



آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD

**Higher Secondary School Certificate
Examination Syllabus**

**BIOLOGY
CLASSES XI-XII**

(based on National Curriculum 2006)

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Examination Syllabus**

**BIOLOGY
CLASSES XI-XII**

**This subject is examined in both
May and September Examination sessions**

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PREFACE

In pursuance of National Education Policy (1998-2010), the Curriculum Wing of the Federal Ministry of Education has begun a process of curriculum reform to improve the quality of education through curriculum revision and textbook development (Preface, National Curriculum documents 2000 and 2002).

AKU-EB was founded in August 2003 with the same aim of improving the quality of education nationwide. As befits an examination board it seeks to reinforce the National Curriculum revision through the development of appropriate examinations for the Secondary School Certificate (SSC) and Higher Secondary School Certificate (HSSC) based on the latest National Curriculum and subject syllabus guidance.

AKU-EB has a mandate by Ordinance CXIV of 2002 to offer such examination services to English and Urdu medium candidates for SSC and HSSC from private schools anywhere in Pakistan or abroad, and from government schools with the relevant permissions. It has been accorded this mandate to introduce a choice of examination and associated educational approach for schools, thus fulfilling a key objective of the National Curriculum of Pakistan: “Autonomy will be given to the Examination Boards and Research and Development cells will be established in each Board to improve the system” (ibid. para. 6.5.3 (ii)).

AKU-EB is committed to creating continuity of educational experience and the best possible opportunities for its students. In consequence it offered HSSC for the first time in September, 2007 to coincide with the arrival of its first SSC students in college or higher secondary school. Needless to say this is not an exclusive offer. Private candidates and students joining AKU-EB affiliated schools and colleges for HSSC Part 1 are eligible to register as AKU-EB candidates even though they have not hitherto been associated with AKU-EB.

This examination syllabus exemplifies AKU-EB’s commitment to national educational goals.

- It is in large part a reproduction, with some elaboration, of the Class XI and XII National Curriculum of the subject.
- It makes the National Curriculum freely available to the general public.
- The syllabus recommends a range of suitable textbooks already in print for student purchase and additional texts for the school library.
- It identifies areas where teachers should work together to generate classroom activities and materials for their students as a step towards the introduction of multiple textbooks, another of the Ministry of Education’s policy provisions for the improvement of higher secondary education (ibid. para. 6.3.4).

This examination syllabus brings together all those cognitive outcomes of the National Curriculum statement which can be reliably and validly assessed. While the focus is on the cognitive domain, particular emphasis is given to the application of knowledge and understanding, a fundamental activity in fostering “attitudes befitting useful and peaceful citizens and the skills for and commitment to lifelong learning which is the cornerstone of national economic development” (Preface to National Curriculum documents 2000 and 2002).

To achieve this end AKU-EB has brought together university academicians, teacher trainers, writers of learning materials and above all, experienced teachers, in regular workshops and subject panel meetings.

AKU-EB provides copies of the examination syllabus to subject teachers in affiliated schools to help them in planning their teaching. It is the syllabus, not the prescribed textbook which is the basis of AKU-EB examinations. In addition, the AKU-EB examination syllabus can be used to identify the training needs of subject teachers and to develop learning support materials for students. Involving classroom teachers in these activities is an important part of the AKU-EB strategy for improving the quality of learning in schools.

The Curriculum Wing of the Federal Ministry of Education has recently released new subject specifications and schemes of study to take effect in September, 2008. These documents are a major step forward towards a standards-related curriculum and have been welcomed by AKU-EB. Our current HSSC syllabuses have been revised to ensure conformity with the new National Curriculum 2006.

We stand committed to all students who have embarked upon the HSSC courses in facilitating their learning outcomes. Our examination syllabus document ensures all possible support.



Dr. Thomas Christie
Director,
Aga Khan University Examination Board
July 2009

1. **Aims/Objectives of the National Curriculum (2006)¹**

Aims

The curriculum for Biology for grades IX-X aims to help individual students develop:

- A scientific understanding of the living world.
- Mental and motor abilities appropriate to the acquisition and use of biological understanding.
- An appreciation of the products and influences of science and technology, balanced by a concern for their wise application.
- An understanding of the nature and limitations of scientific activity.
- An ability to apply biological understanding to appropriate problems (including those of everyday life) and to approach those problems in rational ways.
- Respect for evidence, rationality and intellectual honesty.
- Capacities to express themselves coherently and logically, both orally and in writing, and to use appropriately modes of communication characteristic of scientific work.
- An ability to work effectively with others.

Objectives

A statement of objectives relevant to each of the general aims is listed below. The sequence of objectives used here should not be taken as indicating relative weightings.

Understanding the Living World

Students should understand the scientific concepts inherent in the theme for each chapter to be covered well enough to be able to:

- state, exemplify and interpret the concept.
- use appropriately, fundamental terms and classifications related to the concept.
- cite, and explain or interpret, scientific evidence in support of the concept.

Appropriate Mental and Motor Abilities

Students should show some ability to:

- formulate questions that can be investigated by gathering first or second-hand data.
- find relevant published background information.
- formulate hypotheses and make predictions from them.
- plan an investigation and carry out the planned procedures.

¹ Government of Pakistan (2006), *National Curriculum; Biology Classes XI-XII, Islamabad*, Ministry of Education (Curriculum Wing)

- use the motor skills required to carry out investigations.
- observe phenomena, and describe, measure and record these as data.
- classify, collate and display data.
- interpret and construct visual representations of phenomena and relationships (diagrams, graphs, flow charts, physical models etc.).
- analyze data and draw conclusions.
- evaluate investigative procedures and the conclusions drawn from investigations.

Understanding the Nature and Limitations of Scientific Activity

For each of the facets of scientific activity selected for study, students should:

- describe and exemplify it.
- use appropriately and fundamental terms and classifications related to it.
- recognize that the problem-solving nature of science has limitations.
- acknowledge that people engaged in science, a particularly human enterprise, have the characteristics of people in general.

Appreciation of the Influences of Science and Technology

Students should:

- recognize that the technology resulting from scientific activity influences the quality of lifestyle and economic development through or by improvements in medical/health care, nutrition, agricultural techniques.
- understand that these influences may be the result of unforeseen consequences, rapid exploitation or rapid cultural change.
- realize that advances in technology require judicious application.

Ability to Apply Understanding to Problems

Students should:

- recognize that biological knowledge and scientific approaches have relevance to many situations in everyday life.
- recognize when biological knowledge is relevant to a problem.
- recognize when a scientific approach is relevant to a problem.
- select and apply appropriate biological knowledge and skills to clarify and help produce solutions to problems, especially the personal and social problems of everyday life to which such knowledge and skills can apply.
- use thoughtful, rational strategies for decision-making in those everyday situations to which both biological knowledge and value positions are relevant.

Respect for Evidence, Rationality and Intellectual Honesty

Given the number of emotive issues in the area of biology, students should display respect for evidence, rationality and intellectual honesty.

Capacities to Communicate

Students should:

- comprehend the intention of a scientific communication, the relationships between its parts and its relationship to what they already know.
- select the relevant parts from a communication.
- translate information from communications in particular modes (e.g. spoken word, written word, tables, graphs, flow sheets, diagrams) to other modes.
- structure information and use appropriate modes (including the spoken word, writing and diagrams) to communicate it.

Ability to Work with Others

Students should participate in group work in such a way that he or she:

- shares the responsibility for achieving a group task shows concern for the fullest possible participation of each group member.

2. Rationale of the AKU-EB Examination Syllabus

2.1 General Rationale

2.1.1 In 2007, the Curriculum Wing of the Federal Ministry of Education (MoE) issued a revised part-wise Scheme of Studies. All subjects are to be taught and examined in both classes XI and XII. It is therefore important for teachers, students, parents and other stakeholders to know:

- (a) that the AKU-EB Scheme of Studies for its HSSC examination (Annex A) derives directly from the 2007 Ministry of Education Scheme of Studies;
- (b) which topics will be examined in Class XI and in Class XII;
- (c) at which cognitive level or levels (Knowledge, Understanding, Application and other higher order skills) the topics and sub-topics will be taught and examined;

2.1.2 This AKU-EB examination syllabus addresses these concerns. Without such guidance teachers and students have little option other than following a single textbook to prepare for an external examination. The result is a culture of rote memorization as the preferred method of examination preparation. The pedagogically desirable objectives of the National Curriculum which encourage “observation, creativity and other higher order thinking [skills]” are generally ignored. AKU-EB recommends that teachers and students use multiple teaching-learning resources for achieving the specific objectives of the National Curriculum reproduced in the AKU-EB examination syllabuses.

