─ Urochordata → Tunicates (Ascidia)

| └─ Cephalochordata → Amphioxus

|

└─ Subphylum Vertebrata

├─ Pisces (Fishes) → Rohu, Shark

├─ Amphibia → Frog, Salamander

├─ Reptilia → Lizard, Snake

├─ Aves (Birds) → Pigeon, Parrot

└─ Mammalia → Human, Cow, Dog

Morphology of Flowering Plants

|

├── Root

| ├─ Types

| | ├─ Tap root (Dicots)

| | ├─ Fibrous root (Monocots)

| | └─ Adventitious root (Grass, Banyan prop roots)

| ├─ Modifications

| | ├─ Storage → Carrot, Turnip

| | ├─ Prop → Banyan

| | ├─ Pneumatophores → Mangroves

| | └─ Climbing roots → Ivy

|

├── Stem

| ├─ Features → Nodes, Internodes, Branches

| ├─ Modifications

| | ├─ Underground → Rhizome (Ginger), Tuber (Potato), Bulb (Onion)

| | ├─ Aerial → Tendrils (Cucumber), Thorns (Citrus)

| | └─ Sub-aerial → Runner (Grass), Stolon, Sucker

|

├── Leaf

│ ├─ Parts → Leaf base, Petiole, Lamina

│ ├─ Types → Simple / Compound

│ ├─ Venation → Reticulate (Dicots), Parallel (Monocots)

│ ├─ Modifications → Tendrils (Pea), Spines (Cactus), Pitcher (Nepenthes)

│

├── Inflorescence

│ ├─ Racemose (Main axis continuous, indefinite growth) → Mustard

│ └─ Cymose (Main axis terminates, definite growth) → Jasmine

│

├── Flower

│ ├─ Parts → Calyx, Corolla, Androecium, Gynoecium

│ ├─ Symmetry → Actinomorphic (Radial), Zygomorphic (Bilateral)

│ ├─ Ovary position → Hypogynous, Perigynous, Epigynous

│ └─ Placentation → Marginal, Axile, Parietal, Free central, Basal

├── Fruit

│ ├─ True (from ovary)

│ ├─ False (from ovary + other parts, e.g., Apple)

│ └─ Types → Drupe, Berry, Legume, Capsule

│

└── Seed

├─ Dicot seed (Bean) → Two cotyledons

└─ Monocot seed (Maize) → Single cotyledon

Anatomy of Flowering Plants

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├── Plant Tissues

│ ├─ Meristematic

│ │ ├─ Apical → Root & shoot tips (primary growth)

│ │ ├─ Intercalary → Base of leaves, internodes (grasses)

│ │ └─ Lateral → Cambium, cork cambium (secondary growth)

| └─ Permanent

| ├─ Simple

| | ├─ Parenchyma (photosynthesis, storage)

| | ├─ Collenchyma (support, flexibility)

| | └─ Sclerenchyma (strength, dead cells)

| |

| └─ Complex

| ├─ Xylem (Tracheids, Vessels, Fibres, Parenchyma)

| └─ Phloem (Sieve tubes, Companion cells, Fibres, Parenchyma)

|

├── Tissue Systems

| ├─ Epidermal (protection, stomata, trichomes, root hairs)

| ├─ Ground (photosynthesis, storage, support)

| └─ Vascular (xylem + phloem)

|

├── Dicot Stem (Sunflower)


| ├─ Epidermis

| ├─ Cortex (collenchyma, parenchyma)

| ├─ Endodermis (starch sheath)

| ├─ Vascular bundles → Conjoint, collateral, open (with cambium)

| └─ Pith

|

├── Monocot Stem (Maize)

| ├─ Scattered vascular bundles

| ├─ Closed bundles (no cambium)

| └─ Ground tissue not differentiated

|

├── Dicot Root

| ├─ Radial vascular bundles

| ├─ Xylem & Phloem alternate

| └─ Cambium forms during secondary growth

|

├── Monocot Root

| ├─ Polyarch xylem

| ├─ Large pith

| └─ No secondary growth

├── Secondary Growth

│ ├─ In dicot stem → Vascular cambium, Cork cambium

│ ├─ Annual rings (spring wood & autumn wood)

│ └─ Heartwood vs Sapwood

│

└── Special Structures

├─ Periderm (cork cambium, cork, secondary cortex)

└─ Lenticels (gas exchange)

Structural Organisation in Animals

│

├── Animal Tissues

│ ├─ Epithelial Tissue

│ │ ├─ Simple epithelium

│ │ │ ├─ Squamous (thin, diffusion – alveoli)

│ │ │ ├─ Cuboidal (secretion – glands)

│ │ │ ├─ Columnar (absorption – intestine)

│ │ │ └─ Ciliated (movement – trachea)

│ │ └─ Compound epithelium (stratified – skin)

│ │

│ ├─ Connective Tissue


| | ├─ Loose → Areolar, Adipose

| | ├─ Dense → Regular (tendons), Irregular (skin dermis)

| | ├─ Skeletal → Cartilage, Bone

| | └─ Fluid → Blood, Lymph

| |

| ├─ Muscular Tissue

| | ├─ Striated (skeletal) – voluntary

| | ├─ Smooth (unstriated) – involuntary

| | └─ Cardiac – involuntary, branched

| |

| └─ Nervous Tissue

| ├─ Neurons (cell body, axon, dendrites)

| └─ Neuroglia (supporting cells)

|

├── Earthworm (Pheretima posthuma)

| ├─ Body segmented (metameres)

| ├─ Digestive → Pharynx, gizzard, intestine

| ├─ Circulatory → Closed, blood vessels

| ├─ Excretion → Nephridia

| ├─ Nervous → Ganglia + nerve cord

| └─ Reproduction → Hermaphrodite

├── Cockroach (Periplaneta americana)

│ ├─ Segmented body → Head, thorax, abdomen

│ ├─ Digestive → Crop, gizzard, hepatopancreatic caeca

│ ├─ Circulatory → Open, haemolymph

│ ├─ Respiratory → Tracheal system with spiracles

│ ├─ Excretion → Malpighian tubules

│ ├─ Nervous → Brain + ventral nerve cord

│ └─ Reproduction → Separate sexes, oviparous

│

└── Frog (Rana tigrina)

├─ Digestive → Stomach, intestine, cloaca

├─ Circulatory → Closed, 3-chambered heart

├─ Respiratory → Lungs, skin, buccal cavity

├─ Nervous → Brain, spinal cord, nerves

└─ Reproduction → Sexual, external fertilization

Cell – The Unit of Life

│

├── Cell Theory

│ ├─ Proposed by Schleiden & Schwann

| ├─ Virchow → Omnis cellula e cellula (all cells arise from pre-existing cells)

| └─ Modern cell theory additions (heredity, metabolism, continuity)

|

├── Prokaryotic Cell (Bacteria)

| ├─ Cell wall → Peptidoglycan

| ├─ Plasma membrane → Mesosome (respiration, DNA replication)

| ├─ Nucleoid → Circular DNA

| ├─ Plasmids → Extra-chromosomal DNA

| └─ Appendages → Flagella, Pili, Fimbriae

|

├── Eukaryotic Cell

| ├─ Cell Wall (plants)

| | ├─ Primary wall (cellulose, hemicellulose, pectin)

| | └─ Secondary wall (lignin)

| |

| ├─ Plasma Membrane

| | ├─ Fluid mosaic model (Singer & Nicolson)

| | ├─ Transport → Passive, Active, Endocytosis, Exocytosis

| ├─ Cytoplasm

| | └─ Contains organelles + cytosol

| |

| ├─ Endomembrane System

| | ├─ Endoplasmic Reticulum (RER – protein synthesis, SER – lipids)

| | ├─ Golgi apparatus (packaging, secretion)

| | ├─ Lysosomes (enzymes, autolysis)

| | └─ Vacuoles (storage, turgidity)

| |

| ├─ Mitochondria

| | ├─ Double membrane

| | ├─ Inner folds = cristae

| | └─ Powerhouse, ATP synthesis

| |

| ├─ Plastids (plants only)

| | ├─ Chloroplast (photosynthesis)

| | ├─ Chromoplast (pigments)

| | └─ Leucoplast (storage)

| ├─ Ribosomes

| | ├─ 70S (prokaryotes, mitochondria, chloroplast)

| | └─ 80S (eukaryotic cytoplasm)

