CHAPTER : 1 THE LIVING WORLD

All living beings reproduce their progeny

All living organisms grow in size and number

All biochemical reactions take place inside a living system. A sum total of all biochemical reactions taking place inside a living system is known as metabolism.

Anabolism

Catabolism

The process which results in synthesis of a compound.

The process which results in breaking down of a compound.

Term used to refer the varieties of living organisms found in a geographical area.

Biodiversity

Identification

Classification

Biological Nomenclature

What is Living?

Diversity in the living world

The Living World

Herbarium

Botanical Garden

Museum

Zoological Parks

Taxonomic Aids

Keys

Manuals

Taxonomy and Systematics

Taxonomy and Systematics

Taxonomical Categories

Concept of Species

- Kingdom
- Division/Phylum
- Class
- Order
- Family
- Genus
- Species

Need for Classification

ICBN: KZN

- Generally in Latin and written in italics.
- First component is genus, with capital letter.
- Second component is species, with small letters.
- When handwritten, the names are underlined.

(International code for biological nomenclature)

(International code for zoological nomenclature)

- It makes identification of organisms very clear and easy.
- Study of organisms become convenient
- Evolutionary trends can be easily understood

It is basic unit of classification

- Taxonomy is the study of organisms on the basis of their characteristics
- Systematics is the study of diversity of organisms and all their comparative and evolutionary relationship.

Show historical data about flora and fauna of a particular geographical location.

Specialized gardens having collections of living plants for reference and identification purposes.

Place where dead plants and animals are preserved for study and reference.
CHAPTER : 2 BIOLOGICAL CLASSIFICATION

Biological Classification

Five Kingdoms Classification by Whittaker

- Kingdom Monera (prokaryotes)
- Kingdom Protista
- Kingdom Fungi
- Kingdom Plantae
- Kingdom Animalia

Evolution

- Classification
- Linnean

Two Kingdom

- Kingdom Protista
- Kingdom Eukaryota

Five Kingdoms

- Kingdom Monera
- Kingdom Protista
- Kingdom Fungi
- Kingdom Plantae
- Kingdom Animalia

Characteristics

- Monera
- Protista
- Fungi
- Plantae
- Animalia

Classification

- Fungi
- Protista
- Plantae
- Animalia

Properties

- Monera
- Protista
- Fungi
- Plantae
- Animalia

Chapter 2 Biological Classification

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CHAPTER : 3 PLANT KINGDOM

Plant Kingdom

Plant life cycle

Alternation of generations

Haplo-diplontic

Gametogenesis

Sporogenesis

Zygote

Spores

Meiosis

Hapton

Sporophyte

Gametophyte

Example - Gymnosperm, angiosperm

Example - bryophyte, pteridophyte

Example - Selaginella

Example - Equisetum

Example - Dryopteris

Example - Psilotum

Bryophyta

Mosses

Example - Funaria

Psilopsida

Lycopsida

Pteridopsida

Example - Marchantia

Algae

Bryophyta

Gymnosperm

Angiosperm

Dicotyledones

Monocotyledones

Has two cotyledons in their seeds. E.g: Mustard, Pea, Beans etc.

Has one cotyledon in their seeds. E.g: Grasses, Wheat, Rice etc.

Plant with naked seeds. E.g: Cycas

Examples - Gymnosperm, angiosperm

Example - Spirogyra

Example - Gymnosperm, angiosperm

Example - bryophyte, pteridophyte

Gametogenesis

Meiosis

Gametophyte

Sporophyte

Zygote

Spores

Meiosis

Hapton

Sporophyte

Gametophyte

Example - Gymnosperm, angiosperm

Example - bryophyte, pteridophyte

Example - Spirogyra

Plants with naked seeds. E.g: Cycas

Example - Gymnosperm, angiosperm

Example - bryophyte, pteridophyte

Example - Spirogyra

Plants with naked seeds. E.g: Cycas

Example - Gymnosperm, angiosperm

Example - bryophyte, pteridophyte

Example - Spirogyra

Plants with naked seeds. E.g: Cycas

Example - Gymnosperm, angiosperm

Example - bryophyte, pteridophyte

Example - Spirogyra
CHAPTER 4: ANIMAL KINGDOM

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CHAPTER 7: Structural Organization in Animals