- 2.1.3 The AKU-EB examination syllabuses use a uniform layout for all subjects to make them easier for teachers to follow. Blank sheets are provided in each syllabus for writing notes on potential lesson plans. It is expected that this arrangement will also be found helpful by teachers in developing classroom assessments as well as by question setters preparing material for the AKU-EB external examinations. The AKU-EB aims to enhance the quality of education through improved classroom practices and improved examinations.
- 2.1.4 The Student Learning Outcomes (SLOs) in Section 3 start with command words such as list, describe, relate, explain, etc. The purpose of the command words is to direct the attention of teachers and students to specific tasks that candidates following the AKU-EB examination syllabuses are expected to undertake in the course of their subject studies. The examination questions will be framed using the same command words or the connotation of the command words to elicit evidence of these competencies in candidates' responses. The definitions of command words used in this syllabus are given in Section 7. It is hoped that teachers will find these definitions useful in planning their lessons and classroom assessments.
- 2.1.5 The AKU-EB has classified SLOs under the three cognitive levels, Knowledge (K), Understanding (U) and Application of knowledge and skills (A) in order to derive multiple choice questions and constructed response questions on a rational basis from the subject syllabuses ensuring that the intentions of the National Curriculum should be met in full. The weighting of marks to the Multiple Choice and Constructed Response Papers is also derived from the SLOs, command words and cognitive levels. In effect the SLOs derived from the National Curriculum determine the structure of the AKU-EB subject examination set out in Section 4 and 5.

2.2 Specific Rationale of the AKU-EB Biology Examination Syllabus

- 2.2.1 The National Education Policy (1998-2010) outlines the following objectives for higher secondary education:
- a. To prepare the students well for the pursuit of professional and specialized education;
 - b. To make available such teaching and learning materials that will make learning rewarding and attractive.
 - c. To introduce a system of evaluation that emphasizes learning of concepts and discourages rote memorization.

2.2.2 In line with National Education Policy, the AKU-Examination Board syllabuses in science subject focus on the following:

- a. Broadening student's conceptual understanding through opportunities for enhancing their scientific skills, inquiry and experimentation.
- b. Allocating marks for each cognitive level of learning such as knowledge, understanding and application. The importance of content has been clearly elaborated as student learning outcomes.
- c. Reducing overloading and repetition. There is a need to look at the syllabus critically with due consideration to the fundamental concepts of secondary level science.

3. Topics and Student Learning Outcomes of the Examination Syllabus

Part I (Class XI)

Topics	Student Learning Outcomes		Cognitive Level ²		
			K	U	A
1. Introduction to Biology	Candidates should be able to:				
1.1 Major Fields of Specialization in Biology	1.1.1	recognize the significance of major fields of specialization in biology (molecular biology, environmental biology, microbiology, fresh water biology, marine biology, parasitology, human biology, social biology, biotechnology);		*	
1.2 Levels of Biological Organization	1.2.1	describe different levels of biological organization from subatomic particles to biosphere;		*	
1.3 Biological Method	1.3.1 1.3.2	compare deductive and inductive reasoning; recall hypothesis, theory and scientific law;	*	*	
1.4 Services of Biology to Mankind	1.4.1	give an account of the services of biology to mankind (disease control such as preventive measures, vaccination, drug treatment etc);		*	
1.5 Protection and Conservation of Environment	1.5.1	discuss factors affecting environment and different ways of their remediation.			*

² K = Knowledge, U = Understanding, A= Application (for explanation see section 7: Definition of command words used in Student Learning Outcomes and in Examination Questions).

NOTES

				K	U	A
2. Biological Molecules		Candidates should be able to:				
2.1 Introduction to Biochemistry	2.1.1	define biochemistry, protoplasm and biological molecules;	*			
	2.1.2	differentiate between micro and macro-molecules (on the basis of molecular mass);		*		
	2.1.3	compare atom and molecules, organic and inorganic molecules, covalent, ionic bond and hydrogen bond;		*		
2.2 Importance of Carbon	2.2.1	explain the properties of carbon;		*		
	2.2.2	differentiate between condensation and hydrolysis;		*		
	2.2.3	explain chemical composition of the protoplasm;		*		
2.3 Importance of Water	2.3.1	explain the properties of water (polarity, hydrogen bonding, specific heat, heat of vaporization, cohesion, hydrophobic nature, ionization, low density of ice, amphoteric nature);		*		
2.4 Carbohydrates	2.4.1	define carbohydrates;	*			
	2.4.2	describe properties of monosaccharides, disaccharides and polysaccharides with examples;		*		
	2.4.3	illustrate the formation and breakage of distinguished disaccharides i.e. maltose, sucrose and lactose;		*		
	2.4.4	compare the structure and function of starch, cellulose, glycogen and chitin;		*		
2.5 Lipids	2.5.1	define lipids;	*			
	2.5.2	describe the properties of acylglycerol, phospholipids, terpenoids and waxes;		*		
	2.5.3	illustrate the molecular structure of acylglycerol, (triglycerides), phospholipids, steroids, caretenoids and terpenes;		*		
	2.5.4	describe the roles of steroids and prostaglandins in living organisms;		*		

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			K	U	A
2.6 Proteins	2.6.1	define proteins and amino acids;	*		
	2.6.2	differentiate between essential and non-essential amino acids, acidic and basic amino acids, polar and non-polar amino acids;		*	
	2.6.3	explain amphoteric property of aminoacids;		*	
	2.6.4	differentiate between di-peptides and poly-peptides;		*	
	2.6.5	describe various levels of organization of proteins (primary, secondary, tertiary and quaternary);		*	
	2.6.6	define fibrous and globular proteins;	*		
	2.6.7	describe the significance of sequence of amino acids in a polypeptide chain through sickle cell anaemia;		*	
	2.6.8	list the functions of proteins in the body;	*		
2.7 Nucleic Acids	2.7.1	define nucleic acid and describe the structure of DNA;		*	
	2.7.2	differentiate between nucleotide and nucleoside;		*	
	2.7.3	classify nucleotides according to their sugar molecules and nitrogen bases;		*	
	2.7.4	differentiate between mononucleotide (ATP) and di-nucleotide;		*	
	2.7.5	define genetic code;	*		
	2.7.6	differentiate between DNA and RNA;		*	
	2.7.7	describe various types of RNA molecules with reference to protein synthesis;		*	
2.8 Conjugated Molecules	2.8.1	define conjugated molecules;	*		
	2.8.2	describe the role of glycolipids, glycoproteins, lipoproteins and nucleoproteins.		*	

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			K	U	A
3. Enzymes	Candidates should be able to:				
3.1 Structure of Enzyme	3.1.1	define enzyme, apoenzyme, cofactor, prosthetic group, co-enzyme and holoenzyme;	*		
3.2 Characteristics of Enzymes	3.2.1	describe the characteristics of enzymes;		*	
3.3 Mechanism of Enzyme Action	3.3.1	explain the mechanism of enzyme action through induced fit model comparing it with lock and key model;		*	
	3.3.2	show with the help of a diagram how an enzyme catalyzes specific reactions;		*	
	3.3.3	describe energy of activation and explain through graph how an enzyme speeds up a chemical reaction by lowering the energy of activation;		*	
3.4 Factors Affecting Enzyme Action	3.4.1	explain different factors affecting the rate of enzyme action (through a graph);		*	
	3.4.2	compare the optimum temperature of human body enzymes and thermophilic bacteria;		*	
	3.4.3	compare the optimum pH of different enzymes like trypsin, pepsin;		*	
3.5 Enzyme Inhibition	3.5.1	compare inhibitor and activator and highlight their significance;		*	
	3.5.2	categorize inhibitors into competitive and non-competitive inhibitors;		*	
	3.5.3	explain feedback inhibition;		*	
3.6 Classification of Enzymes	3.6.1	identify different enzymes on the basis of reactions they catalyze and nature of substrate.	*		

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			K	U	A
4. The Cell	Candidates should be able to:				
4.1 Discovery of Cell	4.1.1	recall the discovery of cell;	*		
4.2 Microscope	4.2.1	compare resolution vs. magnification of a microscope;		*	
4.3 Techniques Used in Cell Biology	4.3.1	define cell fractionation, differential staining, centrifugation, micro-dissection, tissue culture, chromatography, electrophoresis and spectrophotometry;	*		
4.4 Structure of Cell	4.4.1	describe in detail the structure, chemical composition and functions of different cellular organelles (cell wall, cell membrane with reference to Fluid Mosaic Model, cytoplasm, endoplasmic reticulum, ribosomes, mitochondria, nucleus, Golgi apparatus, lysosomes, vacuoles, cytoskeleton, centrioles, plastids) revealed from the electron microscope;		*	
	4.4.2	compare <ul style="list-style-type: none"> i. glyoxisome and peroxisome ii. cell wall and cell membrane iii. chloroplast and chromoplast iv. animal cell and plant cell v. prokaryotic and eukaryotic cell. 		*	
5. Variety of Life	Candidates should be able to:				
5.1 Classification	5.1.1	recall the need and basis of classification (homology, bio-chemistry, cytology and genetics);	*		
	5.1.2	explain the concept of species and hierarchy of biological classification (species, genera, family, order, class, phylum/division and kingdom);		*	