| |

| ├─ Cytoskeleton

| | ├─ Microtubules

| | ├─ Microfilaments

| | └─ Intermediate filaments

| |

| ├─ Centrosome & Centrioles

| | └─ Help in spindle fibre formation

| |

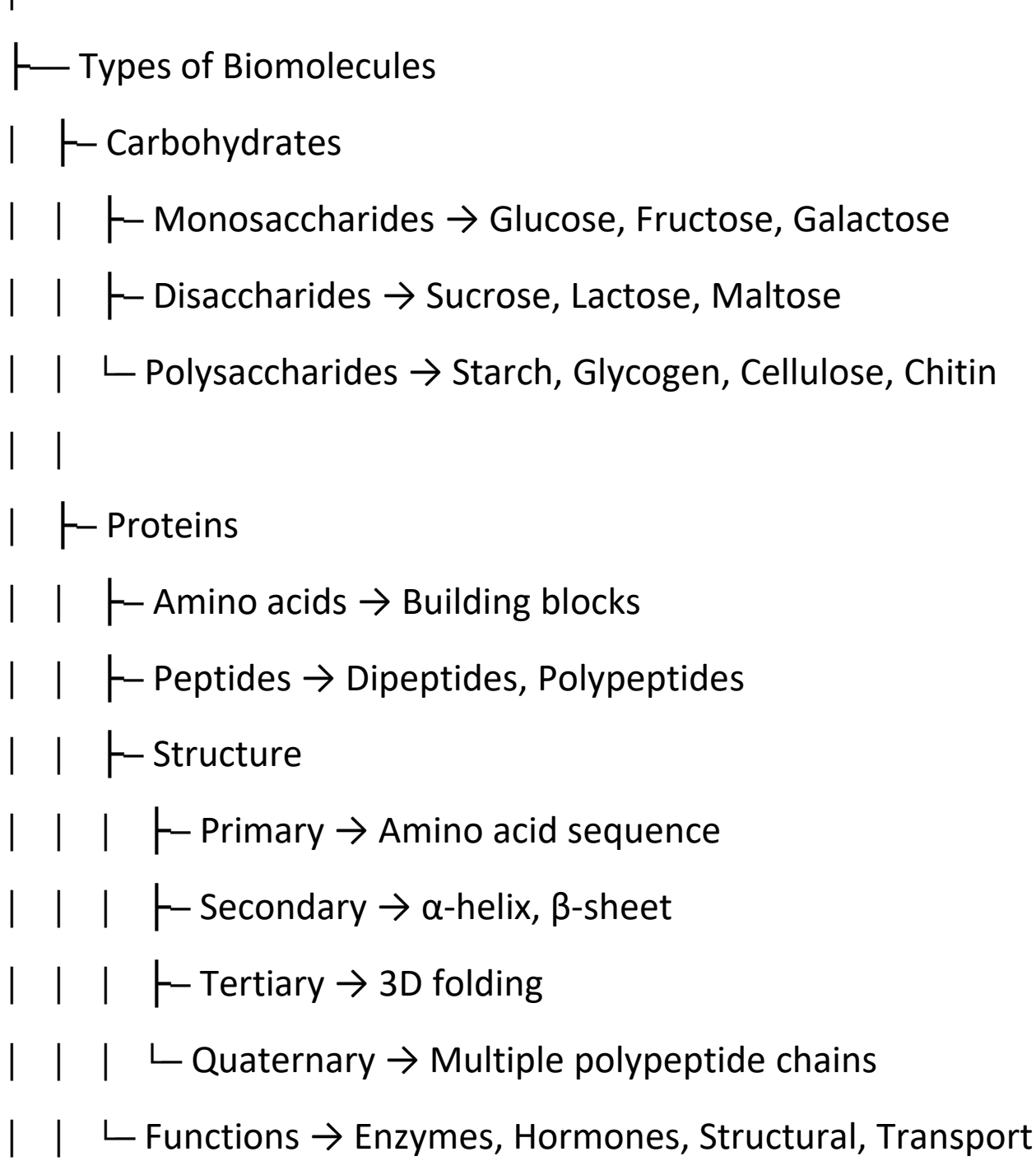
| └─ Nucleus

| ├─ Nuclear envelope (double membrane)

| ├─ Nucleolus (rRNA synthesis)

| └─ Chromatin (Euchromatin – active, Heterochromatin – inactive)

Biomolecules



└── Water

├─ Solvent of life → Medium for reactions

├─ High specific heat → Temperature buffer

├─ Cohesion & Adhesion → Transport in plants

└─ Polar molecule → Hydrogen bonding

Cell Cycle and Cell Division

|

├── Cell Cycle

| ├─ Interphase → Growth & DNA replication

| | ├─ G1 → Cell growth, protein synthesis

| | ├─ S → DNA replication

| | └─ G2 → Preparation for mitosis

| |

| └─ M Phase → Mitosis / Meiosis

|

├── Mitosis (Somatic cells)

| ├─ Purpose → Growth, repair, asexual reproduction

| ├─ Phases

| | ├─ Prophase → Chromosomes condense, spindle forms

| | ├─ Metaphase → Chromosomes align at equator

| | ├─ Anaphase → Sister chromatids separate

| | └─ Telophase → Nuclear envelope forms, cytokinesis

| └─ Result → 2 genetically identical diploid daughter cells

|

├── Meiosis (Germ cells)

| ├─ Purpose → Gamete formation, genetic variation

| ├─ Meiosis I → Reduction division (2n → n)

| | ├─ Prophase I → Synapsis, Crossing over

| | ├─ Metaphase I → Homologous chromosomes align

| | ├─ Anaphase I → Homologous chromosomes separate

| | └─ Telophase I → 2 haploid cells

| ├─ Meiosis II → Equational division (like mitosis)

| └─ Result → 4 genetically distinct haploid cells

|

├── Differences: Mitosis vs Meiosis

| ├─ Mitosis → Somatic, 2 daughter cells, diploid, identical

| └─ Meiosis → Germ, 4 daughter cells, haploid, variation

└── Significance

├─ Mitosis → Growth, repair, asexual reproduction

└─ Meiosis → Genetic variation, sexual reproduction

Transport in Plants

|

├── Types of Transport

| ├─ Diffusion → Movement of molecules from high → low concentration

| ├─ Osmosis → Movement of water through semi-permeable membrane

| ├─ Plasmolysis → Shrinking of protoplast in hypertonic solution

| └─ Active transport → Requires energy, against concentration gradient

├── Water Transport

| ├─ Pathways

| | ├─ Apoplast → Through cell walls

| | ├─ Symplast → Through cytoplasm via plasmodesmata

| | └─ Transmembrane → Across membranes

| ├─ Ascent of Sap

| | ├─ Cohesion-Tension theory → Transpiration pull

| | └─ Root pressure → Guttation

| |

| └─ Factors affecting transpiration → Temperature, Humidity, Wind, Light

|

├── Mineral Transport

| ├─ Passive uptake → Diffusion, facilitated diffusion

| └─ Active uptake → ATP-dependent transport

|

├── Phloem Transport (Food)

| ├─ Translocation → Source (leaves) → Sink (roots, fruits)

| ├─ Mechanism → Pressure-flow hypothesis

| └─ Phloem loading & unloading

|

└── Stomatal Regulation

├─ Opening → K^+ ions, water influx, turgor pressure

└─ Closing → K^+ ions exit, water efflux

Photosynthesis in Higher Plants

|

├── Definition

| └─ Conversion of light energy into chemical energy (glucose)

|

├── Sites of Photosynthesis

| ├─ Chloroplast → Thylakoid (light), Stroma (dark)

| └─ Chlorophyll → Pigment absorbing light (a, b, carotenoids)

|

├── Light Reaction (Photophosphorylation)

| ├─ Location → Thylakoid membranes

| ├─ Process → Water splitting → O_2 release

| ├─ Products → ATP, NADPH, O_2

| └─ Electron transport → Photolysis & electron flow

├── Dark Reaction (Calvin Cycle)

│ ├─ Location → Stroma

│ ├─ CO_2 fixation → Rubisco enzyme

│ ├─ Steps → Carboxylation, Reduction, Regeneration

│ └─ Products → Glucose

│

├── C_3, C_4, and CAM Pathways

│ ├─ C_3 → Calvin cycle, mesophyll cells, e.g., Rice, Wheat

│ ├─ C_4 → Kranz anatomy, bundle sheath + mesophyll, e.g., Maize, Sugarcane

│ └─ CAM → Temporal separation, e.g., Opuntia

│

├── Factors Affecting Photosynthesis

│ ├─ Light → Intensity, quality

│ ├─ CO_2 concentration

│ ├─ Temperature

│ └─ Water availability

└── Importance

  ├─ Source of food

  ├─ Oxygen release

  └─ Basis of energy flow in ecosystems

Respiration in Plants

|

├── Definition

| └─ Oxidation of organic compounds → Release energy (ATP)

|

├── Types of Respiration

| ├─ Aerobic → With O_2, complete breakdown of glucose

| └─ Anaerobic → Without O_2, partial breakdown (fermentation)

|

├── Glycolysis

| ├─ Location → Cytoplasm

| ├─ Process → Glucose → 2 Pyruvate + 2 ATP + 2 NADH

| └─ Anaerobic continuation → Lactic acid (plants/animal), Alcohol + CO_2 (yeast

├── TCA Cycle (Krebs Cycle)

│ ├─ Location → Mitochondrial matrix

│ ├─ Pyruvate → Acetyl CoA → CO_2 + NADH + $FADH_2$ + ATP

│

├── Electron Transport Chain (ETC)

│ ├─ Location → Inner mitochondrial membrane

│ ├─ NADH & $FADH_2$ donate electrons

│ ├─ H^+ gradient → ATP synthase

│ └─ Oxygen → Final electron acceptor → H_2O

│

├── Respiratory Quotient (RQ)

│ ├─ RQ = CO_2 released / O_2 consumed

│ └─ Carbohydrates → 1, Lipids → 0.7, Proteins → 0.8

│

└── Fermentation

├─ Alcoholic → Glucose → Ethanol + CO_2 + 2 ATP (Yeast)

└─ Lactic acid → Glucose → Lactic acid + 2 ATP (Muscle)

└── Fermentation

├─ Alcoholic → Glucose → Ethanol + CO_2 + 2 ATP (Yeast)

└─ Lactic acid → Glucose → Lactic acid + 2 ATP (Muscle)

Plant Growth and Development

|

├── Definition

| └─ Permanent increase in size and differentiation of cells

|

├── Growth

| ├─ Types

| | ├─ Primary → Lengthening of roots and shoots (apical meristem)

| | └─ Secondary → Increase in girth (lateral meristem: cambium, cork cambium)

| |

| ├─ Phases

| | ├─ Cell division → Mitosis

| | ├─ Cell elongation → Vacuole enlargement

| | └─ Cell differentiation → Specialisation

| └─ Measurement

| ├─ Length (cm, m)

| └─ Dry weight increase

|

├── Plant Growth Regulators (Hormones)

| ├─ Auxins → Cell elongation, apical dominance, rooting

| ├─ Gibberellins → Stem elongation, bolting, seed germination

| ├─ Cytokinins → Cell division, delay senescence

| ├─ Abscisic acid (ABA) → Dormancy, stress response

| └─ Ethylene → Fruit ripening, leaf abscission

|

├── Seed Dormancy

| ├─ Inherent → Impermeable seed coat

| └─ Induced → Low temperature, hormone regulation

|

└── Photoperiodism & Vernalisation

├─ Photoperiodism → Response to light duration

| ├─ Short-day → Flower in short days (Chrysanthemum)

| └─ Long-day → Flower in long days (Spinach)