Structural Organization in Animals

Animal Tissues
- Epithelial
- Muscular
- Connective
  - Adipose
  - Areolar
  - Dense connective tissue
  - Dense irregular
  - Dense Regular
  - Supportive connective tissue
Neural
- Neuron
- Neuroglial

Excretion
Reproduction
Male
- Testes
- Ovaries
Female
- Male
- Female

Nervous
- Digestive
- Morphology
  - Head
  - Thorax
  - Prothorax
  - Mesothorax
  - Metathorax
  - Abdomen
- Midgut
- Hindgut
- Foregut
- Circulatory
  - Open type: Have poorly developed blood vessels
- Respiratory
- Trachea
- Spiracles
- Adhering junctions
- Glands
- Fluid connective tissue
- Blood
- Lymph

Morphology of Cockroach
- Morphology
- Prothorax
- Mesothorax
- Metathorax
- Abdomen
- Thorax
- Prothorax
- Metathorax
- Head
- Thorax
- Abdomen
- Segmentation
- Ganglia
- Malpighian tubules
- Cell body
- Dendrons
- Axon
- Chambers
- Anterior aort
- Alary muscle
- Chambers of heart
- 4-chambered
- 3-chambered
- Open type
- Segmentally arranged ganglia joined by paired longitudinal connectives
- Malpighian tubules
- • Cell body
- • Dendrons
- • Axon
- Segmentation
- Ganglia
- Malpighian tubules
- Cell body
- Dendrons
- Axon
- Chambers of heart
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- • Dendrons
- • Axon

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CHAPTER : 8 CELL : THE UNIT OF LIFE

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CHAPTER : 9 BIOMOLECULES

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CHAPTER 10: CELL DIVISION AND CELL CYCLE

Cell Division and Cell Cycle

- **Interphase**
  - G1
  - S
  - G2

- **M-phase**
  - Prophase
  - Metaphase
  - Anaphase
  - Telophase

- **Meiosis**
  - Meiosis I
    - Prophase I
    - Metaphase I
    - Anaphase I
    - Telophase I
  - Meiosis II
    - Prophase II
    - Metaphase II
    - Anaphase II
    - Telophase II

- **Stages of Mitosis**
  - Early Prophase
  - Late Prophase
  - Metaphase
  - Anaphase
  - Telophase

- **Plant cell**

- **Cytokinesis**

- **Cell wall formation starts in the centre**

- **Starts with appearance of furrow in the plasma membrane**

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CHAPTER: 11 TRANSPORT IN PLANTS

Transport in Plants

One molecule move independent of other.

When both molecules move in the same direction

Both molecules move in opposite direction

Energy is required to pump molecules against concentration gradient.

Diffusion

Facilitated Diffusion

Means of Transport

Dielectrophoresis

Unimport

Symport

Antiport

Active Transport

Plant Water Relations

Mass flow hypothesis

It is the most accepted theory for the translocation of sugar from source to sink.
- Source cells are cells which are the supplier of the food material, mainly leaves.
- Sink cells are cells which require food material for growth and repair.

Transport of Mineral Ions

Minerals are absorbed by the roots by passive and active transport. The active uptake of ions requires ATP energy.

Unloading of mineral ions occur at fine vein endings of the leaves through diffusion. Some minerals are also remobilised from old senescing parts N, P, K, S.

It is a positive pressure that develops in the roots by the active absorption of nutrients from the soil.

Transpiration creates transpirational pull for absorption and transport in plants.

