

# Secondary School Certificate Examination Syllabus

## BIOLOGY

### CLASSES IX

(Based on National Curriculum 2006)

Class IX examination in 2010 and onwards

### Part I (Class IX)

#### **1. Introduction to Biology:**

##### **1.1 Introduction to Biology:**

1.1.1 Define biology and its major divisions i.e. botany, zoology and microbiology

##### **1.2 Divisions and Branches of Biology:**

1.2.1 Define the branches of biology

morphology, anatomy, physiology, embryology, taxonomy, cell biology, histology, paleontology, environmental biology, biotechnology, socio-biology, parasitology, immunology, entomology, genetics, pharmacology and their significance

##### **1.3 Relation of Biology to other Sciences:**

1.3.1 Explain the relationship of biology with other branches of science (physics, chemistry, mathematics, geography and economics) with examples

##### **1.4 Impact of Biological Studies on Human Welfare:**

1.4.1 Explain how the study of biology can lead to medicine and surgery, fisheries, agriculture, animal husbandry, biotechnology, horticulture, farming, forestry and pollution control

1.4.2 Identify and evaluate the impact of scientific advancements in technology on society (disease control, hereditary diseases, cloning, bio-pesticides)

##### **1.5 Quran Instructs to Reveal the Study of Life:**

1.5.1 State at least three verses from Holy Quran, instructing for the study of the origin and the characteristics of life

##### **1.6 Contribution of Scientists:**

1.6.1 Relate the contributions of Jaber Bin Hayan, Abdul Malik Asmai and Bu Ali Sina with the current knowledge about plants and animals

##### **1.7 The Levels of Organization:**

1.7.1 Describe bio elements as the most basic level of biological organization;

1.7.2 Define bio molecules and distinguish them with examples micro molecules and macromolecules

1.7.3 Describe the level of organization of life (organelles, cells, tissues, organs, organ systems and individuals)

1.7.4 Construct a linkage chart connecting different organs with the relative organ system

1.7.5 Explain division of Labour among cells and tissues in a multi cellular organism

1.8.1 Differentiate between unicellular and multi cellular organisms

1.8.2 Describe cellular organization in unicellular organisms i.e. Amoeba

## **1.8 Unicellular and multi cellular Organisms:**

- 1.8.3 Describe the cellular organization in multi cellular organisms (mustard and frog)  
(Only brief description referring to cellular organization is required. Details of organs and organs-systems of frog and mustard should be avoided)

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## **2. Solving a Biological Problem:**

### **2.1 Biological Method:**

- 2.1.1 Describe the steps involved in biological method i.e. recognition of a biological problem, observation and identification, building up hypotheses, drawing deductions, devising experiments and inferring results (malaria as an example)
- 2.1.2 Solve a biological problem following the scientific method
- formulate and test a working hypothesis
  - write instructions for conducting investigations or following a procedure
  - select appropriate instruments and materials to conduct an investigation
  - describe safe laboratory procedures
  - organize data appropriately using techniques such as tables and graphs
  - analyze data to make predictions, decisions, or draw conclusions
  - confirm, modify, or reject a hypothesis using data analysis
  - use ratio and proportion in appropriate situations to solve problems

## **3. Biodiversity:**

### **3.1 Introduction:**

- 3.1.1 Define biodiversity
- 3.1.2 Describe the major variety of life on the planet earth
- 3.1.3 Relate the importance of biodiversity with natural ecosystems (land and water) through examples

### **3.2 Aims and Principles of Classification:**

- 3.2.1 Describe the bases of classification of living organisms (with reference to homology, analogy, morphology, anatomy and embryology)
- 3.2.2 Explain the aims and principles of classification with its historical background
- 3.3.1 Identify the contribution of Aristotle as the founder of biological classification
- 3.3.2 Explain the bases for establishing five kingdoms

### **3.3 History of Classification Systems:**

- 3.3.3 Compare Two-kingdom and Five-kingdom classification systems
- 3.3.4 Rationalize that Five-kingdom classification system better explains diversity of living organisms
- 3.3.5 Describe the contributions of Abu Usman Umer Aljahiz in unfolding the characteristics of animal species

