
Advanced Biology Syllabus

Unit 1: Introduction: The Scientific Method and Life Processes

Unit 2: Basic Biochemistry

- A) Bonds
 - i. Covalent—the Chemistry of Carbon
 - ii. Ionic
- B) Intermolecular forces of attraction
- C) Water and hydrogen bonding
- D) Acids, bases, buffers and pH
- E) Major Classes of biochemicals
 - i. Functional groups
 - ii. Carbohydrates (mono-, di- and poly-saccharides)
 - iii. Lipids (triglycerides, saturated/unsaturated (mono and poly) fats)
 - iv. Nucleic Acids
 - v. Proteins
 - 1. Amino acids, polypeptides
 - 2. Enzymes
 - 3. Structural proteins
 - vi. Glycoproteins, glycolipids, phospholipids

Unit 3: The Cell

- A) Cell Theory
- B) Cell Structure
 - i. Plasma membrane
 - ii. Cytoskeleton
 - iii. Nucleus
 - iv. Other Organelles
 - 1. Synthesis, processing, storage
 - a. Endoplasmic reticulum (RER/SER)
 - i. Protein transport
 - ii. Protein processing and storage
 - b. Ribosomes and polypeptide synthesis
 - c. Golgi Complex and glycosylation
 - d. Lysosomes , peroxisomes and glyoxysomes
 - e. Vacuoles
 - f. Centrioles
 - 2. Energy production
 - a. Chloroplasts
 - b. Mitochondria

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3. Movement

- a. Dynein
- b. Actin/ Myosin
- C) Prokaryotes vs Eukaryotes
- D) Animal cells vs Plant cells--Cell Walls

Unit 4: Energy Considerations of Biological Activity

- A) Thermodynamic principles
- B) ATP
- C) Enzymes and Co-enzymes
- D) The Electron Transport Chain and ATP

Unit 5: Cellular Respiration

- A) Anaerobic respiration
 - i. Fermentation
 - ii. Lactic Acid production
- B) Aerobic respiration
 - i. Pyruvate → AcetylCoA
 - ii. Citric Acid Cycle/Kreb's Cycle
 - iii. Electron Transport Chain—Chemiosmotic Theory Revisited
- C) Photorespiration

Unit 6: Photosynthesis

- A) Overall equation
- B) Light-independent reactions
 - i. Calvin-Benson Cycle
 - ii. Carbon fixation
- C) Light-dependent reactions (Hill reactions)
 - i. Chloroplasts/ thylakoids
 - ii. Photosystem I
 - iii. Photosystem II
- D) C-4 synthesis
- E) Crassulacean Acid Metabolism (CAM Photosynthetic Pathway)

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Unit 7: Cellular Reproduction

- A) The Nucleus revisited
 - i. DNA and Chromatin
 - ii. Chromosomal Structure
 - iii. The Cell Cycle
- B) Mitosis
- C) Meiosis
- D) Mitosis vs Meiosis
 - i. Differences in Mitotic/Meiotic Processes between Plant and Animal Cells

Unit 8: Mendelian Genetics

- A) Mendel's Laws
- B) Genes and Alleles
- C) Crosses
 - i. Monohybrid and dihybrid
 - ii. Test crosses
- D) Dominance Relationships
 - i. Incomplete
 - ii. Complete
 - iii. Multiple Alleles
 - iv. Epistasis
 - v. Pleiotropy
 - vi. Linked Genes
- E) Sex-linked Inheritance
- F) Human Genetic Defects

Unit 9: Molecular Genetics

- A) Historical Development
- B) Structure of DNA and RNA
- C) The Central Dogma: One Gene-One Polypeptide
- D) Overview of Gene Expression
- E) Codons and the Genetic Code
- F) DNA Replication
- G) Structure of RNA
- H) Transcription and Translation
 - i. RNA synthesis
 - 1. rRNA and ribosomes
 - 2. tRNA

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- 3. mRNA
- ii. Initiation, Elongation, Termination
- iii. Polyribosomes (polysomes)
- Gene Regulation
 - 1. Operons
 - 2. Inducible genes
- i. Mutations
- ii. Point mutations
- iii. Chromosomal mutations
 - 1. Nondisjunction
 - 2. Deletions
 - 3. Inversions
 - 4. Translocations
 - 5. Transpositions
- B) Recombinant DNA and Genetic Engineering
 - i. Techniques: Current applications and issues

Unit 10: Evolution

- A) Historical Development (Oparin-Haldane)
- B) Darwin's Theory
- C) Evidence
 - i. Variation
 - ii. Adaptation/Speciation
 - iii. Comparative Anatomy, embryology, biochemistry
 - iv. Paleontology
- D) Natural Selection
- E) Hardy-Weinberg Equilibrium
- F) Macroevolution vs microevolution
- G) Taxonomy
- H) Patterns of Evolution
 - i. Convergent
 - ii. Divergent
- I) Human Evolutionary History
- J) Animal behavior and Population Genetics
- K) Origins of Life
 - i. Heterotrophic
 - ii. Endosymbiotic