Absorption of water

Water movement up a plant

Symplast Pathway

Apoplastic Pathway

- Water Potential (Ψw) : Ψs + Ψp
- Osmosis Diffusion of solvent (water) across the semi-permeable membrane.
- Plasmolysis: Shrinking of protoplasm in a cell, away from its cell wall and toward the center
- Imbibitions

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CHAPTER : 12 MINERAL NUTRITION

Nitrogen cycle

Metabolism of Nitrogen

Development of root nodules in Soyabean

Mineral Nutrition

Toxicity of Micronutrients

Essential Mineral Elements

Methods to Study the Mineral Requirements of Plants

Hydroponics

Plant is cultured in soil-free defined minerals solution

In higher dose, micronutrient become toxic. Toxicity of one element may lead to deficiency of other elements since the former may inhibit the uptake of latter.

Element must be absolutely necessary for normal growth and development

Element must be directly involved in the metabolism of plant.

Requirement of element must be specific and not replaceable

Two Categories of Elements

Macro nutrient

Required in large quantity. E.g. Hydrogen, Oxygen, Nitrogen, phosphorus, sulphur, potassium, calcium and Magnesium

Micro nutrient

Required in less quantity. E.g. Cobalt, manganese, Zinc, Iron, Copper, Molybdenum, Boron, chlorine and nickel.

Deficiency symptoms are morphological changes in plants, indicating nutrient deficiency.
CHAPTER: 13 PHOTOSYNTHESIS IN HIGHER PLANTS

Photosynthesis is an enzyme-regulated anabolic process of manufacture of organic compounds inside the chlorophyll-containing cells, from carbon dioxide and water with the help of sunlight as the source of energy.

6CO₂ + 12H₂O → \text{light} \xrightarrow{\text{Chlorophyll}} C₆H₁₂O₆ + 6H₂O + 6O₂

Photosynthesis is a Means of Autotrophic Nutrition

Factors Affecting Photosynthesis
- Light
- Carbon dioxide
- Temperature
- Water

Site of photosynthesis: Chloroplast in leaves

Pigments Involved in Photosynthesis
- Chl a
- Chl b
- Xanthophylls
- Carotenoids

C₃ or Calvin cycle
- Occurs in mesophyll and bundle sheath cells.
- Enzyme RubisCo is absent from the mesophyll cells

C₄ or Hatch and Slack pathway
- Carboxylation
- Reduction
- Regeneration
- For every CO₂ molecules, 3 molecules of ATP and 2 molecules of NADPH are required

Chemiosmotic hypothesis
- Photophosphorylation
- Photophosphorylation is involved in the process of ATP synthesis in thylakoids of chloroplast

Non-cyclic
- Involves only photosystem I
- Only ATP is formed
- Electrons move in a closed circle

Cyclic
- Involves both photosystem I and II
- Both ATP and NADPH are produced
- Electrons do not move in a closed circle

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CHAPTER : 14 RESPIRATION IN PLANTS

Respiration is an energy releasing enzymatically controlled catabolic process which involves a step-wise oxidative breakdown of food substances inside living cells.

Respiration is termed as amphibolic pathway as it involves both anabolism and catabolism.

RQ formula

\[ RQ = \frac{\text{Volume of } CO_2 \text{ Evolved}}{\text{Volume of } O_2 \text{ Consumed}} \]

R.Q. values = 1 (for carbohydrate... R.Q. = 0.7...
R.Q. = 0.9....

Fermentation (Incomplete oxidation of pyruvic acid, under anaerobic condition)

Glycolysis box

2nd of - Electron transport chain (Site: Inner mitochondrial membrane)

TCA Tricarboxylic Acid (Matrix of mitochondria)

3rd of-TCA/ Tricarboxylic acid (Site: Matrix of mitochondria)

Glucose

C6H12O6

\[ \text{Glyceraldehyde 3-phosphate} \]

\[ \text{Pyruvic acid} \]

\[ \text{Lactic acid} \]

\[ \text{NAD}^+ \text{H} \]

\[ \text{NAD}^+ \text{H} \]

\[ \text{Ethanol} + \text{CO}_2 \]

The Citric acid cycle

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CHAPTER : 15 PLANT GROWTH AND DEVELOPMENT

Plant Growth and Development

Growth rate

Increase in growth per unit time

Conditions of growth

Water
Oxygen
Nutrients
Optimum temperature
Gravity

Differentiation

Process in which cells become specialized to perform specific function

Dedifferentiation

Process in which differentiated cells that have lost the capacity to divide regain their capacity to divide under certain conditions.