### **3.4 Units of Classification:**

- 3.4.1 Define the units of classification (species, genus, family, order, class, division / phyla, kingdom)

### **3.5 The Five Kingdoms:**

- 3.5.1 Describe the salient features of Kingdom Prokaryotae with examples
- 3.5.2 Describe the salient features of Kingdom Protocista with examples
- 3.5.3 Describe the salient features of Kingdom Fungi with examples

- 3.5.4 Describe the salient features of Kingdom Plantae with examples (a brief description of the structural features of Bryophytes, Tracheophytes, Pteridophytes, Gymnosperms and Angiosperms should be included)
- 3.5.5 Describe the salient features of Kingdom Animalia with examples (a brief description of structural features of Invertebrates and Vertebrates should be included)
- 3.5.6 Describe the cellular structure of virus and justify why viruses are excluded from the Five Kingdom classification system

### **3.6 Binomial Nomenclature:**

- 3.6.1 Describe the aims and principles of binomial nomenclature with examples

### **3.7 Conservation of Biodiversity:**

- 3.7.1 Define the concept of conservation and its importance
- 3.7.2 Explain the impact of human beings on biodiversity
- 3.7.3 Identify causes of deforestation and hunting and its effects on biodiversity
- 3.7.4 Describe the reason why a named animal species becomes endangered due to human interference

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## **4. Cells and Tissues:**

- 4.1 Microscopy and the Emergence of Cell Theory
  - 4.1.1 Explain the concepts of light microscopy and electron microscopy
  - 4.1.2 Explain the relationship between developments in imaging technology and the current understanding of the cell
  - 4.1.3 Trace the development of the cell theory: from Aristotle to Hooke, Pasteur, Brown, and Schwann and Schleiden
  - 4.1.4 Construct a time line that traces the development of the cell theory from the first observations by Robert Hooke to our current understanding of cell structure
  - 4.1.5 Rationalize that there are sub-cellular particles, such as viruses and prions, which have some characteristics of living things
- 4.2 **Cellular Structures and Functions:**
  - 4.2.1 Describe the structure and functions of the components of plant and animal cell (cell wall, cell membrane, nucleus, cytoplasm, Golgi bodies, mitochondria, lysosomes, vacuole, ribosomes, endoplasmic reticulum, centromere, plastids)
  - 4.2.2 Differentiate between plant and animal cell
  - 4.2.3 Explain how the cells of the leaf system have a variety of specialized structures and functions
  - 4.2.4 State the relationship between cell structure and cell function (for absorption - root hair cells; conduction and support - xylem vessels; transport of oxygen - red blood cells)
  - 4.2.5 Describe the cell as a structural and functional unit of life
  - 4.2.6 Determine ways in which various types of cells contribute to the healthy functioning of the human body
  - 4.2.7 Assess the capabilities of animal and plant cell types, owing to the presence or absence of chloroplasts and cell wall
  - 4.2.8 Describe the differences in the structure and function of prokaryotic and

eukaryotic cells

- 4.2.9 Describe the capabilities of prokaryotic and eukaryotic cells, owing to the presence or absence of nucleus and mitochondria
- 4.2.10 Describes cell size and shape as they relate to surface area to volume ratio
- 4.2.11 Explain how surface area to volume ratio limits cell size (e.g., compare nerve cells and blood cells in animals, or plant root hair cells and chloroplast containing cells on the surface of leaves)

#### **4.3 Active and Passive Transport of Matter:**

- 4.3.1 Define the terms diffusion, osmosis, active transport, hypertonic solution, hypotonic solution and isotonic solution
- 4.3.2 Describe different types of membranes (permeable, partial-permeable and impermeable)
- 4.3.3 Describe the phenomena of diffusion, facilitated diffusion, osmosis, filtration, active transport, endocytosis and exocytosis with daily life examples
- 4.3.4 Compare passive transport of matter by diffusion and osmosis with active transport (e.g. diffusion of glucose from intestine to villus epithelium and active transport of sodium ions from nerve cell to outside)
- 4.3.5 Describe how knowledge about partially-permeable or differentially permeable membranes, diffusion and osmosis is applied in various contexts (e.g., separation of bacteria from viruses, purification of water, cheese making, use of honey as an antibacterial agent)
- 4.3.6 Define turgor and describe its importance
- 4.3.7 Describe the phenomena of plasmolysis and deplasmolysis and explain its relationship with osmosis
- 4.3.8 Describe the role of the cell membrane in maintaining equilibrium while exchanging matter