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				K	U	A
5.2	Nomenclature	5.2.1	describe binomial nomenclature;		*	
5.3	Two and Five Kingdom System	5.3.1	describe kingdoms of biology (Two kingdom system, Five kingdom system of Whittaker, Five kingdom system of Marguilis and Schwartz);		*	
5.4	Characteristics of Viruses	5.4.1	recall the historical background of discovery of viruses;	*		
		5.4.2	state the characteristic features of viruses;	*		
		5.4.3	explain how viruses survive inside a host cell;		*	
		5.4.4	explain the survival of viruses outside the host cell;		*	
5.5	Classification of Viruses	5.5.1	classify viruses on the basis of their structure, type of nucleic acid and host;		*	
		5.5.2	list the diseases caused by viruses in animals and plants;	*		
5.6	Life Cycle of a Bacteriophage	5.6.1	describe lytic and lysogenic life cycle of a bacteriophage;		*	
		5.6.2	assess the use of a bacteriophage in genetic engineering;			*
5.7	Viral Diseases	5.7.1	describe the causative agent, symptoms, treatment and preventive measures of hepatitis, polio, AIDS and tobacco mosaic disease;		*	
5.8	Prions and Viroids	5.8.1	define prions and viroids;	*		
		5.8.2	list diseases caused by prions and viroids;	*		
5.9	Economic Loss by Viruses	5.9.1	discuss how viral infections cause global economic loss.			*

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		K	U	A
6. Kingdom Prokaryotae	Candidates should be able to:			
6.1 Characteristic Features of Kingdom Prokaryotae	6.1.1	list characteristic features of Kingdom Prokaryotae;	*	
6.2 Morphology of Bacteria	6.2.1	state characteristic features of archaebacteria (thermophilic, acidophilic, hallophilic);	*	
	6.2.2	describe the discovery, occurrence and habitat of bacteria;		*
	6.2.3	describe morphological diversity (shapes) of bacteria;		*
	6.2.4	differentiate between gram positive and gram negative bacteria;		*
	6.2.5	explain structure of bacteria (cell wall, cell membrane, cytoplasm, mesosome, chromatin, flagella and capsule);		*
6.3 Nutrition in Bacteria	6.3.1	describe autotrophic, heterotrophic, symbiotic and parasitic bacteria;		*
	6.3.2	differentiate between the chlorophyll present in bacteria and plant;		*
6.4 Respiration in Bacteria	6.4.1	describe facultative and obligatory aerobes, micro-aerobes, facultative and obligatory anaerobes;		*
6.5 Locomotion in Bacteria	6.5.1	describe the methods of locomotion in bacteria (chemotaxis, magnetotaxis);		*
6.6 Growth in Bacteria	6.6.1	explain different phases of growth in bacteria;		*
6.7 Reproduction in Bacteria	6.7.1	describe different modes of reproduction in bacteria (binary fission, endospore formation and genetic recombination; conjugation, transduction and transformation);		*

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			K	U	A	
6.8	Economic Importance of Bacteria	6.8.1	describe the role of beneficial bacteria in terms of medicine, agriculture, industry, symbiosis, research and harmful bacteria (pathogens, food spoiling);		*	
6.9	Control and Prevention of Bacteria	6.9.1	describe different physical and chemical methods to control bacteria;		*	
		6.9.2	describe immunization and vaccination;		*	
		6.9.3	discuss uses and misuses of antibiotics;			*
6.10	Cyanobacteria	6.10.1	list general characteristics of cyanobacteria;	*		
		6.10.2	describe the habitat, structure, nutrition and reproduction in nostoc;		*	
		6.10.3	describe the importance of cyanobacteria in terms of nitrogen fixation.		*	
7. Kingdom Protista (Protoctista)		Candidates should be able to:				
7.1	Unifying Features	7.1.1	identify protists on the basis of their characters;	*		
7.2	Diversity among Protists	7.2.1	describe evolutionary relationship among protists;		*	
7.3	Animal like Protists	7.3.1	describe the salient features of animal like protists;		*	
		7.3.2	classify these animals on the basis of their locomotary organelles and give examples;		*	
		7.3.3	list the pathogenic protozoan, apicomplexans and diseases caused by them;	*		

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			K	U	A	
7.4	Plant like Protists	7.4.1 7.4.2 7.4.3	describe the salient features of plant like protists; classify the photosynthetic protists (preferably in tabular form); differentiate between brown, red and green algae;		*	
7.5	Fungi like Protists	7.5.1 7.5.2	compare salient features of myxomycota and oomycota; describe the importance of <i>Phytophthora infestans</i> .		*	
8. FUNGI		Candidates should be able to:				
8.1	General Characteristics	8.1.1 8.1.2 8.1.3 8.1.4	list the characteristics of fungi which distinguish them from other groups; describe the structure and nutrition in fungi; compare lichens with mycorrhizae; explain different methods of asexual and sexual reproduction in fungi;	*		
8.2	Classification of Fungi	8.2.1	describe the main groups of fungi based on reproductive structures and methods of reproduction;		*	
8.3	Land Adaptations	8.3.1	give an account of land adaptations in fungi;		*	
8.4	Importance of Fungi	8.4.1	discuss ecological, commercial importance and economic losses due to fungi.			*

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		K	U	A
9. Kingdom Plantae	Candidates should be able to:			
9.1 Diversity among Plants	9.1.1	state the general characteristics of plants;	*	
	9.1.2	describe phylogeny of kingdom plantae;		*
	9.1.3	classify kingdom plantae using a flowchart;		*
	9.1.4	state the characteristic features of bryophytes;	*	
	9.1.5	classify bryophytes as musci, hepaticae or anthocerotae;		*
	9.1.6	give an account of the life cycle of mosses;		*
	9.1.7	state the significance of alternation of generation;	*	
9.2 Adaptation to the Land Habitat	9.2.1	explain the land adaptation of plants absorption of water, carbon dioxide, heterogamy, protection of reproductive cells and formation of embryo;		*
9.3 Tracheophyta	9.3.1	give an account of major groups of tracheophyta (psilopsida, lycopsida, pteropsida, sphenopsida);		*
	9.3.2	explain the evolution of single-veined (microphyllus) and multi-veined (megaphyllus) leaf;		*
	9.3.3	differentiate between homosporous and heterosporous;		*
	9.3.4	explain the evolution of seed;		*
9.4 Seed Plants	9.4.1	describe the general characteristics of gymnosperms and angiosperms;		*
	9.4.2	explain the life cycle of pinus (gymnosperm) with a diagram;		*
	9.4.3	explain the life cycle of an angiosperm with diagram;		*
	9.4.4	compare dicotyledonous and monocotyledonous seed;		*
	9.4.5	describe why vascular plants became the most successful group of land plants;		*

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			K	U	A
9.5 Angiospermic Families	9.5.1	give an account of the vegetative characters, floral formula, economic importance of plants of family <i>rosaceae</i> , <i>solanaceae</i> , <i>fabaceae</i> , <i>caesalpinaceae</i> , <i>mimosaceae</i> and <i>poaceae</i> .		*	
10. Kingdom Animalia	Candidates should be able to:				
10.1 Introduction	10.1.1	describe the general characteristics of animals;		*	
10.2 Criteria for Animal Classification	10.2.1	classify animals on the basis of presence or absence of tissue;		*	
	10.2.2	differentiate diploblastic and triploblastic level of organization;		*	
	10.2.3	describe different types of symmetry found in animals;		*	
	10.2.4	differentiate pseudocoelomates and coelomates;		*	
	10.2.5	classify coelomates into protostomes and deuterostomes;		*	
10.3 Invertebrates	10.3.1	explain the general characteristics and classification of invertebrates;		*	
10.4 Parazoa Phylum Porifera	10.4.1	explain the general characteristics and economic importance of phylum porifera;		*	
10.5 Grade Radiata Phylum Coelenterate	10.5.1	explain the general characteristics, origin of diploblastic organization, radial symmetry, polymorphism, alternation of generation, formation of coral reefs in coelenterates;		*	
10.6 Grade Bilateria Triploblastic Animals-Acoelomates Phylum Platyhelminthes	10.6.1	explain the general characteristics, adaptations for parasitic mode of life, importance of infestation and disinfestations (tapeworm) in platyhelminthes;		*	

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			K	U	A
10.7	Grade Bilateria Triploblastic Animals- Pseudocoelomates Phylum Nematoda	10.7.1	explain the general characteristics, importance and parasitic adaptations of nematodes (aschelminthes);	*	
10.8	Grade Bilateria Triploblastic Animals- Coelomates Phylum Annelida	10.8.1 10.8.2 10.8.3	explain the general characteristics, segmentation and its advantages, coelom and its advantages in annelids; classify the phylum annelida upto classes; describe the importance of phylum annelida;	* * *	
10.9	Phylum Arthropoda	10.9.1 10.9.2	explain the general characteristics, diversity and major groups (arachnida, crustaceae, insecta, myriapoda) of arthropods; give an account of: <ul style="list-style-type: none"> • economic importance of insects (beneficial and harmful); • metamorphosis in insects; • insects as the successful group of animals; 	* *	
10.10	Phylum Mollusca	10.10.1	explain the general characteristics, classification (gastropoda, bivalvia, cephalopoda) and economic importance of molluscs;	*	
10.11	Phylum Echinodermata	10.11.1	explain the general characteristics of spiny skinned animals (echinoderms) and their affinities;	*	
10.12	Phylum Hemichordata	10.12.1	describe the basic characters of hemichordates;	*	
10.13	Phylum Chordata	10.13.1 10.13.2 10.13.3	highlight fundamental characters of chordates; classify phylum chordata; differentiate between acraniata and craniata, urochordata and cephalochordate;	* * *	