Sequence of developmental processes

Promotion of flowering by a period of low temperature

Auxin
Cytokinin
Ethylene
ABA

Growth of a particular system per unit time, expressed on a common basis

Relative growth rate

Measurement and comparison of total growth per unit time.

Absolute growth rate

Quantitative comparison between growth is done by

Phases of plant growth

Size/weight of the organ

Log phase

Exponential phase

Stationary phase

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CHAPTER 16: DIGESTION AND ABSORPTION

- Parts
  - Mouth, Pharynx, Oesophagus, Stomach, Small Intestine, Large Intestine, Rectum, Anus.

Histology
- Serosa
- Muscularis
- Sub-mucosa
- Mucosa

Gastric glands
- Maca: neck cells
- Parietal cells

Digestive System
- Protein, Energy, Maltose, Kwaabker
- Macarons

Digestion of Food
- Chemical: Trypsin, amylase, lipase, nuclease, maltase, lactase, nuclease

Digestion and Absorption
- Absorption of Digested Products
  - Mouth: Certain drugs, stomach: Water, simple sugars, some drugs and alcohol, small intestine: Almost all nutrients including minerals, vitamins etc.
  - Large intestine: Water, some minerals and some drugs

Disorders of Digestive System
- Nutritional disorders
- Improper digestion
- Infection
- Frequent defecation of liquid stools
- Vomiting
- Excretion of stomach content
- Disease of liver
- Jaundice
- Constipation
- Dry stools

Physiological
- Carbohydrates: 4 kcal/g
- Protein: 4.1 kcal/g
- Fat: 9 kcal/g
- Carbohydrates: 4 kcal/g
- Protein: 5.6 kcal/g
- Fat: 9.5 kcal/g
- Gastrin
- Enterogastrone
- Secretin
- Cholecykkin
- Villi
- Stomatesatin

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CHAPTER : 17 BREATHING AND EXCHANGE OF GASES

Examples –
- Sponges, coelenterate, flatworm

Examples –
- Insects, centipede, millipede etc.

Example –
- Fishes, tadpoles, prawn etc.

Example –
- Terrestrial animals like human being

Body surface

Tracheal tube

Cilia

Respiratory organs in animals

Human respiratory system

Respiratory volumes and capacities

Transport of O₂

Transport of CO₂

Transport of Gases

Exchange of Gases

Between blood and tissues

Between Alveoli and blood

Regulation of Respiration

Respiratory disorders

- As blood plasma (About 3%)
- As oxyhaemoglobin (About 97%)

- As Carbonic acid (About 7%)
- As carbamino- haemoglobin (About 20-25%)
- As bicarbonates (About 70%)

\[
\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{Carbonic Anhydrase}} \text{H}_2\text{CO}_3 \xrightarrow{\text{Carbonic Anhydrase}} \text{HCO}_3^- + \text{H}^+
\]

- Occupational Respiratory Disorders
- Emphysema
- Asthma
- Bronchitis
- Pneumonia
- Lung cancer

- Neural regulation- Involves respiratory centers, afferent and efferent nerves.
- Chemical regulation- Through chemoreceptors.

Inspiration (Breathing in)

Expiration (Breathing out)

Mechanism of Breathing

- Tidal volume → 500 ml
- IRV → 2500 ml to 3000 ml
- ERV → 1000 ml to 1100 ml
- RV → 1100 ml to 1200 ml
- IC → TV + IRV
- EC → TV + ERV
- FRC → ERV + RV
- VC → ERV + TV + IRV
- Total lung capacity → RV + ERV + TV + IRV or V.C + TRV

Diaphragm relaxed and arched upwards

Volume of thorax decreased

Ribs and sternum raised

Air entering lungs

Diaphragm contracted

Volume of thorax increased

Air expelled from lungs

Ribs cage

Diaphragm decreased

Expiration

Inspiration

Breathing and Exchange of Gases

Examples –
- Insects, centipede, millipede etc.

