✅ UNIT 1 – Introduction & Classification

◆ Biology as a Science

- Study of life and living organisms.

- Based on observation, hypothesis, experiment.

- Life shows growth, reproduction, metabolism, evolution.

◆ Science vs Engineering

- Science → Understand natural systems (eye).

- Engineering → Apply principles (camera).

◆ 18th Century Observations

- **Robert Brown** → Brownian motion.

- **Julius Robert Mayer** → Energy conservation idea.

◆ Classification

Based on:

- Cellularity (unicellular/multicellular)

- Prokaryote vs Eukaryote

- Autotroph vs Heterotroph

- Aminotelic, ureotelic, uricotelic

- Habitat

- Molecular taxonomy (3 domains)

◆ Model Organisms

- Escherichia coli

- Drosophila melanogaster

- Arabidopsis thaliana

✅ UNIT 2 – Genetics

◆ Mendel's Laws

- Law of Segregation

- Law of Independent Assortment

🔷 Alleles

- Alternative forms of gene.

- Dominant vs Recessive.

🔷 Mitosis vs Meiosis

- Mitosis → Growth (identical cells)

- Meiosis → Gametes, variation

🔷 Gene Mapping

- Based on recombination frequency.

- Unit: centiMorgan.

🔷 Gene Interaction

- Epistasis → One gene masks another.

🔷 Single Gene Disorders

- Sickle-cell disease

- Hemophilia

🔷 Complementation

- Mutations in different genes restore normal phenotype.

✅ UNIT 3 – Enzymes & Information Transfer

🔷 Enzymes

- Biological catalysts.

- Lower activation energy.

- Highly specific.

Enzyme Classification

- Oxidoreductases

- Transferases

- Hydrolases

- Lyases

- Isomerases

- Ligases

Enzyme Kinetics

- Vmax → Maximum rate

- Km → Substrate affinity

- Michaelis-Menten equation

RNA Catalysis

- Ribozymes (RNA as enzyme).

🔷 Information Transfer

DNA as Genetic Material

- Double helix structure by
  James Watson and
  Francis Crick

Genetic Code

- Triplet codons

- Universal

- Degenerate

Central Dogma

DNA → RNA → Protein

✅ UNIT 4 – Macromolecular Analysis

🔷 Reductionism

- Study biological systems at molecular level.

🔷 Protein Structure Hierarchy

1. Primary – Amino acid sequence

2. Secondary – Alpha helix, Beta sheet

3. Tertiary – 3D folding

4. Quaternary – Multiple subunits

🔷 **Protein Functions**

- Enzymes

- Transporters

- Receptors

- Structural proteins

🔷 **Structure determines function.**

✅ **UNIT 5 – Metabolism**

🔷 **Thermodynamics**

- First Law → Energy conservation

- Second Law → Entropy increases

🔷 **Exergonic vs Endergonic**

- $\Delta G < 0$ → Spontaneous

- $\Delta G > 0$ → Non-spontaneous

🔷 **ATP**

- Energy currency of cell.

- ATP → ADP + Pi + Energy

🔷 **Glycolysis**

- Glucose → Pyruvate

- Produces ATP & NADH

🔷 **Krebs Cycle**

- Discovered by Hans Krebs

- Produces NADH, $FADH_2$

🔷 **Photosynthesis**

- $CO_2 + H_2O$ → Glucose

- Occurs in chloroplast.

🔷 **Energy Charge**

$(ATP + \frac{1}{2} ADP) / (ATP + ADP + AMP)$

✅ UNIT 6 – Microbiology, Plant Physiology & Ecology

🔷 Microbiology

- Single-celled organisms perform all life functions.
- Species vs Strain concept.
- Growth phases: Lag, Log, Stationary, Death.
- Sterilization: Autoclave, filtration.
- Microscopy: Light & Electron.

🔷 Plant Physiology

Transpiration

- Water loss through stomata.
- Drives water transport.

Mineral Nutrition

- Macronutrients (N, P, K)
- Micronutrients (Fe, Zn)

🔷 Ecology

Ecosystem Components

- Biotic (living)
- Abiotic (non-living)

Food Chain

Producer → Consumer → Decomposer

Ecological Pyramids

- Numbers
- Biomass
- Energy (always upright)