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10.14 Sub-phylum Vertebrata	10.14.1	explain the general characteristics (including aquatic adaptations) of super-class pisces and its sub-classes;		*	
	10.14.2	distinguish between cartilaginous (chondrichthyes) and bony fishes (osteichthyes);		*	
	10.14.3	list some familiar edible fishes in Pakistan;	*		
	10.14.4	explain the origin, general characteristics of amphibians and describe their trends for land habitat;		*	
	10.14.5	assess amphibians as unsuccessful land vertebrates;			*
	10.14.6	explain the general characteristics of reptiles;		*	
	10.14.7	explain why reptiles are considered as successful land vertebrates;		*	
	10.14.8	explain the general characteristics of birds and adaptations for aerial mode of life (flight adaptations);		*	
	10.14.9	distinguish between flightless and flying birds with examples;		*	
	10.14.10	describe evolutionary origin of birds with reference to archaeopteryx;		*	
	10.14.11	explain the general characteristics, diversity and classification of mammalians (prototheria, metatheria and eutheria);		*	
	10.14.12	describe the evolutionary origin of class mammalia.		*	
11. Bioenergetics		Candidates should be able to:			
11.1 Role of ATP	11.1.1	define bioenergetics;	*		
	11.1.2	describe the role of ATP as currency of energy in metabolism;		*	
11.2 Photosynthesis	11.2.1	define photosynthesis and state its reactants and products;	*		
	11.2.2	explain the role of chlorophyll and other photosynthetic pigments, light, carbon dioxide and water in photosynthesis;		*	
	11.2.3	describe the main events of light dependent reactions (energy conversion, formation of ATP and NADPH);		*	

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	11.2.4	compare cyclic and non-cyclic phosphorylation in light dependent reactions;		*	
	11.2.5	describe the three phases of light independent (dark) reactions;		*	
11.3	Respiration	11.3.1	define respiration, cellular respiration, oxidative phosphorylation, aerobic respiration and fermentation;	*	
		11.3.2	distinguish between alcoholic and lactic acid fermentation;		*
		11.3.3	state the role of mitochondria in respiration;	*	
		11.3.4	describe different stages of cellular respiration;		*
		11.3.5	describe the reactions of glycolysis;		*
		11.3.6	explain the pyruvic acid oxidation (formation of acetyl CoA);		*
		11.3.7	explain the reactions of Kerb's cycle (citric acid cycle);		*
		11.3.8	explain respiratory chain;		*
12. Nutrition		Candidates should be able to:			
12.1	Nutrition in Plants	12.1.1	define nutrition;	*	
		12.1.2	differentiate between autotrophic and heterotrophic nutrition;		*
		12.1.3	differentiate between phototrophic and chemotrophic nutrition;		*
		12.1.4	describe various conditions caused by the deficiency of minerals (N,P,K,Mg);		*
		12.1.5	describe various modes of heterotrophic nutrition in plants with examples (saprophytic, parasitic, symbiotic and insectivorous plants);		*
12.2	Nutrition in Animals	12.2.1	define heterotrophic nutrition in animals (holozoic, saprotrophic, parasitic, detritivores, predators, herbivores, carnivores and omnivores);	*	
		12.2.2	differentiate between macrophagous and microphagous feeders, fluid feeders and filter feeders;		*

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	12.2.3	describe steps of holozoic nutrition;		*	
	12.2.4	differentiate between intercellular and intracellular digestion;		*	
	12.2.5	describe different modes of ingestion in animals with examples;		*	
12.3	Nutrition in Non-chordates	12.3.1 describe nutrition in amoeba, hydra, planaria and cockroach;		*	
		12.3.2 differentiate between complete and incomplete alimentary canal;		*	
12.4	Digestion in Man	12.4.1 describe gastrointestinal tract (dentitions, salivary glands, function of tongue, swallowing, peristalsis, antiperistalsis, non-directional peristalsis, bile production);		*	
		12.4.2 describe the process of digestion in man;		*	
		12.4.3 describe different types of dental diseases, their causes, prevention and control;		*	
		12.4.4 describe the disorders of GIT (diarrhoea, dysentery, constipation, piles, dyspepsia, peptic ulcer, food poisoning, malnutrition, over-nutrition, under-nutrition, anorexia and bulimia nervosa);		*	
		12.4.5 describe parasitic nutrition in animals;		*	
		12.4.6 differentiate between ectoparasites and endoparasites.		*	
13. Gaseous Exchange		Candidates should be able to:			
13.1	Gaseous Exchange in Plants	13.1.1 define respiration;	*		
		13.1.2 describe the conditions necessary for gaseous exchange;		*	
		13.1.3 describe gaseous exchange in plants (through stomata and lenticels);		*	
		13.1.4 describe the process and importance of photorespiration;		*	

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13.2 Gaseous Exchange in Animals	13.2.1	describe the properties of respiratory surface;		*	
	13.2.2	describe the process of respiration (gaseous exchange) in hydra, earthworm and cockroach;		*	
	13.2.3	describe the process of respiration in fishes;		*	
	13.2.4	describe different types of respiration in frog;		*	
	13.2.5	describe the process of respiration in birds;		*	
	13.2.6	differentiate between complete and incomplete ventilation;		*	
13.3 Respiratory System of Man	13.3.1	describe respiratory system of man (organs of respiration, route of air);		*	
	13.3.2	describe the mechanism of breathing in man;		*	
	13.3.3	describe voluntary and involuntary control in breathing rate;		*	
	13.3.4	describe the transportation of carbon dioxide and oxygen by the blood;		*	
13.4 Respiratory Disorders	13.4.1	state causes, symptoms and control of upper respiratory tract infections (sinusitis, otitis) and lower respiratory tract infections (pneumonia, tuberculosis);	*		
	13.4.2	describe disorders of lungs (emphysema, lung cancer);		*	
	13.4.3	list the effects of smoking on respiratory system.	*		

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		K	U	A
14. Transport	Candidates should be able to:			
14.1 Introduction	14.1.1	define transport;	*	
	14.1.2	state the importance of transport of material in living organisms;	*	
14.2 Transport in Plants	14.2.1	explain uptake of water and minerals by roots and processes (apoplast, symplast and vacuolar) involved in it;		*
	14.2.2	define water potential, osmotic potential and pressure potential;	*	
	14.2.3	distinguish between plasmolysis and deplasmolysis;		*
14.3 Ascent of Sap	14.3.1	define ascent of sap;	*	
	14.3.2	explain the factors affecting ascent of sap (cohesive and adhesive forces and xylem vessels);		*
	14.3.3	describe the mechanism of transpiration pull (with reference to Cohesion Tension theory, root pressure and imbibition);		*
	14.3.4	define bleeding in plants;	*	
14.4 Transpiration	14.4.1	define transpiration;	*	
	14.4.2	describe different types of transpiration (cuticular, lenticular and stomatal);		*
	14.4.3	explain the mechanism involved in opening and closing of stomata (starch sugar hypothesis and influx of potassium ions);		*
	14.4.4	describe the factors affecting rate of transpiration (light, temperature, humidity, carbon dioxide concentration, wind and availability of soil water);		*
	14.4.5	explain why transpiration is considered as a necessary evil;		*

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14.5 Translocation	14.5.1	define translocation;	*		
	14.5.2	explain transport of phloem and patterns of transport;		*	
	14.5.3	describe the mechanism of phloem translocation (diffusion and Pressure Flow hypotheses);		*	
14.6 Transportation in Animals	14.6.1	describe need of transportation;		*	
	14.6.2	describe the process of transportation in amoeba, hydra and planaria;		*	
	14.6.3	define circulatory system;	*		
	14.6.4	list characteristics of circulatory system;	*		
	14.6.5	differentiate between open and closed circulatory system, single circuit and double circuit circulation;		*	
	14.6.6	describe evolution of vertebrates' heart (fish, amphibians, reptiles, birds and mammals);		*	
	14.6.7	compare circulatory systems of fishes, amphibians, reptiles, birds and mammals;		*	
14.7 Circulatory System of Man	14.7.1	describe the composition and functions of blood;		*	
	14.7.2	describe disorders of blood (leukaemia, thalassaemia and oedema);		*	
	14.7.3	describe the structure and function of heart (cardiac cycle, heartbeat, S.A. node, A.V. node, artificial pace maker);		*	
	14.7.4	describe the cause of blue babies;		*	
	14.7.5	differentiate among artery, vein and capillary;		*	
	14.7.6	define blood pressure;	*		
	14.7.7	differentiate between blood pressure and pulse pressure;		*	
	14.7.8	describe lymphatic system, lymph vessels and lymph node;		*	
	14.7.9	list functions of lymphatic system;	*		

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14.8	Cardiovascular Disorders	14.8.1	describe the causes, effects and preventions of atherosclerosis, hypertension, thrombus formation, coronary thrombosis, embolus, myocardial infarction and stroke; differentiate between haemorrhage and haematoma;		*
		14.8.2			*
14.9	Immune System	14.9.1	define immunity;	*	
		14.9.2	explain innate and adaptive immune system;		*
		14.9.3	differentiate between primary and secondary immune responses, active and passive immunity.		*

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Part II (Class XII)

Topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
15. Homeostasis	Candidates should be able to:				
15.1 Introduction	15.1.1	define homeostasis;	*		
	15.1.2	explain various aspects and need for homeostasis;		*	
15.2 Feedback System	15.2.1	define the term feedback system;	*		
	15.2.2	describe components of feedback system;		*	
	15.2.3	compare positive and negative feedback with examples;		*	
15.3 Osmoregulation	15.3.1	define osmosis, water potential and solute potential;	*		
	15.3.2	give an account of osmoregulation in plants (hydrophytes, halophytes, mesophytes, xerophytes);		*	
	15.3.3	define hypotonic, isotonic and hypertonic solution;	*		
	15.3.4	explain osmoregulation in aquatic (fresh water and marine) and terrestrial animals;		*	
15.4 Excretion in Plants	15.4.1	define excretion;	*		
	15.4.2	explain different excretory products in plants and methods by which they are stored and removed from the plant body;		*	
15.5 Excretion in Animals	15.5.1	describe different types of excretory products and relationship of these wastes to the habitat of animals;		*	
	15.5.2	explain the process of excretion in hydra, planaria, earthworm and cockroach;		*	

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15.6 Excretion in Man	15.6.1	give an account of metabolic waste and excretory organs in man (kidney, liver, skin);		*	
	15.6.2	describe the role of liver in urea formation (urea cycle or ornithine cycle);		*	
	15.6.3	explain the liver as a homeostatic organ;		*	
	15.6.4	give an account of urinary system of man;		*	
	15.6.5	explain the mechanism of excretion through kidney (simple filtration, reabsorption, secretion, counter current);		*	
	15.6.6	describe adaptation of kidney and effect of hormones on the working of kidney, composition of urine and variation in the composition of urine and its significance;			
15.7 Kidney Problems	15.7.1	explain kidney problems (kidney stone, renal failure) and their cure (lithotripsy, dialysis and kidney transplantation);		*	
15.8 Thermoregulation in Plants	15.8.1	give an account of adaptations of plants to low and high temperature;		*	
15.9 Thermoregulation in Animals	15.9.1	classify animals on the basis of thermoregulation;		*	
	15.9.2	describe adaptations in animals for temperature regulation (structural, physiological, behavioural);		*	
	15.9.3	explain thermoregulation in mammals (human) in cold and hot environment;		*	
	15.9.4	describe thermostatic function of brain and feedback control in humans;		*	
	15.9.5	define pyrexia (fever).	*		

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		K	U	A
16. Support and Movement	Candidates should be able to:			
16.1 Support in Plants	16.1.1	describe the supporting structures in plants (parenchyma, collenchyma and sclerenchyma), secondary growth and significance of secondary growth;		*
16.2 Movement in Plants	16.2.1	differentiate between autonomic and paratonic movement;		*
	16.2.2	describe autonomic movement with examples (locomotory, tactic movement, growth and curvature and turgor movement);		*
	16.2.3	differentiate between tropic movement and nastic movement;		*
	16.2.4	describe paratonic movement with examples (phototropism, geotropism, chemotropism, hydrotropism, thigmotropism, photonastic and hyponastic);		*
	16.2.5	describe the role of growth substances (plant hormones) in plant movement;		*
16.3 Support and Locomotion in Animals	16.3.1	define skeleton;	*	
	16.3.2	describe types of skeleton with examples (hydrostatic skeleton, exoskeleton and endoskeleton);		*
	16.3.3	describe the disadvantage of exoskeleton (ecdysis or moulting);		*
16.4 Human Skeleton	16.4.1	differentiate between bones and cartilage;		*
	16.4.2	describe human skeletal system (axial and appendicular skeleton);		*
	16.4.3	describe the functions of skeleton;		*
	16.4.4	describe joints (articulation) and its types with examples;		*
	16.4.5	describe the structure of synovial joint with diagram;		*
	16.4.6	differentiate between tendon and ligament, origin and insertion;		*

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	16.4.7	describe deformities of skeleton (cleft palate, microcephaly, osteoarthritis, rickets);		*	
	16.4.8	describe skeleton related diseases and their control (disc slip, spondylitis, sciatica, osteoarthritis);		*	
	16.4.9	describe the repairing of broken bones;		*	
16.5 Muscular System	16.5.1	describe muscular tissue;		*	
	16.5.2	differentiate between voluntary and involuntary muscles;		*	
	16.5.3	describe different types of muscles and their occurrence (skeletal, smooth and cardiac muscles);		*	
	16.5.4	describe the structure of skeletal muscles;		*	
	16.5.5	describe the process of muscle contraction (sliding filament theory of Huxley, control of muscle contraction, all or no response of muscles, muscle fatigue)		*	
	16.5.6	describe abnormal muscle contraction (tetany and cramps);		*	
	16.5.7	define antagonistic muscles;	*		
	16.5.8	describe different types of antagonistic muscles which help to move shoulder in man;		*	
16.6 Locomotion in Animals	16.6.1	define locomotion;	*		
	16.6.2	describe locomotion in protozoa (amoeboid movement, flagellary and cilliary movement);		*	
	16.6.3	describe locomotion in invertebrates (jelly fish, earth worm, snail, starfish and cockroach);		*	
	16.6.4	describe locomotion with examples among vertebrates (fishes, tetrapods, bipedal locomotion, brachiation);		*	

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17. Coordination and Control	Candidates should be able to:				
17.1 Need for Coordination	17.1.1	define coordination and control;	*		
	17.1.2	describe the need of coordination;		*	
17.2 Coordination in Plants	17.2.1	describe control through hormones in plants;		*	
	17.2.2	give an account of responses to environmental stresses in plants;		*	
	17.2.3	describe defence against pathogens in plants;		*	
	17.2.4	explain biological clock and circadian rhythm;		*	
	17.2.5	give an account of different plant hormones and their commercial application;		*	
17.3 Coordination In Animals	17.3.1	define nervous coordination, receptors and neurons;	*		
	17.3.2	classify receptors with examples;		*	
	17.3.3	explain working of sensory receptors with special reference to skin;		*	
	17.3.4	describe the structure and types of neurons;		*	
	17.3.5	explain reflex arc, types of reflex arcs and reflex action by giving examples;		*	
	17.3.6	define nerve impulse;	*		
	17.3.7	explain different steps involved in initiation and propagation of nerve impulse;		*	
	17.3.8	define synapse, presynapse, post synapse and neurotransmitter;	*		
17.4 Evolution of Nervous System	17.4.1	differentiate between diffused and centralized nervous system;		*	
	17.4.2	explain the nervous system of hydra and planaria;		*	
	17.4.3	describe different parts and functions of human brain;		*	
	17.4.4	explain the structure of spinal cord;		*	
	17.4.5	give an account of peripheral nervous system;		*	
	17.4.6	differentiate between sympathetic and parasympathetic nervous system;		*	

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	17.4.7	describe nervous disorders (Parkinson's disease, Epilepsy and Alzheimer's disease);		*	
	17.4.8	give an account of effects of drugs on coordination;		*	
17.5	Chemical Coordination	17.5.1 differentiate between nervous and chemical coordination;		*	
		17.5.2 describe the chemical nature of hormones and hormone action;		*	
		17.5.3 explain endocrine gland of mammals, hormones secreted from them and their disorders;		*	
		17.5.4 give an account of feedback mechanism with reference to endocrine gland (thyroid gland);		*	
		17.5.5 explain disorders caused by endocrine glands which lead to infertility in males and females;		*	
17.6	Behaviour	17.6.1 define behaviour;	*		
		17.6.2 differentiate between innate and learning behaviour;		*	
		17.6.3 describe different types of innate behaviour with examples;		*	
		17.6.4 give an account of types of learning behaviour through examples and experiments performed on them;		*	
18. Reproduction		Candidates should be able to:			
18.1	Asexual Reproduction in Plants	18.1.1 define asexual reproduction, sexual reproduction and parthenocarpy in plants;	*		
		18.1.2 describe the process of fruit ripening in plants;		*	
		18.1.3 state advantages and disadvantages of asexual reproduction;	*		
		18.1.4 explain the role of mitosis and meiosis in reproduction;		*	
		18.1.5 describe natural and artificial methods of reproduction (spores, vegetative reproduction and apomixis) in plants;		*	
		18.1.6 describe the importance of asexual reproduction;		*	

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18.2	Photoperiodism	18.2.1 18.2.2	define photoperiodism, long day, short day and day neutral plants; describe discovery, day length/night length and mechanism involved in light quality;	*	*	
18.3	Sexual Reproduction in Plants	18.3.1 18.3.2 18.3.3 18.3.4	describe salient features in the life cycle of gymnosperms; explain structure of flower, pollination, inflorescence and its different types; recall alternation of generation in plants; explain the process of sexual reproduction in angiosperms (development of male and female gametophyte, double fertilization, mature seeds);	*	*	*
18.4	Germination in Plants	18.4.1 18.4.2 18.4.3 18.4.4	describe seed dormancy ; define germination and its types (epigeal and hypogeal); describe the process of vernalization; differentiate between florigan and phytochromes;	*	*	*
18.5	Asexual Reproduction in Animals	18.5.1 18.5.2 18.5.3	describe asexual reproduction in animals, (fission, budding, regeneration, parthenogenesis); describe identical and fraternal twins; discuss socio-cultural and moral implications of cloning;		*	*