└─ Vernalisation → Cold treatment to induce flowering

Breathing and Exchange of Gases

|

├── Respiratory System

| ├─ Organs → Nose, Pharynx, Larynx, Trachea, Bronchi, Bronchioles, Lungs, Alveoli

| └─ Features → Large surface area, thin walls, moist, vascularised

|

├── Mechanism of Breathing

| ├─ Inspiration → Diaphragm contracts, thoracic cavity expands, air in

| └─ Expiration → Diaphragm relaxes, thoracic cavity decreases, air out

|

├── Respiratory Pigments

| ├─ Haemoglobin (Hb) → O_2 transport

| ├─ Oxyhaemoglobin → Hb + O_2

| └─ Dissociation curve → Effect of pH, CO_2, temperature

|

├── Transport of Gases

| ├─ Oxygen → Mostly bound to Hb, some dissolved in plasma

| └─ Carbon dioxide → Dissolved, as bicarbonate ions, bound to Hb

|

├── Regulation of Breathing

│ ├─ Medulla oblongata → Controls rhythm

│ └─ Chemoreceptors → Sense CO_2, O_2, pH

│

└── Disorders

├─ Asthma → Bronchiole constriction

├─ Emphysema → Alveoli damage

├─ Pneumonia → Infection of lungs

└─ Tuberculosis → Mycobacterium infection

Body Fluids and Circulation

│

├── Components of Blood

│ ├─ Plasma → 55% (water, proteins, nutrients, hormones)

│ ├─ Cellular components → RBC, WBC, Platelets

│ └─ Functions → Transport, immunity, clotting

│

├── Lymph

│ ├─ Colorless fluid → Similar to plasma, less proteins

│ └─ Function → Drain tissue fluid, immune response

├── Circulatory System

│ ├─ Heart → 4 chambers (2 atria, 2 ventricles)

│ ├─ Blood vessels → Arteries (away from heart), Veins (towards heart), Capillaries (exchange)

│ ├─ Valves → Prevent backflow (AV, semilunar)

│ ├─ Cardiac cycle → Systole (contraction), Diastole (relaxation)

│ └─ Cardiac output → Stroke volume × Heart rate

│

├── Blood Pressure

│ ├─ Systolic / Diastolic

│ └─ Measured by sphygmomanometer

│

├── Heartbeat Regulation

│ ├─ SA node → Pacemaker

│ ├─ AV node → Delays signal

│ ├─ Bundle of His → Conducts impulse

│ └─ Purkinje fibres → Ventricular contraction

└── Disorders

├─ Hypertension → High BP

├─ Hypotension → Low BP

├─ Atherosclerosis → Artery blockage

└─ Heart attack → Myocardial infarction

Excretory Products and Their Elimination

|

├── Excretion

| └─ Removal of metabolic waste products from the body

|

├── Excretory Organs

| ├─ Kidney → Main excretory organ in humans

| ├─ Liver → Excretes bile pigments (bilirubin)

| ├─ Lungs → CO_2, water

| └─ Skin → Sweat (water, salts, urea)

|

├── Kidney Structure

| ├─ Cortex → Outer layer

| ├─ Medulla → Inner layer, contains pyramids

| ├─ Nephron → Functional unit

| | ├─ Renal corpuscle → Glomerulus + Bowman's capsule

| | └─ Renal tubule → Proximal tubule, loop of Henle, distal tubule, collecting duct

| └─ Ureter → Carries urine to bladder

|

├── Mechanism of Urine Formation

| ├─ Glomerular filtration → Blood plasma filtered in Bowman's capsule

| ├─ Tubular reabsorption → Useful substances reabsorbed

| └─ Tubular secretion → Wastes secreted into tubule

|

├── Regulation

| ├─ ADH → Water reabsorption in collecting duct

| ├─ Aldosterone → Na^+ reabsorption, K^+ excretion

| └─ Renin-Angiotensin system → Blood pressure regulation

|

└── Disorders

├─ Kidney stones → Precipitation of salts

├─ Nephritis → Kidney inflammation

├─ Uremia → Urea accumulation in blood

└─ Dialysis → Artificial removal of waste in kidney failure

Locomotion and Movement

|

├── Types of Movement

| ├─ Amoeboid → Cytoplasmic streaming, pseudopodia (Amoeba)

| ├─ Ciliary → Cilia movement (Paramecium, Trachea)

| └─ Muscular → Contraction & relaxation of muscles (Humans)

|

├── Skeletal System

| ├─ Types of bones → Long, Short, Flat, Irregular, Sesamoid

| ├─ Human skeleton → Axial (skull, vertebral column, rib cage) + Appendicular (limbs, girdles)

| ├─ Vertebral column → Cervical, Thoracic, Lumbar, Sacral, Coccygeal

| └─ Joints → Fibrous (immovable), Cartilaginous (slightly movable), Synovial (freely movable)

|

├── Muscular System

| ├─ Types of muscles → Skeletal (voluntary), Smooth (involuntary), Cardiac (involuntary)

| ├─ Structure → Myofibrils → Sarcomere → Actin & Myosin

| ├─ Mechanism → Sliding filament theory (Contraction)

| └─ Energy source → ATP

|

├── Disorders

| ├─ Arthritis → Joint inflammation

| ├─ Osteoporosis → Bone mass reduction

| ├─ Muscular dystrophy → Muscle degeneration

| └─ Sprain/Strain → Ligament/tendon injury

|

└── Movement Coordination

├─ Antagonistic muscles → Flexor & Extensor pairs

└─ Tendons → Connect muscle to bone, Ligaments → Connect bone to bone

Neural Control and Coordination

|

├── Nervous System

| ├─ Central Nervous System (CNS) → Brain + Spinal cord

| └─ Peripheral Nervous System (PNS) → Cranial nerves + Spinal nerves

├── Neuron

│ ├─ Structure → Cell body, Dendrites, Axon, Myelin sheath, Nodes of Ranvier

│ ├─ Types → Sensory (afferent), Motor (efferent), Interneurons

│ └─ Function → Transmit impulses

│

├── Synapse

│ ├─ Junction between two neurons

│ ├─ Electrical → Rare, direct passage of ions

│ └─ Chemical → Neurotransmitters (Acetylcholine, Dopamine)

│

├── Brain

│ ├─ Forebrain → Cerebrum (conscious mind), Thalamus, Hypothalamus

│ ├─ Midbrain → Relay between forebrain & hindbrain

│ └─ Hindbrain → Cerebellum (balance, coordination), Pons, Medulla oblongata

│

├── Spinal Cord

│ ├─ Structure → Grey matter (centre), White matter (periphery)

│ ├─ Reflex arc → Stimulus → Sensory neuron → Interneuron → Motor neuron → Effector

│ └─ Function → Reflex actions, signal transmission

├── Peripheral Nervous System

│ ├─ Somatic → Voluntary movements (skeletal muscles)

│ └─ Autonomic → Involuntary, Sympathetic & Parasympathetic

│

└── Disorders

├─ Parkinson's → Dopamine deficiency

├─ Alzheimer → Memory loss

├─ Paralysis → Spinal cord injury

└─ Epilepsy → Neuronal hyperactivity

Chemical Coordination and Hormones

│

├── Endocrine System

│ ├─ Glands → Pituitary, Thyroid, Parathyroid, Adrenal, Pancreas, Pineal

│ └─ Secrete hormones → Regulate metabolism, growth, reproduction

│

├── Hormones

│ ├─ Definition → Chemical messengers secreted in blood, act on target organs

│ ├─ Types → Steroid (lipid soluble), Peptide (water soluble)

├── Pituitary Gland (Master Gland)

│ ├─ Anterior → GH (growth), TSH (thyroid), ACTH (adrenal), FSH/LH (gonads)

│ └─ Posterior → ADH (water balance), Oxytocin (labor, milk ejection)

│

├── Thyroid & Parathyroid

│ ├─ Thyroid → T3/T4 (metabolism), Calcitonin (lowers blood Ca^{2+})

│ └─ Parathyroid → PTH (raises blood Ca^{2+})

│

├── Adrenal Glands

│ ├─ Cortex → Cortisol (stress), Aldosterone (Na^{+}, K^{+} balance)

│ └─ Medulla → Adrenaline/Noradrenaline (fight/flight)