#### **4.4 Tissues (Types of Plant):**

- 4.4.1 Describe tissue as the group of similar cells, performing the same function; and Animal Tissues)
- 4.4.2 Differentiate between simple and compound tissues;
- 4.4.3 Describe the major animal tissues (epithelial, connective, muscular and nervous) in terms of their cell specificities, locations and functions;
- 4.4.4 Describe the major plant tissues i.e. simple tissues (meristematic tissues, permanent tissues including epidermal, parenchyma, collenchyma and sclerenchyma) and compound tissues (xylem tissues and phloem tissues) in terms of their cell specificities, locations and functions
- 4.4.5 Relate the function of a particular tissue to its structure and ultimately to the function of the cells constituting it
- 4.4.6 Justify why a colony of cells does not get tissue level of organization, in spite of having many cells

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## **5. Cell Cycle:**

### **5.1 Cell Cycle (Inter phase):**

- 5.1.1 Define cell cycle and describe its main phases i.e. interphase and division; and

Division)

- 5.1.2 Describe the sub-phases of the interphase of cell cycle
- 5.1.3 Explain the importance of S-phase of the interphase
- 5.1.4 Describe the two types of cell division in eukaryotic cells i.e. mitosis and meiosis;
- 5.1.5 Differentiate between haploid and diploid cells with examples

### **5.2 Mitosis:**

- 5.2.1 Enlist the events through which mitotic apparatus is formed in prophase in animal and plant cells
- 5.2.2 Describe the formation of metaphase plate and the division of centromere, during metaphase
- 5.2.3 State the separation of chromatids during anaphase
- 5.2.4 Describe the reformation of nuclei during telophase
- 5.2.5 Describe the physical division of cytoplasm during cytokinesis in animal and plant cells
- 5.2.6 Compare the details of events during mitosis in animal and plant cells
- 5.2.7 Describe the significance of mitosis as giving rise to genetically identical cells and state the role of mitosis in growth, repair of damaged tissues, replacement of worn out cells and asexual reproduction

### **5.3 Meiosis:**

- 5.3.1 Describe the events of Prophase-I
- 5.3.2 Describe the events taking place in Metaphase-I
- 5.3.3 Explain what happens during Anaphase-I
- 5.3.4 Describe the events of Telophase-I
- 5.3.5 Explain the events occurring during the second meiotic division
- 5.3.6 Compare the second meiotic division with mitosis
- 5.3.7 Describe the significance of meiosis as leading to the formation of haploid cells, that may function directly as gametes as in animals or may divide by mitosis as in plants, fungi and many protists
- 5.3.8 Describe the significance of meiosis with reference to the recombination of genes that leads to variations
- 5.3.9 Contrast mitosis and meiosis, emphasizing the events that lead to different outcomes

### **5.4 Necrosis and Apoptosis:**

- 5.4.1 Describe necrosis and apoptosis
- 5.4.2 Correlate necrosis and apoptosis with cell cycle

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## **6. Enzymes:**

- 6.1.1 Define metabolism and differentiate between catabolism and anabolism
- 6.1.2 Describe enzymes as the proteins that speed up biochemical reactions

### **6.1 Characteristics of Enzymes:**

- 6.1.3 Categorize enzymes as intra and extra cellular
- 6.1.4 Comprehend that enzymes increase rate of reaction
- 6.1.5 State that small quantity of enzyme is effective for large amount of substrate
- 6.1.6 Infer that enzymes are specific for specific substrates

- 6.1.7 Explain some enzymes require co-factor for their functioning
- 6.1.8 Describe the concept of energy of activation and how it is lowered by enzyme

### **6.2 Factors Affecting Activity of Enzyme:**

- 6.2.1 Explain the effect of pH, temperature and concentration of substrate on the activity of an enzyme
- 6.2.2 Draw graph showing the effect of pH, temperature and concentration of substrate on the activity of an enzyme
- 6.3.1 Describe, through equation, that enzyme substrate complex is formed and release of enzyme takes place after completing the reaction