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18.6 Sexual Reproduction in Animals	18.6.1	differentiate between asexual and sexual reproduction;		*	
	18.6.2	state basic steps of sexual reproduction (gametogenesis, mating, fertilization);	*		
	18.6.3	differentiate spermatogenesis and oogenesis;		*	
	18.6.4	differentiate between sexual and bisexual animals;		*	
	18.6.5	describe external and internal fertilization and their relation to habitat of animals;		*	
	18.6.6	describe oviparity, viviparity and placenta;		*	
	18.6.7	describe female reproductive system;		*	
	18.6.8	explain different stages of reproduction cycle/and its hormonal control in human female;		*	
	18.6.9	differentiate between menstrual cycle and oestrous cycle;		*	
	18.6.10	define conception, implantation, pregnancy, gestation, placenta and umbilical cord;	*		
	18.6.11	describe extra-embryonic coats;		*	
	18.6.12	explain the role of different hormones in birth;		*	
	18.6.13	explain the changes in uterus, vagina and mammary glands which take place after birth;		*	
	18.6.14	define lactation;	*		
	18.6.15	give an account of test tube babies;		*	
	18.6.16	describe sexually transmitted diseases (gonorrhoea, syphilis, genital herpes and AIDS);		*	
	18.6.17	differentiate between miscarriage and abortion.		*	

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19. Growth and Development		Candidates should be able to:				
19.1	Introduction	19.1.1	differentiate between growth and development; embryo and larva;		*	
19.2	Growth and Development in Plants	19.2.1	define growth in plants;	*		
		19.2.2	define meristem;	*		
		19.2.3	describe the types of meristem;		*	
		19.2.4	state the roles of meristem in the development of plants;	*		
19.3	Phases of Growth in Plants	19.3.1	explain primary and secondary growth in plants;		*	
		19.3.2	describe phases of growth in plants;		*	
		19.3.3	describe the external and internal factors affecting the growth rate in plants;		*	
		19.3.4	define differentiation and correlations;	*		
		19.3.5	explain growth correlation effects in plants;		*	
19.4	Growth and Development in Animals	19.4.1	describe the process of development in vertebrates;		*	
		19.4.2	draw key events which occur during development of animals;		*	
19.5	Development of Chick	19.5.1	describe development of chick up to three germinal layers;		*	
		19.5.2	explain notochord formation, neurulation, differentiation of mesoderm and coelom in chick embryo;		*	
		19.5.3	explain the role of cytoplasm in development;		*	
		19.5.4	describe the role of nucleus in development;		*	

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19.6	Cell Differentiation and its Mechanism	19.6.1 19.6.2 19.6.3 19.6.4	explain cell differentiation with examples; explain embryonic induction; differentiate between aging and regeneration; describe the process of regeneration in invertebrates and vertebrates;		*	
19.7	Abnormal Development	19.7.1 19.7.2	state the abnormalities inherited from parent to offspring; describe different environmental and metabolic factors involved in abnormal development.	*	*	
20. Chromosomes and DNA		Candidates should be able to:				
20.1	Structure and Types of Chromosomes	20.1.1 20.1.2 20.1.3 20.1.4 20.1.5	define chromosomes with examples of some organisms with different number of chromosomes; describe types of chromosomes (autosomes, sex chromosomes, homologous, telocentric, acrocentric, metacentric and submetacentric chromosome); describe the structure and chemical composition of chromosomes; describe chromosome karyotype; differentiate between heterochromatin and euchromatin;	*	*	
20.2	Chromosomal Theory of Inheritance	20.2.1	describe the chromosomal theory of inheritance (Karl Correns 1900, Walter Sutton 1902, and Thomas Hunt Morgan 1910);		*	
20.3	DNA as the Hereditary Material	20.3.1 20.3.2	explain DNA as a heredity material (Frederick Griffith experiment, Colin Macleod and Maclyn McCarty and Alfred Hershey and Martha Chase experiment); describe structure of DNA (Watson and Crick model);		*	

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20.4 DNA Replication	20.4.1	describe the replication of DNA;		*	
	20.4.2	prove that replication is a semi-conservative process;		*	
20.5 Gene Expression	20.5.1	describe gene and genetic code;		*	
	20.5.2	discuss one gene-one enzyme hypothesis;		*	
	20.5.3	describe the mechanism of protein synthesis by means of DNA and RNA;		*	
20.6 Mutations	20.6.1	define mutation and describe types of mutation;		*	
	20.6.2	differentiate between chromosomal aberration and gene mutation;		*	
	20.6.3	describe chromosomal aberration and their effects;		*	
	20.6.4	describe gene mutation and causes of mutation (ionization radiation, ultraviolet radiation, chemical mutagens);		*	
	20.6.5	describe sickle cell anaemia and phenylketonuria (PKT).		*	
21. Cell Cycle	Candidates should be able to:				
21.1 Phases of Cell Cycle	21.1.1	define cell cycle;	*		
	21.1.2	differentiate between interphase and M phase;		*	
	21.1.3	describe the changes occurring during G-phase, Go phase, S-phase and G ₂ -phase;		*	
	21.1.4	describe amitotic cell division, cell death, necrosis and apoptosis;		*	
	21.1.5	distinguish between karyokinesis and cytokinesis;		*	
21.2 Mitosis	21.2.1	define mitosis;	*		
	21.2.2	describe different stages of mitosis;		*	
	21.2.3	state the significance of mitosis;	*		
	21.2.4	describe cancer as uncontrolled cell division;		*	

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				K	U	A
21.3	Meiosis	21.3.1 21.3.2 21.3.3	define meiosis; describe different stages of meiosis; state the significance of meiosis;	*	*	
21.4	Meiotic Errors (Non-disjunction)	21.4.1 21.4.2	define meiotic errors (non-disjunction) and its types; describe Down's syndrome, Klinefelter's syndrome and Turner's syndrome.	*	*	
22. Variation and Genetics		Candidates should be able to:				
22.1	Gene and Allele	22.1.1 22.1.2	define the terms gene, loci, alleles, gene pool, phenotype, genotype, homozygous, heterozygous, dominant, recessive; describe the measurement of gene pool with suitable examples;	*	*	
22.2	Mendel's Law of Inheritance	22.2.1 22.2.2 22.2.3	state the characteristics of the plant used by Gregor Mendel in his experiment; describe Mendel's law of dominance, segregation and independent assortment, law of inheritances by considering tongue rolling, ear lobe types, eyes and hair colour; demonstrate Mendel's laws through test cross;	*	*	*
22.3	Incomplete Dominance and Co- dominance	22.3.1	demonstrate through test cross, incomplete dominance, co-dominance with suitable examples;			*
22.4	Multiple Allele	22.4.1 22.4.2 22.4.3 22.4.4 22.4.5 22.4.6	describe multiple alleles with reference to ABO blood group system; describe Rh factor in blood group; describe the effect of Rh-ve mother to her Rh+ve baby; define epistalsis and describe the dominant and recessive epistalsis; define pleiotropy with an example; describe polygenic inheritance with suitable examples;	*	*	*

NOTES

				K	U	A
22.5	Linkage and Crossing over	22.5.1	describe linkage and crossing over with suitable examples of <i>Drosophila</i> ;		*	
22.6	Sex Determination and Sex Linkage	22.6.1	describe sex determination mechanism with example (variation in number of chromosome, XY system, ZW system of birds and fish);		*	
		22.6.2	describe sex determination in <i>Drosophila</i> ;		*	
		22.6.3	describe the sex linked inheritance in <i>Drosophila</i> ;		*	
		22.6.4	describe sex linked inheritance in man (colour blindness and haemophilia);		*	
		22.6.5	describe diabetes mellitus and differentiate between type I and type II.		*	
23. Biotechnology		Candidates should be able to:				
23.1	Importance of Biotechnology	23.1.1	define biotechnology and describe its importance;		*	
23.2	Genetic Engineering	23.2.1	describe steps of genetic engineering through recombinant DNA technology;		*	
		23.2.2	explore the applications of genetically engineered bacteria;			*
		23.2.3	describe transgenic plants and animals;		*	
		23.2.4	describe the isolations of eukaryotic gene for transgenesis;		*	
23.3	Gene Sequencing	23.3.1	describe gene sequencing;		*	
		23.3.2	describe polymerase chain reaction and its significance;		*	
		23.3.3	describe the process (gel electrophoresis) and importance of DNA fingerprinting;		*	
		23.3.4	describe human genome project (goals, advancements and significance);		*	