│

├── Pancreas

│ ├─ Insulin → Lowers blood glucose

│ └─ Glucagon → Raises blood glucose

│

├── Pineal Gland → Melatonin → Circadian rhythm

├── Thymus → Thymosin → T-cell maturation

└── Disorders

├─ Diabetes mellitus → Insulin deficiency

├─ Goitre → Iodine deficiency, thyroid enlargement

├─ Cretinism → Thyroid hormone deficiency in childhood

└─ Acromegaly → Excess GH in adults

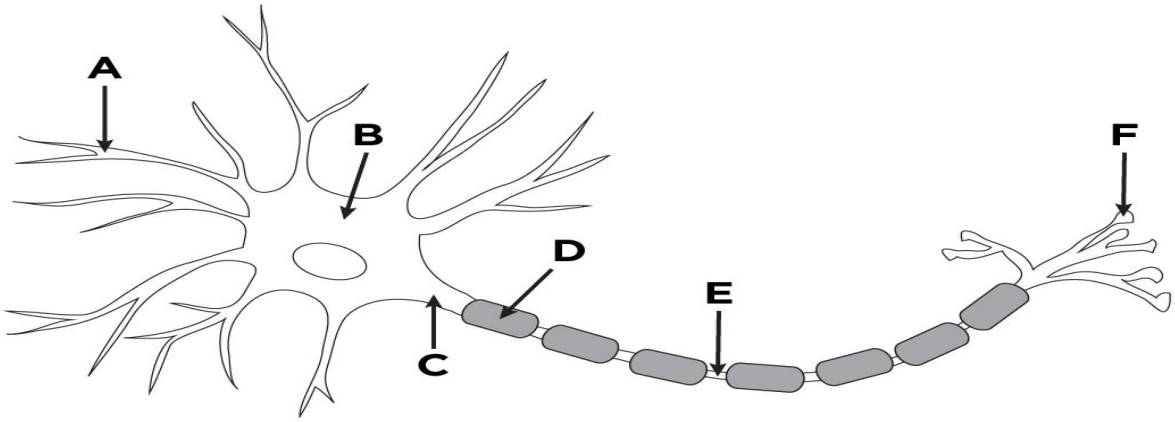
Structure of Neuron

1. Identify the diagram and write its biological name.

2. Label any four parts of the neuron.

3. State the function of dendrites.

4. Why is the node of Ranvier important in impulse transmission?



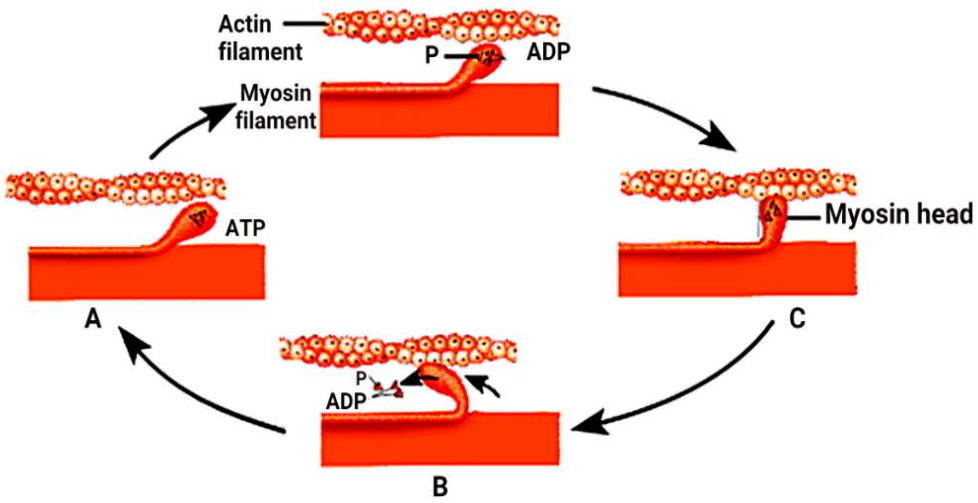
Cross-Bridge Cycle (Muscle Contraction)

1.Identify the diagram.

2.Name the two filaments involved in contraction.

3.What happens when ATP binds to myosin head?

4.Explain the power stroke stage.



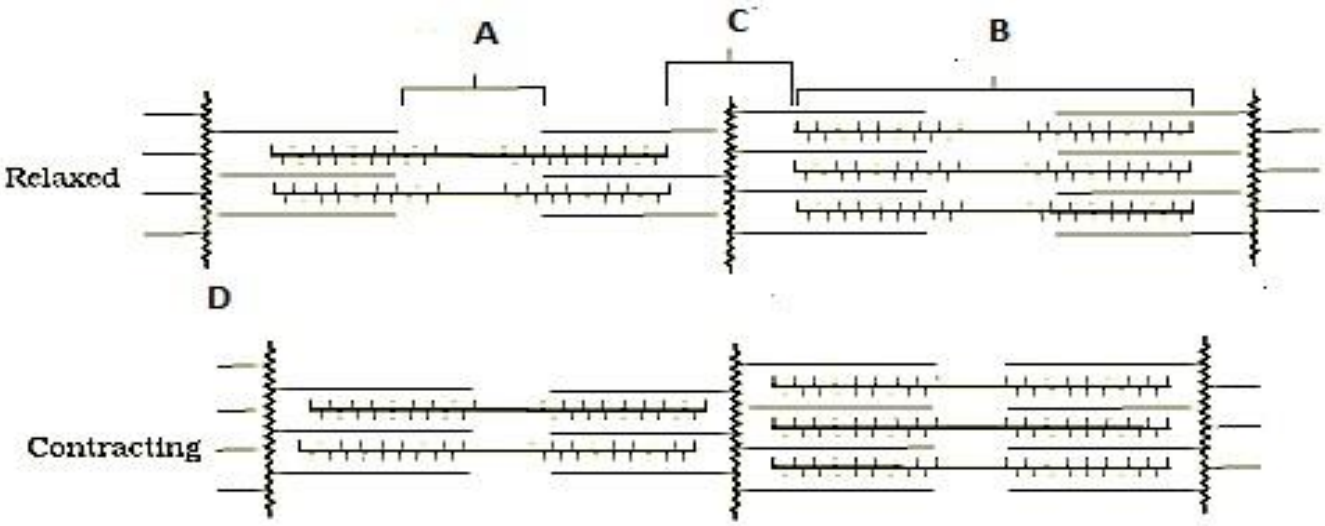
Sarcomere – Relaxed & Contracted States

1.Identify the diagram.

2.Label Z-disc, A-band, I-band, H-zone.

3.Which region disappears during contraction and why?

4.State one reason why muscles shorten but filaments do not.



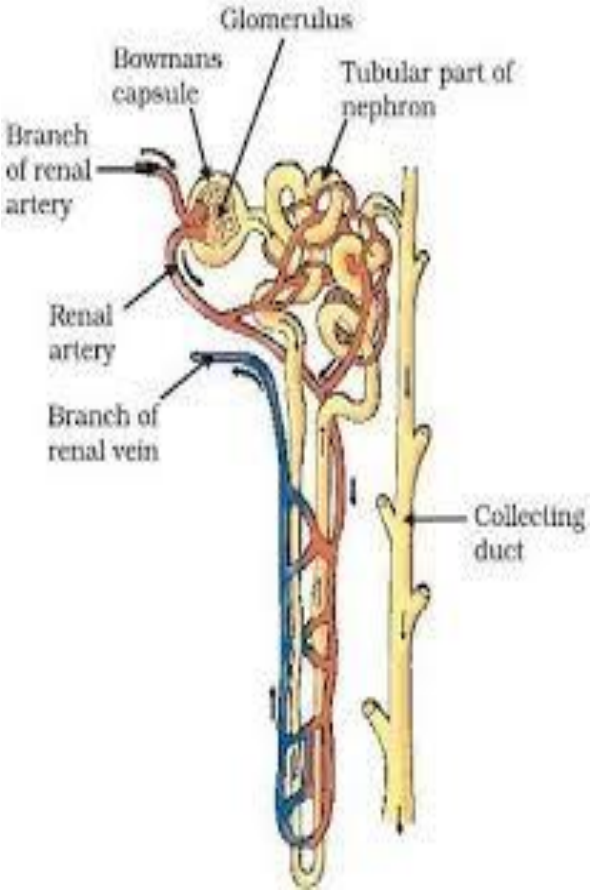
Tubular Parts of Nephron (PCT–Loop–DCT)

1.Identify the diagram.

2.Name the substances reabsorbed in PCT.

3.Which limb of Henle is impermeable to water

4.Explain the role of DCT in ionic balance.



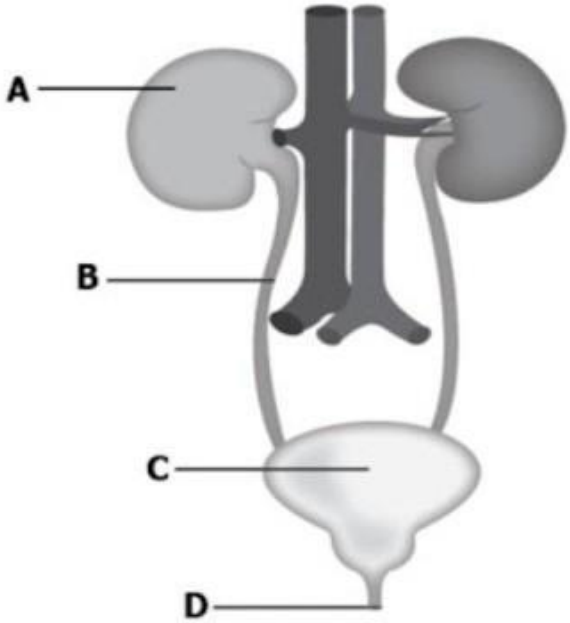
Human excretory system

1.Label kidney, ureter and urinary bladder.

2.State the function of renal artery and renal vein.

3.Differentiate between cortex and medulla of kidney.

4.Explain the pathway of urine formation using the diagram.