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Unit 11: The Six Kingdoms: Diversity of Life

- A) Archaeobacteria
 - i. Methanogens
 - ii. Extreme halophiles
 - iii. Thermoacidophiles
- B) Monera—Prokaryotes
 - i. Blue-green algae
 - ii. Bacteria and bacterial reproduction
- C) Protista-- Eukaryotes
 - i. Protozoans
 - ii. Slime molds
 - iii. Algae
 - iv. reproduction
- D) Fungi
 - i. Division
 - ii. Reproduction
- E) Plantae
 - i. Non-Vascular : Bryophytes
 - ii. Vascular: Traecheophytes
 - iii. Anthrophytae
 - iv. Seed plants (Monocot, Dicot)
 - 1. Angiosperms
 - 2. Gymnosperms
- F) Animalia
 - i. Invertebrates
 - 1. Phylum Porifera
 - 2. Phylum Cnidaria
 - 3. Phylum Platyhelminthes
 - 4. Phylum Nematoda
 - 5. Phylum Rotifera
 - 6. Phylum Annelida
 - 7. Phylum Mollusca
 - 8. Phylum Echinodermata
 - 9. Phylum Arthropoda
 - ii. Vertebrates/Chordates
 - 1. Phylum Hemichordata
 - 2. Phylum Chordata
 - a. Subphylum Urochordata
 - b. Subphylum Cephalochordata
 - 3. Subphylum Vertebrata
 - a. Class Agnatha
 - b. Class Chondrichthyes

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- c. Class Osteichthyes
 - d. Class Amphibia
 - e. Class Reptilia
 - f. Class Aves
 - g. Class Mammalia
- G) Viruses
- i. DNA
 - ii. RNA
 - iii. Bacteriophages
- H) Lichen

Unit 12: Plant Reproduction and Structure

- I) Asexual Reproduction
- i. Binary fission
 - ii. Budding
 - iii. Sporulation
 - iv. Regeneration
 - v. Vegetative Propagation
- J) Sexual Reproduction
- i. Flower structure
 - ii. Seed Development
- K) Leaf structure
- L) Vascular Structure
- i. Water Transport—transpirational pull
 - ii. Sugar transport

Unit 13: Animal Function: Anatomy and Physiology

- M) Anatomy
- i. Organ
 - 1. Brain
 - 2. Eye
 - 3. Heart
 - 4. Endocrine
 - 5. Exocrine
 - 6. Skin
 - ii. Tissue
 - 1. Neuron
 - 2. Muscle
 - 3. Vascular
 - 4. Glandular

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- 5. Epithelial
- N) Physiology
 - i. Support and Movement
 - 1. Skeletal
 - 2. Muscular
 - a. Voluntary
 - b. Smooth
 - c. Cardiac
 - ii. Neural Control
 - 1. The neuron
 - 2. The Nervous System
 - a. CNS
 - b. Peripheral
 - i. Somatic
 - ii. Autonomic
 - c. The Senses
 - i. Receptors
 - ii. Tactile reception
 - iii. Thermoreception
 - iv. Chemoreception
 - v. Proprioception
 - vi. Auditory reception
 - vii. Visual reception
 - iii. Regulatory Systems
 - 1. Thermoregulation
 - 2. Osmoregulation and Excretion
 - 3. Exocrine
 - 4. Endocrine
 - 5. Homeostasis—networking of the systems
 - iv. Digestion and Nutrition
 - v. Circulation
 - vi. Respiration
 - vii. Immunoregulation

Unit 14: Reproduction

- O) Ontogeny Recapitulates Phylogeny
- P) Asexual
- Q) Sexual
 - i. Invertebrates
 - ii. Vertebrates
- R) Human Reproduction

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- i. Male Reproductive System
 - ii. Female Reproductive System
- S) Development
 - i. Gametogenesis
 - ii. Fertilization
 - iii. Embryogenesis
- T) Species Differences

Unit 15: Behavioral Ecology

- U) Development
 - i. Genetic Basis
 - ii. Instinct
 - iii. Learning
 - iv. Memory
 - v. Interactions of Genes, Instinct, Learning and Memory
- V) Adaptations of Behavior
 - i. Causation
 - 1. Proximate
 - 2. Ultimate
 - ii. Biorhythms
 - 1. Diurnal
 - 2. Nocturnal
 - iii. Orientation and Navigation
 - iv. Communication
 - 1. Visual
 - 2. Chemical
 - 3. Aural
 - 4. Tactile
 - v. Social Behavior
 - 1. Agonistic Behavior
 - 2. Cooperation
 - 3. Fighting
 - 4. Symbiosis
 - 5. Altruism

Unit 16: Ecology

- W) Niches: Individual, Population and community
- X) Succession—Flora and Fauna
 - i. Pioneer Organism
 - ii. Climax community
- Y) Nitrogen, Carbon and Phosphorus Cycles