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			K	U	A	
23.4	Detection and Treatment of Genetic Diseases	23.4.1	describe genetic diseases (Huntington's disease and cystic fibrosis);		*	
23.5	Biotechnology and Health	23.5.1	evaluate the role of biotechnology in diagnosis of diseases, gene therapy, amniocenteses;			*
		23.5.2	apply the knowledge of genetic counselling, tissue culture and cloning;			*
23.6	Applications of Biotechnology	23.6.1	apply the knowledge of biotechnology in agriculture and medicine (improve agriculture traits, drought tolerant, improved food quality trait, increased plant productivity);			*
		23.6.2	discuss the hazardous effects of biotechnology.			*
24. Evolution		Candidates should be able to:				
24.1	Introduction	24.1.1	define organic evolution and give reference of Quranic verses with reference to evolution (Al-Quran- 6:98, 21:30, 37:11, 4:1, 29:19, 51:49, 6:39, 88:17, 67:19, 24:45, 80:24-32);	*		
		24.1.2	compare evolution vs special creation;		*	
		24.1.3	explain evolution from prokaryotes to eukaryotes;		*	
24.2	Theories of Evolution	24.2.1	describe inheritance of acquired characters as proposed by Lamarck;		*	
		24.2.2	describe Darwin's theory and the modern theory of evolution and the objections put forward on Darwin's theory;		*	
24.3	Evidences of Evolution	24.3.1	give an account of evidences of organic evolution (biogeographical, paleontological, from classification, domestication, vestigial organs, comparative anatomy, comparative embryology and biochemistry);		*	

NOTES

			K	U	A	
24.4	Mechanism of Evolution	24.4.1	compare artificial selection vs natural selection;		*	
		24.4.2	explain natural selection as a possible mechanism for evolution;		*	
		24.4.3	describe the role of artificial selection in the production of economically important plants and animals and controlled breeding;		*	
		24.4.4	define gene pool, allele, genotype and gene frequency;	*		
		24.4.5	describe gene frequency and their role in evolution;		*	
		24.4.6	explain Hardy Weinberg law and its implications;		*	
		24.4.7	give an account of factors affecting gene frequency;		*	
		24.4.8	explain endangered species, their causes and risk for extinction.		*	
25. Ecosystem		Candidates should be able to:				
25.1	Introduction	25.1.1	define ecosystem;	*		
		25.1.2	define population, community, environment, habitat, niche, biome and biosphere;	*		
		25.1.3	describe different types of approaches to ecology;		*	
25.2	Components of Ecosystem	25.2.1	distinguish between abiotic and biotic components;		*	
		25.2.2	state climatic, topographic and edaphic factors;	*		
		25.2.3	define producers, consumers and decomposers in an ecosystem;	*		
		25.2.4	differentiate between positive and negative ecological interactions with examples;		*	
		25.2.5	define parasitism, symbiosis, predation and grazing with examples;	*		

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			K	U	A
25.3 Biogeochemical Cycles	25.3.1	describe nitrogen cycle, nitrogen depletion and its remedies;		*	
	25.3.2	give an account of energy flow through an ecosystem;		*	
	25.3.3	describe pyramids of energy;		*	
	25.3.4	define primary productivity, gross primary and net primary productivity;	*		
	25.3.5	define food chain and describe advantages of short food chain;		*	
25.4 Ecological Succession	25.4.1	define succession;	*		
	25.4.2	differentiate between primary and secondary succession;		*	
	25.4.3	describe main stages involved in hydrarch and xerarch;		*	
	25.4.4	give an account of concept of climax.		*	
26. Some Major Ecosystems		Candidates should be able to:			
26.1 Fresh Water Ecosystem	26.1.1	explain abiotic and biotic components of fresh water ecosystem;		*	
26.2 Lake Ecosystem	26.2.1	describe zonation in fresh water and their abiotic and biotic components;		*	
26.3 Terrestrial Ecosystem	26.3.1	describe abiotic and biotic components of terrestrial ecosystems i.e. tropical rain forest, coniferous forest and temperate deciduous forest;		*	
	26.3.2	explain grass land ecosystem;		*	
	26.3.3	give an account of biotic and abiotic components of savannah;		*	
	26.3.4	explain desert ecosystem (desert biome);		*	
	26.3.5	give an account of tundra.		*	

NOTES

			K	U	A
27. Man and his Environment	Candidates should be able to:				
27.1 Resources	27.1.1	define renewable and non-renewable resources;	*		
	27.1.2	explain different types of renewable resources;		*	
	27.1.3	describe the main sources of energy (renewable and non-renewable) and its conservation;		*	
27.2 Man's Impact on Environment	27.2.1	discuss degradation and depletion of resources;			*
	27.2.2	discuss the effect of rising population on food resources and need of population control;			*
	27.2.3	describe the effect of human population on agriculture;		*	
	27.2.4	differentiate between deforestation and afforestation;		*	
27.3 Pollution	27.3.1	define pollution;	*		
	27.3.2	classify different types of pollution (air pollution with reference to green house effect, acid rain, ozone depletion, land pollution, water pollution including eutrophication);		*	
27.4 Protection and Conservation of Environment	27.4.1	highlight the importance and awareness about management of natural resources, pollution control and recycling of waste;		*	
27.5 Conservation of Organism and their Habitat	27.5.1	describe the conservation of organism and their habitat;		*	
27.6 Health and Diseases	27.6.1	classify diseases as infectious, parasitic, nutritional, genetic and diseases related to aging (discuss cause, transmission and control).		*	

NOTES

4. Scheme of Assessment

Class XI

Table 1: Number of Student Learning Outcomes by Cognitive Level

Topic No.	Topics	No. of Sub Topics	SLOs			Total
			K	U	A	
1.	Introduction to Biology	5	1	4	1	6
2.	Biological Molecules	8	8	24	0	32
3.	Enzymes	6	2	10	0	12
4.	The Cell	4	2	3	0	5
5.	Variety Of Life	9	6	8	2	16
6.	The Kingdom Prokaryote	10	3	15	1	19
7.	The Kingdom Protista	5	2	8	0	10
8.	Fungi	4	1	5	1	7
9.	Kingdom Plantae	5	4	14	0	18
10.	Kingdom Animalia	14	1	32	1	34
11.	Bioenergetics	3	4	11	0	15
12.	Nutrition	4	2	16	0	18
13.	Gaseous Exchange	4	3	14	0	17
14.	Transport	9	12	26	0	38
	Total	90	51	190	6	247
	Percentage		21	77	2	100

**Table 2: Allocation of Marks for the Multiple Choice Questions (MCQs),
Constructed Response Questions (CRQs) and
Extended Response Questions (ERQs)**

Topic No.	Topics	No. of Sub Topics	Marks			Total
			Multiple Choice Questions	Constructed Response Questions	Extended Response Questions	
1.	Introduction to Biology	5	7	4	7	18
2.	Biological Molecules	8				
3.	Enzymes	6				
4.	The Cell	4				
5.	Variety of Life	9	2	4	0	6
6.	The Kingdom Prokaryote	10	3	4	0	7
7.	The Kingdom Protoctista	5	3	4	0	7
8.	The Kingdom Fungi	4	2	4	0	6
9.	The Kingdom Plantae	5	6	10	8	24
10.	The Kingdom Animalia	14				
11.	Bioenergetics	3				
12.	Nutrition	4				
13.	Gaseous Exchange	4	7	10	0	17
14.	Transport	9				
	Total	90	30	40	15	85
	Practical					15
	Total					100

Table 3: Paper Specifications

Topic No.	Topic	Marks Distribution			Total Marks
1.	Introduction to Biology	MCQs 7 @ 1 Mark CRQ 1 @ 4 Marks *ERQ 1 @ 7 Marks Choose any ONE from TWO			18
2.	Biological Molecules				
3.	Enzymes				
4.	The Cell				
5.	Variety of Life	MCQs 2 @ 1 Mark CRQ 1 @ 4 Marks			6
6.	Kingdom Prokaryote	MCQs 3 @ 1 Mark CRQ 1 @ 4 Marks			7
7.	Kingdom Protoctista	MCQs 3 @ 1 Mark CRQ 1 @ 4 Marks			7
8.	Kingdom Fungi	MCQs 2 @ 1 Mark CRQ 1 @ 4 Marks			6
9.	Kingdom Plantae	MCQs 6 @ 1 Mark CRQs 2 @ 5 Marks each ERQ 1 @ 8 Marks Choose any ONE from TWO			24
10.	Kingdom Animalia				
11.	Bioenergetics				
12.	Nutrition				
13.	Gaseous Exchange	MCQs 7 @ 1 Mark CRQs 2 @ 5 Marks each			17
14.	Transport				
	Total	MCQs 30	CRQs 40	ERQs 15	85
	Practical				15
	Total Marks				100

- * Extended response questions (ERQs) will require answers in more descriptive form. The answers will be in a paragraph rather than a word or a single sentence.