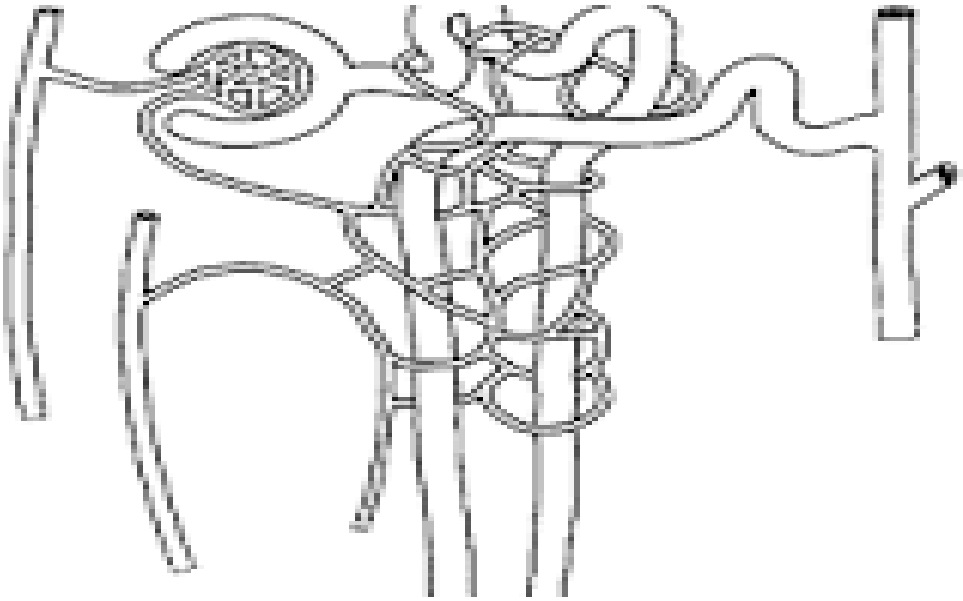
Structure of nephron

1.What is the role of glomerulus in filtration?

2.Why is afferent arteriole wider than efferent arteriole?

3.Explain counter-current mechanism with reference to diagram.

4.How does vasa recta help in maintaining osmotic gradient?



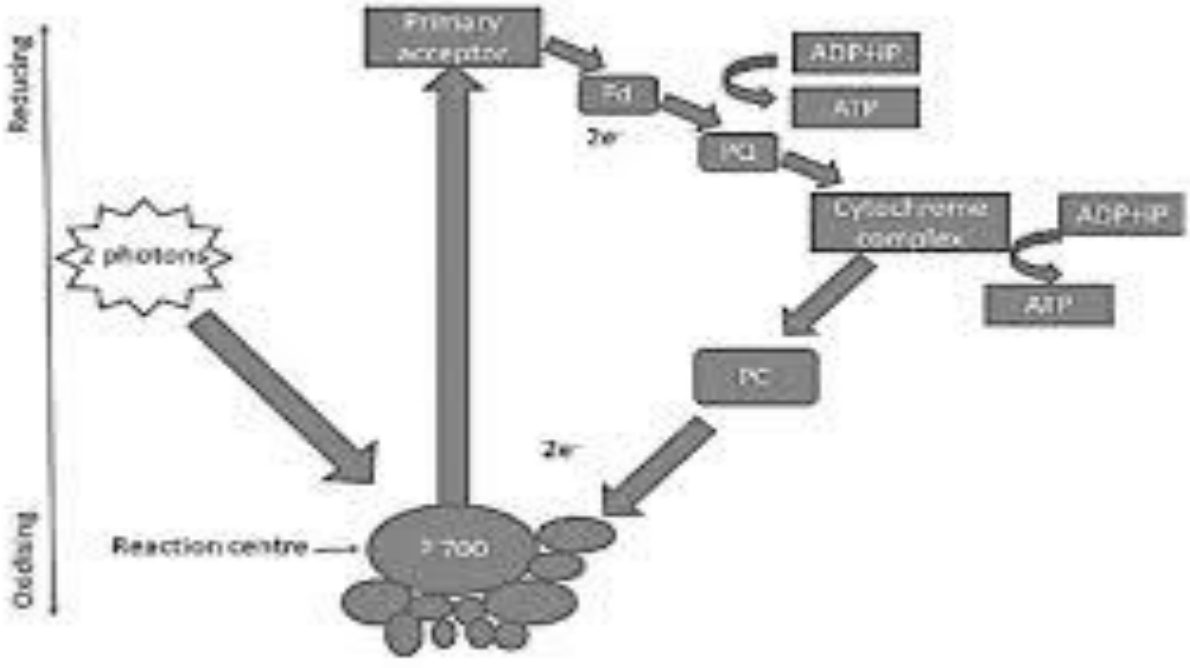
Cyclic photophosphorylation

1.Which photosystem is involved in cyclic photophosphorylation?

2.Why is NADPH not formed in this process?

3.Explain the pathway of electron flow shown.

4.State one advantage of cyclic photophosphorylation.



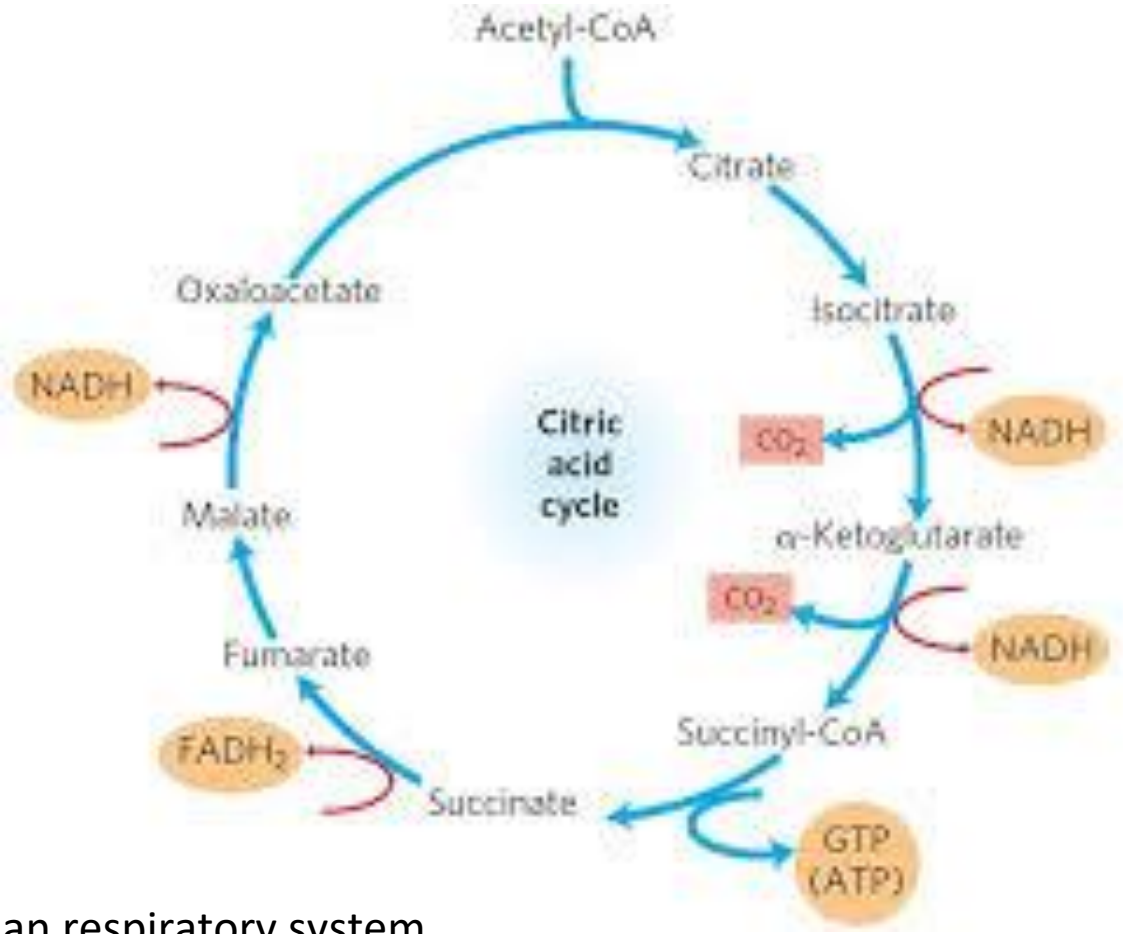
Citric acid Cycle

1.Name the first stable compound formed in Krebs cycle.

2.How many NADH, $FADH_2$ and ATP are produced per cycle?

3. the steps where CO_2 is released.

4.Why is Krebs cycle called an amphibolic pathway?



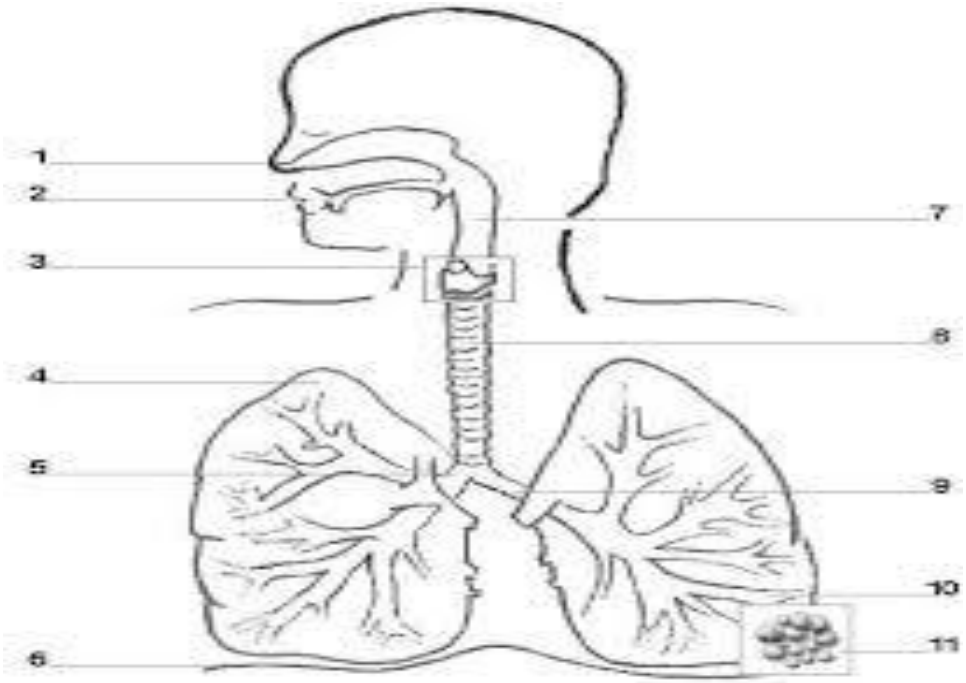
Human respiratory system

1.Label trachea, bronchi and alveoli.