Example –
- Fishes, tadpoles, prawn etc.

Example –
- Terrestrial animals like human being

Examples –
- Sponges, coelenterate, flatworm
CHAPTER : 20 Locomotion and Movement

- Cartilaginous (Slightly movable)
- Fibrous (Immovable)
- Synovial (movable)
- Joints
- • Ball and socket joint
  • Hinge joint
  • Pivot joint
  • Gliding joint
  • Saddle joint

Types of Movement
- Disorders of muscular and skeletal system
- Properties of muscle fibers
- Types of muscles
  • Excitability
  • Contractility
  • Extensibility
  • Elasticity
- Amoeboid
- Ciliary
- Muscular
- Skeletal
- Visceral
- Cardiac

Locomotion and Movement

Axial (80 bones)
- Skull (40 bones)
- Vertebral column
- Ribs (12 pairs)
- Appendicular (126)
- Limb bones
- Bones of forelimbs (30 x 2 = 60)
- Bones of hindlimbs (30 x 2 = 60)
- Pectoral girdle (2 x 2 = 4)
- Pelvic girdle (2)

H zone
I band
A band
Relaxed
Z line
Z line
Z line
Contracting
Maximally Contracted
Two Sarcomeres
CHAPTER 21: NEURAL CONTROL AND COORDINATION

Neural organization is very simple in lower invertebrates.

- Human Eye
  - Outer Ear: Middle Ear: Inner Ear
  - Retina: Sclera: Cornea

- Human Ear
  - Cochlea: Middle Ear: Inner Ear

- Brain
  - Cerebrum: Thalamus: Hypothalamus

- CNS
  - Brain: Mid brain: Hind brain

- Spinal Cord
  - Somatic: Parasympathetic: Autonomic

- Spinal Nerve (21 pairs)

- Nerve Fibres

- Structure
  - Axon chain: Non-myelinated axon

- Types of Neuron
  - Multinodal: Bipolar: Unipolar

- Generation and conduction of nerve impulse
  - Maintenance of resting potential
  - Action potential
  - Propagation of action potential

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CHAPTER: 22 CHEMICAL COORDINATION AND INTEGRATION

Hormones (Chemical messengers of the body)

- Exocrine (With duct)
- Endocrine (Without duct)
- Heterocrine (Partly endocrine and partly exocrine)

Gland Types

- Releasing hormone
- Inhibiting hormone
- Adenohypophysis
- Neurohypophysis
- Melatonin
- Pineal
- Thyroid
- T3
- T4 (Thyroxine)
- Thyrocalcitonin
- Parathyroid hormone
- Thymosins
- Thymus

Hormones of Heart, Kidney and Gastrointestinal Tract

- Heart → ANF
- Kidney → Renin, Erythropoietin and calcitriol
- Gastrointestinal Tract → Gastrin, GIP, Secretin, Cholecystokinin, Duodcinin, Villikinin, Enterocinin

Mechanism of Hormone Action

- Adrenal cortex
- Adrenal medulla
- Pancreas
- Testes
- Ovary

Chemical Coordination and Integration

- Hypothalamus
- Pineal
- Pancreas
- Testosterone
- Insulin
- Glucagon
- Adrenaline
- Noradrenaline
- Estrogen
- Progesterone

Water soluble hormones
- Hormone (e.g., FSH)
- Overton red membrane
- Response 1
- (Generation of second messenger: AMP or Ca²⁺)
- Biochemical responses
- Physiological responses (e.g., ovarian growth)

Lipid soluble hormones

Human Endocrine System

- Ovary (in female)
- Testis (in male)