### **6.3 Mechanism of Enzyme Action (Lock-n-Key Model):**

- 6.3.2 Describe the action of enzyme through Lock-and-Key model

### **6.4 Specificity of Enzymes:**

- 6.4.1 Describe the specificity of different enzymes for different substrates
- 6.4.2 Relate that specificity of enzyme is due to its shape
- 6.4.3 Categories those proteases will act on proteins only and lipases will act on lipids or fats only

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## **7. Bioenergetics:**

### **7.1 Bioenergetics and ATP:**

- 7.1.1 Define bioenergetics as the study of energy relationships and energy conversions in living organisms
- 7.1.2 Describe the importance of Oxidation-Reduction reactions for the flow of energy through living systems
- 7.1.3 Explain ATP as a molecule that is the chief energy currency of all cells
- 7.1.4 Describe the synthesis and breaking of ATP through ATP-ADP cycle

### **7.2 Photosynthesis:**

- 7.2.1 State that photosynthesis is the fundamental process by which plants manufacture carbohydrates from raw materials
- 7.2.2 State the equation (in words or symbols) for photosynthesis
- 7.2.3 Reason out that all forms of life are completely dependent on photosynthesis
- 7.2.4 Describe that chlorophyll traps light energy and converts it into chemical energy for the formation of carbohydrates and their subsequent storage
- 7.2.5 Outline the processes (Light and Dark reactions) involved in photosynthesis
- 7.2.6 Explain how the structure of the leaf is adapted for photosynthesis

### **7.3 Factors Affecting Rate:**

- 7.3.1 Explain the concept of limiting factors in photosynthesis; of Photosynthesis
- 7.3.2 State the effect of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis

### **7.4 Respiration:**

- 7.4.1 Define respiration
- 7.4.2 Describe aerobic respiration by means of word and symbol equation
- 7.4.3 Describe anaerobic respiration by means of word and symbol equation;
- 7.4.4 Describe the importance of anaerobic respiration with reference to the examples of athletes during race or a person doing strenuous exercise

- 7.4.5 Discuss the fate of lactic acid in the body
- 7.4.6 Explain the mechanism of respiration while defining Glycolysis, Krebs cycle and Electron Transport Chain
- 7.4.7 Compare aerobic and anaerobic respiration
- 7.4.8 Describe ways in which respiratory energy is used in the body

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## **8. Nutrition:**

### **8.1 Mineral Nutrition in Plants:**

- 8.1.1 Define mineral nutrition in plants
- 8.1.2 Categorize minerals nutrients into macronutrients and micronutrients
- 8.1.3 State that nitrogen is important in protein synthesis and magnesium for chlorophyll formation
- 8.1.4 State the effect of lack of nitrate and magnesium ions on plant growth
- 8.1.5 Describe the importance of fertilizers (manure and chemical) in agriculture
- 8.1.6 Discuss environmental hazards related to chemical fertilizers' use

### **8.2 Components of Human Food:**

- 8.2.1 Distinguish among carbohydrates, proteins and fats in terms of their sources, energy values and metabolic functions
- 8.2.2 Specify the food sources and metabolic functions of Vitamins A, C and D
- 8.2.3 Describe the food sources and metabolic functions of Calcium and Iron
- 8.2.4 Describe the deficiency symptoms of Vitamins A, C and D and of Calcium and Iron
- 8.2.5 Specify the sources and metabolic functions of Water and Dietary fibers;

### **8.3 Balanced Diet:**

- 8.3.1 Describe the concept and need for a balanced diet
- 8.3.2 Explain the components of a balanced diet with relation to age, sex and activity;
- 8.3.3 Explain why diet, especially energy intake, should be related to age, sex and activity of an individual

### **8.4 Problems related to Nutrition:**

- 8.4.1 Describe the problems of Protein Energy Malnutrition (PEM), Mineral Deficiency Diseases (MDD), and Over Intake of Nutrients (OIN)
- 8.4.2 State the effects of malnutrition in relation to starvation, heart disease, constipation and obesity
- 8.4.3 Rationalize the unequal distribution of food, drought and flooding, and increasing population as the factors that contribute to famine