2..Why are alveoli suitable for gaseous exchange?

3.Explain the role of diaphragm in breathing.

4.How does pleural fluid help in respiration?



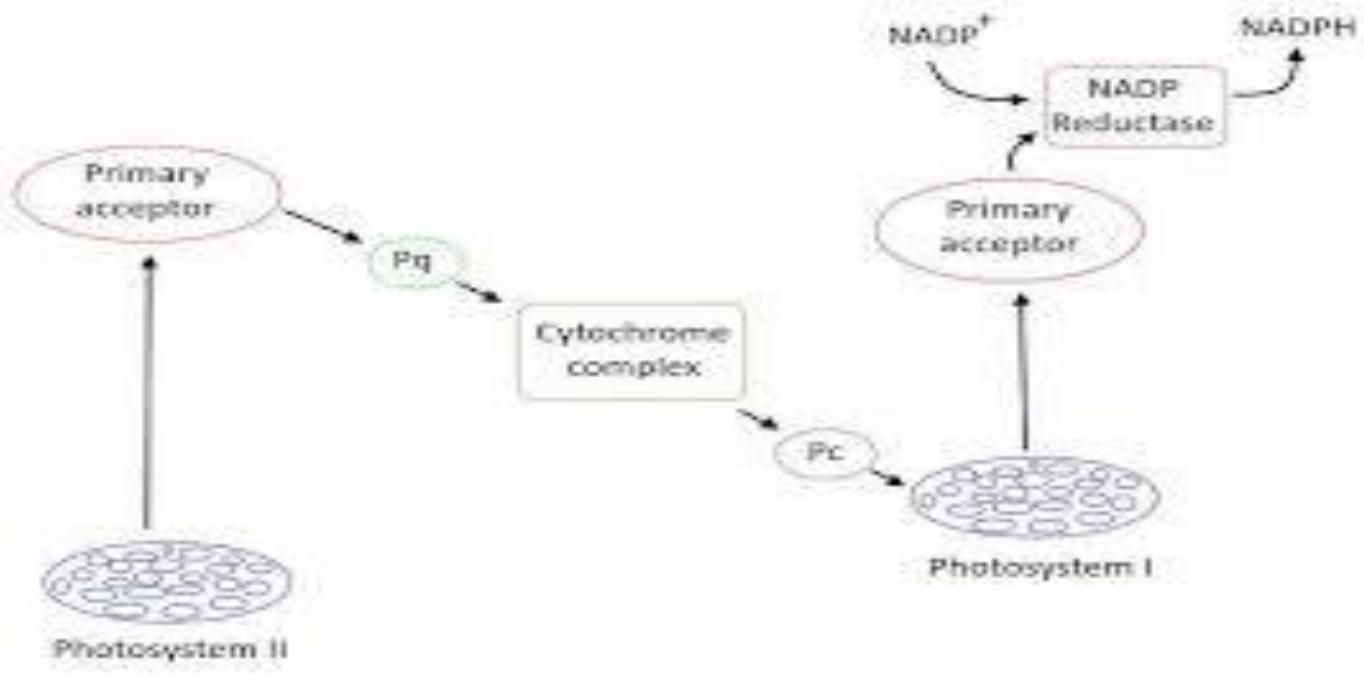
Non-cyclic photophosphorylation

1.Name the two photosystems involved.

2.What is the role of water splitting complex?

3.Explain formation of ATP and NADPH using the diagram.

4.Why is oxygen released only in non-cyclic photophosphorylation?



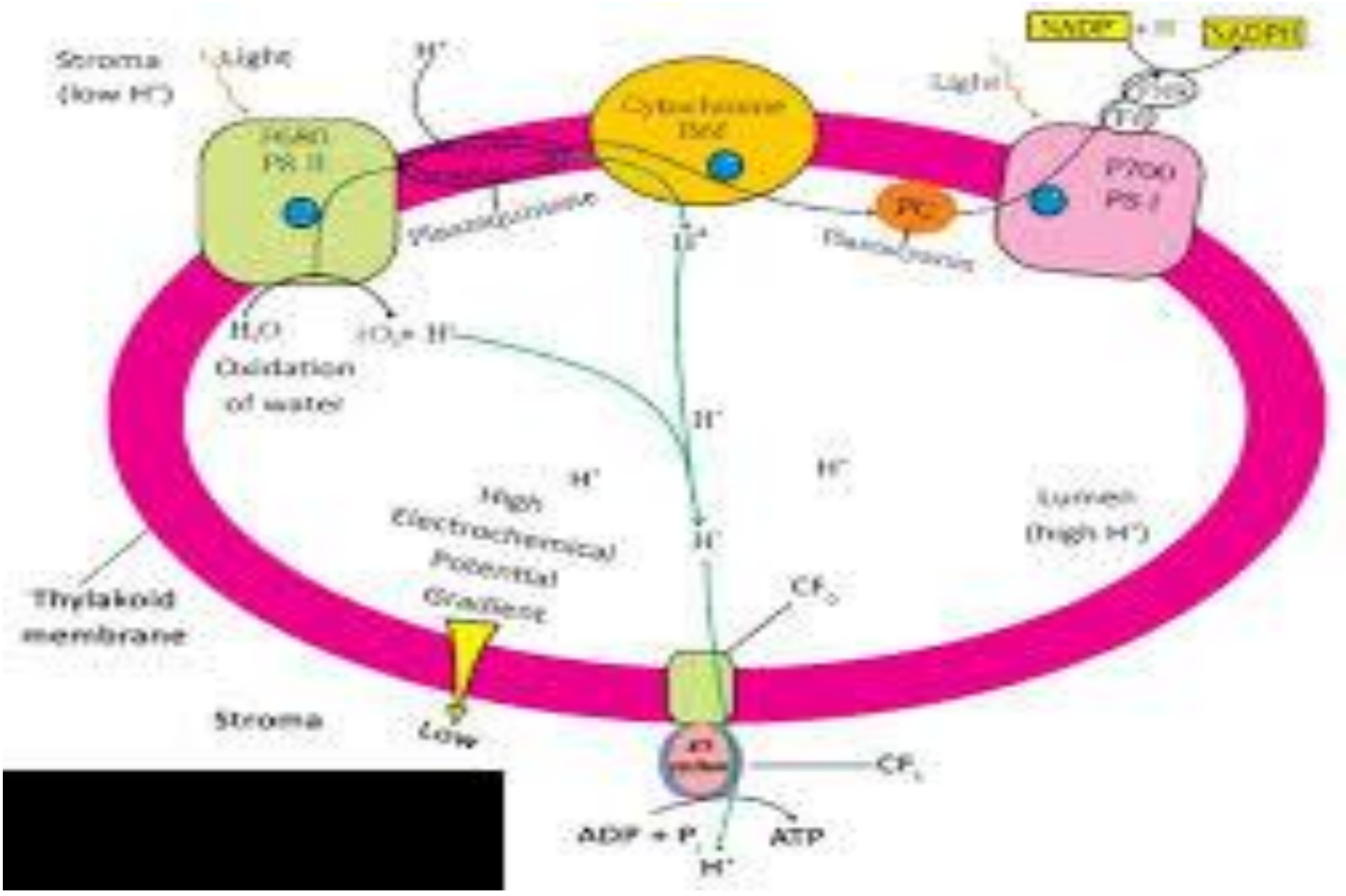
Chemiosmotic hypothesis

1.What causes proton accumulation in thylakoid lumen?

2.Explain the role of ATP synthase.

3.How is proton gradient utilised for ATP formation?

4.State the significance of chemiosmosis.



Hatch-Slack Pathway

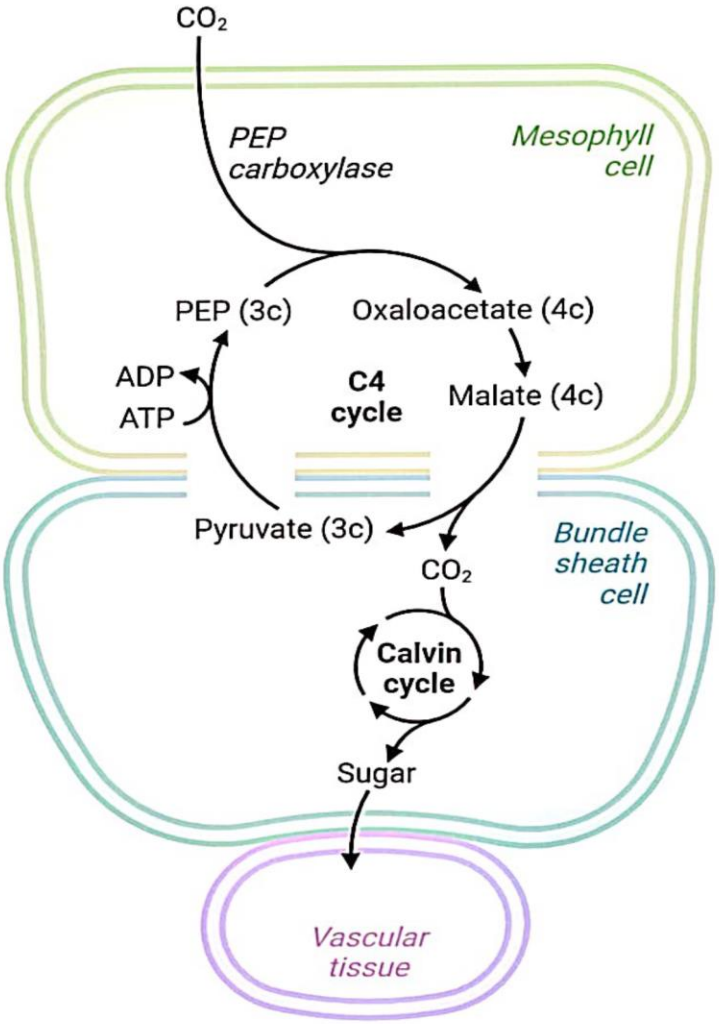
1.Name the enzyme that fixes CO_2 in mesophyll cells.