- 8.5.1 Describe the needs of ingestion, digestion, absorption, assimilation and egestion

### **8.5 Ingestion, Digestion and Absorption of Food in Man:**

- 8.5.2 Identify and describe the structures of the main regions of the alimentary canal and the associated organs
- 8.5.3 Describe the main functions of these parts in relation to ingestion, digestion, absorption, assimilation and egestion of food
- 8.5.4 Describe swallowing and peristalsis
- 8.5.5 Sort out the action of enzymes in specific regions of alimentary canal, with respect to their substrates and products
- 8.5.6 State the role of the liver in the metabolism of glucose and amino acids, and in the

formation of urea

8.5.7 Describe the structure of a villus, including the roles of capillaries and lacteals

8.5.8 Describe the significance of villi in increasing the internal surface area

8.5.9 State the function of the hepatic portal vein as the route taken by most of the food absorbed from the small intestine

### **8.6 Disorders of Gut:**

8.6.1 State the signs and symptoms, causes, treatments and preventions of the disorders of gut i.e. diarrhea, constipation, and ulcer.

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## **9. Transport:**

### **9.1 Introduction:**

9.1.1 Describe the importance of transport system in living organisms

### **9.2 Transports in Plants:**

9.2.1 Explain the internal structure of root and root hair

9.2.3 Define root pressure, capillary action and transpiration pull

9.2.4 Describe how roots take up water and mineral salts by active and passive absorption

### **9.3 Transpiration:**

9.3.1 Define transpiration and relate this process with cell surface

9.3.2 Relate transpiration with stomatal opening and closing

9.3.3 Describe temperature, wind and humidity as the factors affecting the rate of transpiration

9.3.4 Describe the significance of transpiration

9.3.5 Relate wilting with excessive transpiration

9.3.6 Describe the pathway of water and food in stem

9.3.7 Explain the movement of water in terms of transpiration pull

9.3.8 Explain the mechanism of food translocation by the theory of Pressure Flow Mechanism

### **9.4 Transports in Animals Blood:**

9.4.1 List the components of blood

9.4.2 Describe the functions of the components of blood

9.4.3 Describe the blood groups in ABO and Rh blood group systems, with reference to the presence / absence of antigens and antibodies

9.4.4 State the risk of incompatibility in blood transfusion due to antigen-antibody reactions

9.4.5 List the appropriate donors and recipients for each of the four blood groups

9.4.6 State the signs and symptoms, causes and treatments of the diseases of blood (leukemia and thalassemia)

### **9.5 Human Heart:**

9.5.1 Describe the external and internal structure of human heart;

9.5.2 Describe the circulation of blood through atria and ventricles of the heart, explaining the role of the bicuspid, tricuspid and semilunar valves

9.5.3 Describe the low-pressure circulation to the lungs and a high-pressure circulation to the body tissues and relate these differences to the different functions of the two circuits

9.5.4 Explain how the heart is structurally adapted to its functions

9.5.5 Define the terms heartbeat, heart rate and pulse rate

**9.6 Blood Vessels:**

9.6.1 Compare the structure and function of an artery, a vein and a capillary

9.6.2 Describe the transfer of materials between capillaries and tissue fluid

9.7.1 Describe the major pathway of blood through circulatory system

9.7.2 Describe the origins, locations and target areas of main arteries i.e. pulmonary arteries, aorta with hepatic artery, renal arteries and femoral arteries;

**9.7 General Plan of Human Blood Circulatory System:**

9.7.3 Describe the originating areas, locations and target heart chambers of main veins i.e. pulmonary veins, superior vena cava, inferior vena cava with femoral veins, renal veins and hepatic vein

9.7.4 Identify the main arteries and veins in charts, diagrams, models etc

9.7.5 Discuss the contributions of Ibn-al-Nafees and William Harvey in revealing the knowledge about the circulation of blood in human body

**9.8 Cardiovascular Disorders:**

9.8.1 Define cardiovascular disorders and differentiate between atherosclerosis and arteriosclerosis

9.8.2 State the causes, treatments and prevention of myocardial infarction

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