2.Why is C_4 pathway more efficient than C_3?

4.Explain the role of bundle sheath cells.

5.How does C_4 cycle reduce photorespiration?

The C4 Cycle



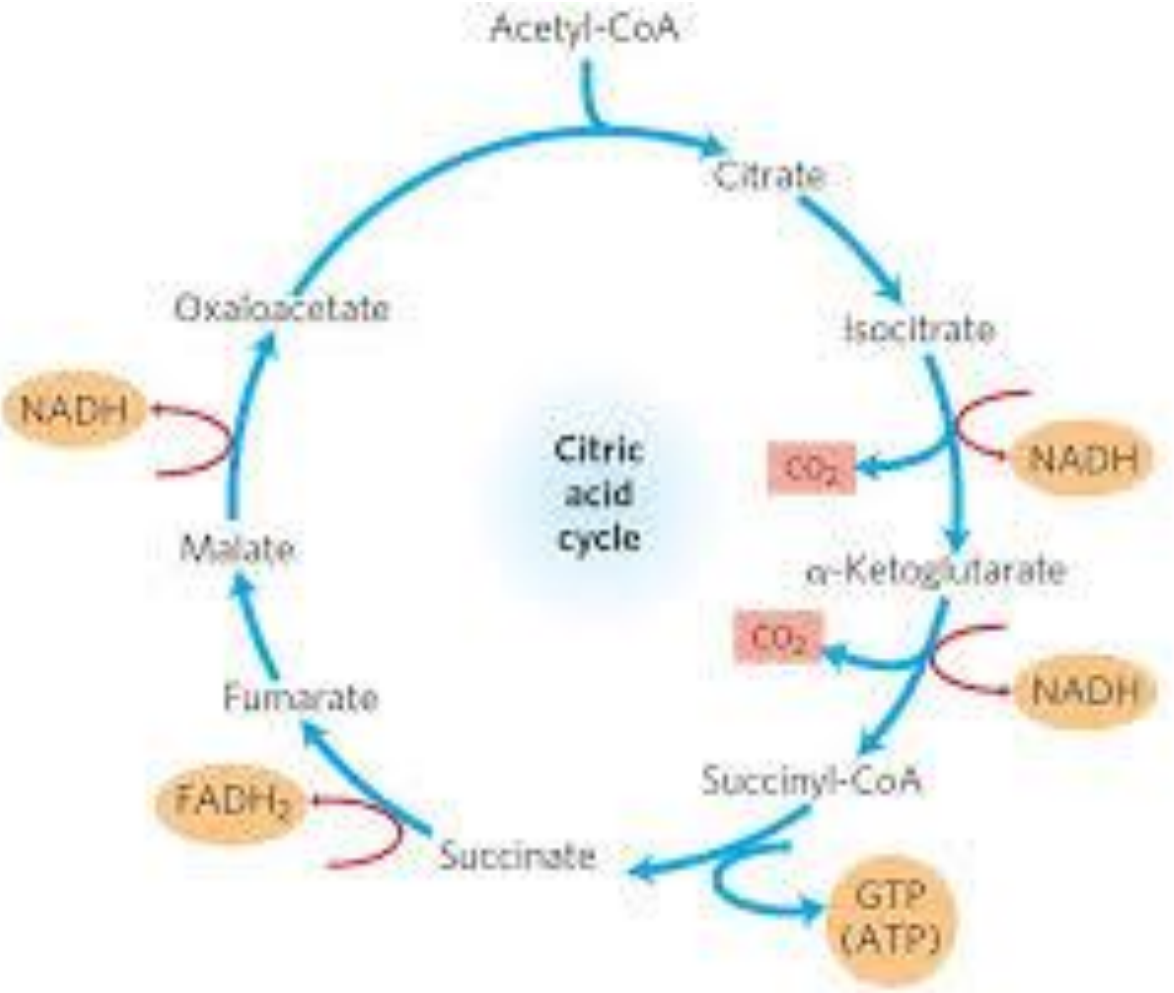
Calvin Cycle

1.Name the three phases of Calvin cycle.

2.What is the role of RuBisCO enzyme?

3.How many ATP and NADPH are required to form one glucose molecule?

4.Why is Calvin cycle called light-independent reaction?



Prophase I of meiosis

1. In which division does prophase I occur?
2. During which sub-stage does synapsis takes place?
3. During which sub-stage does crossing over occur?
4. During which sub-stage are chiasmata visible?
5. What is the significance of chiasmata?

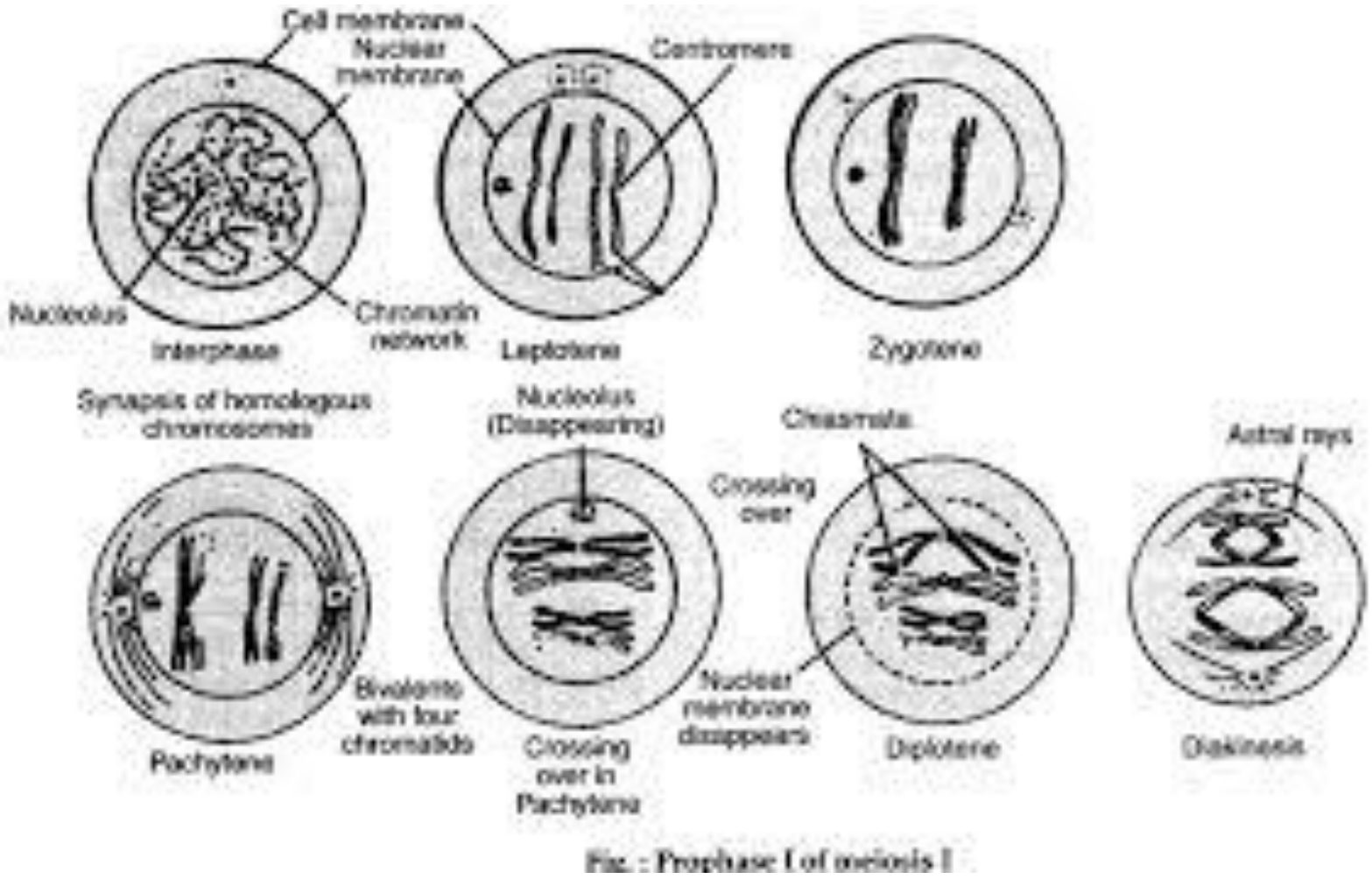


Fig. : Prophase I of meiosis I

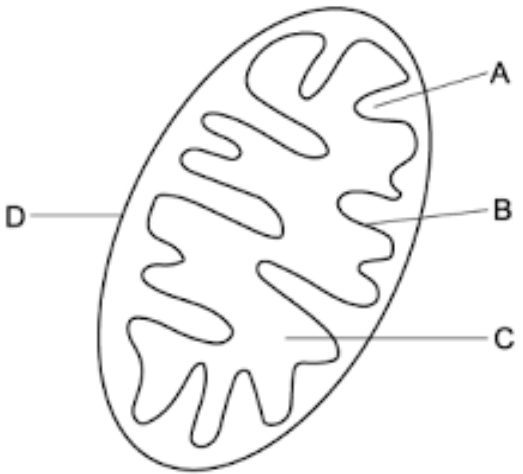
Mitochondria

1.Label outer membrane, inner membrane and cristae.

2.Why is inner membrane folded?

3.Name the site of Krebs cycle and ETS.

4.Why is mitochondria called the powerhouse of cell?



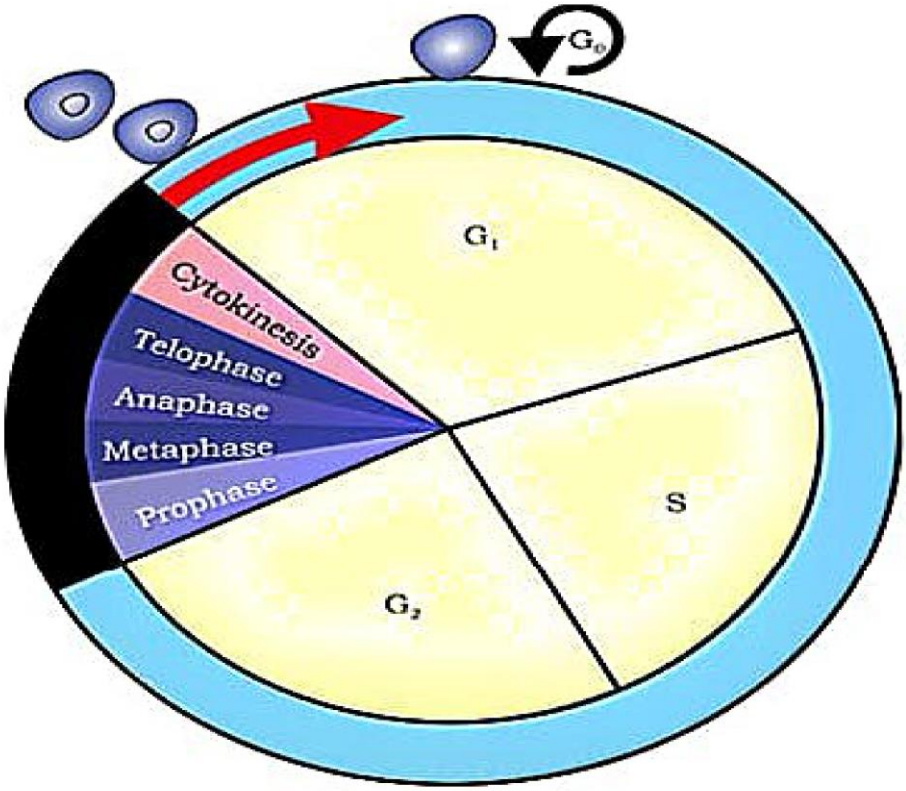
Interphase stage of cell cycle

1.What happens during S-phase?

2.Why is G_1 phase important?

3.Differentiate between mitotic phase and interphase.

4.How does Prophase-I differ from Prophase of mitosis?



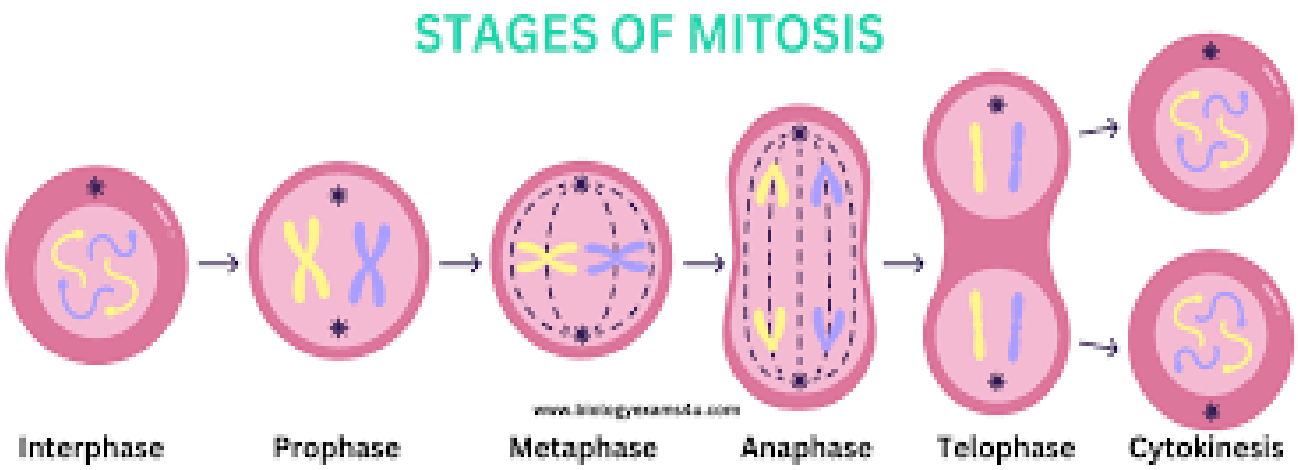
Mitosis stage of cell cycle

1.Identify the stages shown in sequence.

2.What happens to chromosomes during metaphase?

3.Explain cytokinesis in animal cell.

4.State the significance of mitosis.



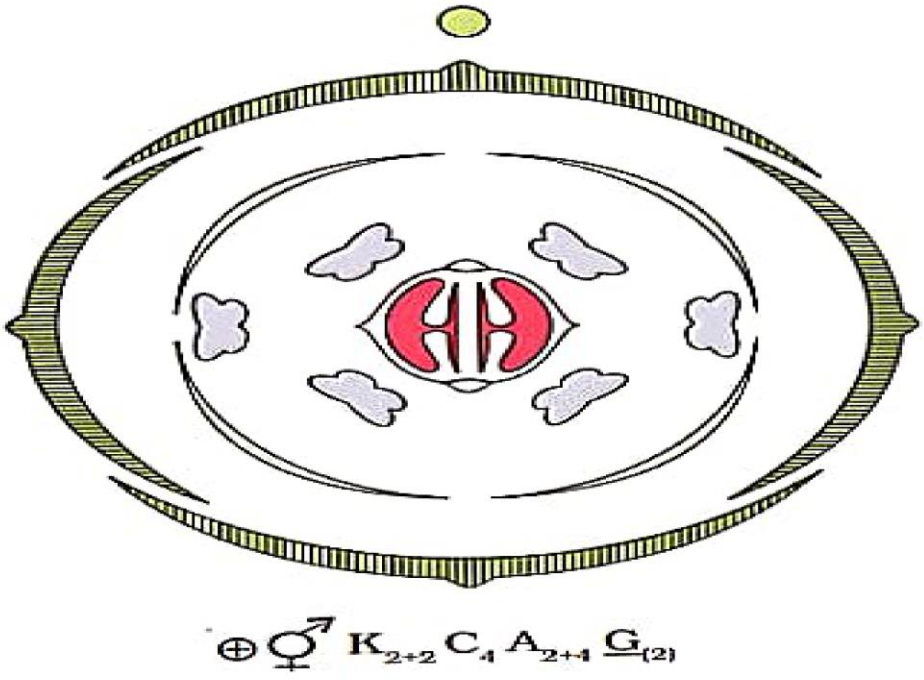
Floral diagram of Angiosperm

1.Identify the type of flower shown.

2.Write the floral formula based on diagram.

3.What does symmetry shown indicate?

4.State the importance of floral diagrams.



Types of chromosome

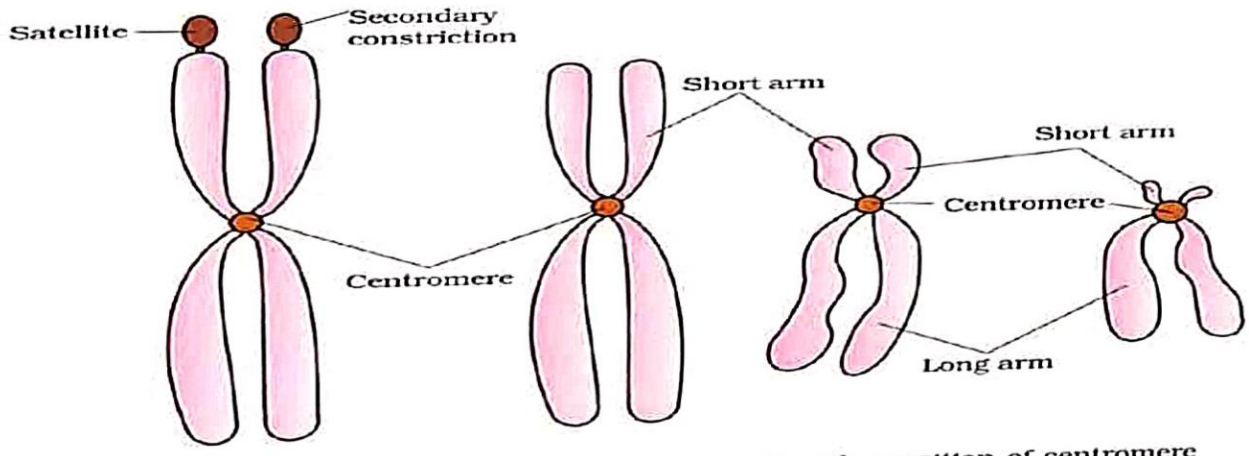
1.Which chromosome has terminal centromere?

2.Differentiate between metacentric and acrocentric chromosome.

3.How does centromere position affect chromosome shape?

4.Which chromosome type has a centrally placed centromere?

5.Name the chromosome type with maximum symmetry?



Types of chromosomes based on the position of centromere