Class XII

Table 4: Number of Student Learning Outcomes by Cognitive Level

Topic No.	Topics	No. of Sub Topics	SLOs			Total
			K	U	A	
15.	Homeostasis	9	6	20	0	26
16.	Support and Movement	6	3	27	0	30
17.	Co-ordination and Control	6	5	27	0	32
18.	Reproduction	6	8	27	1	36
19.	Growth and Development	7	5	17	0	22
20.	Chromosome and DNA	6	1	17	0	18
21.	Cell Cycle	4	6	8	0	14
22.	Variation and Genetics	6	3	13	2	18
23.	Biotechnology	6	0	9	5	14
24.	Evolution	4	2	12	0	14
25.	Ecosystem	4	7	10	0	17
26.	Some Major Ecosystem	3	0	7	0	7
27.	Man and his Environment	6	2	8	2	12
	Total	73	48	202	10	260
	Percentage		18	78	4	100

**Table 5: Allocation of Marks for the Multiple Choice Questions (MCQs),
Constructed Response Questions (CRQs) and
Extended Response Questions (ERQs)**

Topic No.	Topics	No. of Sub Topics	Marks			Total
			Multiple Choice Questions	Constructed Response Questions	Extended Response Questions	
15.	Homeostasis	9	10	12	7	29
17.	Co-ordination and Control	6				
18.	Reproduction	6				
20.	Chromosome and DNA	6				
16.	Support and Movement	6	6	10	0	16
19.	Growth and Development	7				
21.	Cell Cycle	4				
22.	Variation and Genes	6	8	10	8	26
23.	Biotechnology	6				
25.	Ecosystem	4				
27.	Man and his Environment	6				
24.	Evolution	4	6	8	0	14
26.	Some Major Ecosystems	3				
	Total	73	30	40	15	85
	Practical					15
	Total					100

Table 6: Paper Specifications

Topic No.	Topic	Marks Distribution			Total Marks
15.	Homeostasis	MCQs 10 @ 1 Mark CRQs 3 @ 4 Marks each ERQ 1 @ 7 Marks Choose any ONE from TWO			29
17.	Co-ordination and Control				
18.	Reproduction				
20.	Chromosome and DNA				
16.	Support and Movement	MCQs 6 @ 1 Mark CRQs 2 @ 5 Marks each			16
19.	Growth and Development				
21.	Cell Cycle				
22.	Variation and Genes	MCQs 8 @ 1 Mark CRQs 2 @ 5 Marks each ERQ 1 @ 8 Marks Choose any ONE from TWO			26
23.	Biotechnology				
25.	Ecosystem				
27.	Man and his Environment				
24.	Evolution	MCQs 6 @ 1 Mark CRQs 2 @ 4 Marks each			14
26.	Some Major Ecosystems				
	Total	MCQs 30	CRQs 40	ERQs 15	85
	Practical				15
	Total				100

* Extended response question will require answer in more descriptive form. Student will be writing the answer in a paragraph rather than a word or a simple sentence.

- 4.1 Tables 1 and 4 summarize the number and nature of SLOs in each topic in classes XI and XII. This will serve as a guide in the construction of the examination paper. It also indicates that more emphasis has been given to Understanding (77% and 78%), Application and higher order skills (2% and 4%) to discourage rote memorization. Tables 1 and 4 however do not translate directly into marks.
- 4.2 There will be two examinations, one at the end of Class XI and one at the end of Class XII.
- 4.3 In each class, the theory paper will be in two parts: paper I and paper II. Both papers will be of duration of 3 hours.
- 4.4 Paper I theory will consist of 30 compulsory multiple choice items. These questions will involve four response options.
- 4.5 Paper II theory will carry 55 marks and consist of a number of compulsory, structured questions and a number of extended response questions. Each extended response question will be presented in an either/or form.
- 4.6 Practical examination will be conducted separate from the theory paper. It will be based on the list of practical activities listed in the examination syllabus.

- 4.7 All constructed response questions will be in a booklet which will also serve as an answer script.
- 4.8 Practical exams to assess performance skills will carry 15 marks in class XI and 15 marks in class XII.
- 4.9 It is essential for each school to equip its laboratories with chemicals, instruments, apparatus, specimens etc. according to the requirements of the practicals. Each school will be responsible to make sure that each student is provided the opportunity to do the practicals.

List of practicals is attached as annex B.

5. Teaching-Learning Approaches and Classroom Activities

To promote effective teaching and learning a teacher has to play an effective and vital role as a facilitator, guide, supervisor, advisor etc. Work plan to be worked out beforehand for the speculated period. Lesson should be pre-planned keeping in view the set objectives. Theoretical concepts must be augmented by relevant practical activities. Teaching aids should be developed and tested beforehand. Classroom environment must be conducive, absorbing and friendly. Evaluation, assessment and measurement must be a regular feature for the scheme of work. Lesson evaluation should be formative and summative and to be done beforehand. Field trips to be pre-planned. Short-term projects to be designed with perfection, and should be executed effectively. Lab should be properly equipped to cater to the needs of given set of practical.

- Study of prepared slides
- Identification, classification and physical features of preserved specimens
- Study of models of different organs such as eye, brain, ear, skin
- Collaborative learning (group assignments/ peer work)
- Gathering information from the internet / library/ documentary/ field visits (seashore, river, pond, forest, hospitals)
- Group and individual projects/ models
- Home assignments
- Science exhibitions/ quiz participation/ declamation contest

6. Recommended Texts and Reference Materials

Recommended Book

1. *Textbook for Biology XI.* (2007). Lahore: Punjab Textbook Board.
2. *Textbook for Biology XII.* (2007). Lahore: Punjab Text Book Board.
3. Dr. Farkhanda Manzoor (2003). *Biology Practical Notebook F.Sc. Part I.* Star Publishers.
4. Dr. Farkhanda Manzoor (2003). *Biology Practical Notebook F.Sc Part II.* Star Publishers.

Reference Books

1. *Textbook for Biology XI.* (2007). Jamshoro: Sindh Textbook Board.
2. *Textbook for Biology XII.* (2007). Jamshoro: Sindh Textbook Board.
3. Campbell, Neil A. (1946) (2nd Edition). *Biology: Concepts and Connections.* Benjamin Cummings.
4. Raven and Johnson. (2005) (7th Edition). *Biology.* Tata McGraw-Hill.
5. D. J. Taylor. (1997) (3rd Edition). *Biological Science I.* UK: Cambridge University Press.
6. Micheal Kent. (2000) (1st Edition). *Advanced Biology.* Pakistan: Oxford University Press.
7. Zahid Latif (2004) (5th Edition). *A Practical Approach, Botany for First Year Science Students.* Karachi.
8. Zahid Latif (2005) (4th Edition). *A Practical Approach, Botany for Second Year Science Students.* Karachi.

Recommended Websites

<http://www.bbc.co.uk/schools/gcsebitesize/science/aqa/>
<http://www.planet-science.com>
http://faculty.fmcc.suny.edu/mcdarby/animals&plantsbook/site_map.htm
<http://fds.oup.com/www.oup.com/pdf/13/9780199151431.pdf>
http://www.hhmi.org/biointeractive/disease/dna_chem_structure.html

7. Definition of Cognitive Levels and Command Words

7.1. Definition of Cognitive Levels

Knowledge

This requires knowing and remembering facts and figures, vocabulary and contexts, and the ability to recall key ideas, concepts, trends, sequences, categories, etc. It can be taught and evaluated through questions based on: who, when, where, what, list, define, identify, label, tabulate, quote, name, state, etc.

Understanding

This requires understanding information, grasping meaning, interpreting facts, comparing, contrasting, grouping, inferring causes/reasons, seeing patterns, organizing parts, making links, summarizing, solving, identifying motives, finding evidence, etc. It can be taught and evaluated through questions based on: why, how, show, paraphrase, describe, summarize, explain, prove, identify the main idea/theme, predict, compare, differentiate, discuss, chart the course/direction, report, etc.

Application

This requires using information or concepts in new situations, solving problems, organizing information and ideas, using old ideas to create new ones, generalizing from given facts, analyzing relationships, relating knowledge from several areas, drawing conclusions, evaluating worth, etc. It can be taught and evaluated through questions based on: differentiate, analyze, show relationship, propose an alternative, prioritize, give reasons for, categorize, illustrate, corroborate, compare and contrast, create, demonstrate, design, formulate, integrate, interpret, rearrange, reconstruct/recreate, recognise, predict consequences, solve etc.

7.2 Definition of Command Words

Knowledge

- Define:** Only a formal statement or equivalent paraphrase is required. No examples need to be given.
- Identify:** To describe with specific examples of how a given term or concept is applied in daily life.
- List:** It requires a number of points, generally each of one word, with no elaboration. Where a given number of points is specified, this should not be exceeded.
- Recall:** To bring back to mind and write down, as it is given in the text that you have already memorized.
- State:** A concise answer with little or no supporting argument, e.g. a numerical answer that can be obtained “by inspection”.

Understanding

- Categorise:** State a basis for classification of a set of related entities and assign examples.
- Classify:** To state a basis for categorization of a set of related entities and assign examples to categories.
- Compare:** To list the main characteristics of two entities clearly identifying similarities or differences
- Describe:** To state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena.
- Differentiate/
Distinguish:** To identify those characteristics which always or sometimes differentiate two categories.

- Draw:** To make a simple freehand sketch or diagram. Care should be taken with proportions and the clear labelling of parts.
- Explain:** To reason in detail or use some reference to theory, depending on the context.
- Give an account:** *Give an account of* should be interpreted more generally, i.e. the candidate has greater discretion about the nature and the organization of the material to be included in the answer.
- Highlight:** Bring to light the key features of a phenomenon or an object or living organism.
- Illustrate:** Clarify by giving examples with the help of diagram.
- Recognize:** It involves looking at a given example and stating what it most probably is.
- Show:** To demonstrate with evidence.

Application

- Apply:** To use the available information in different context to relate and draw conclusions.
- Assess:** To evaluate or estimate the nature, ability, or quality of something.
- Discuss:** To give a critical account of the points involved in the topic.
- Evaluate:** To weigh evidence and make judgments based on given criteria.
- Explore:** To investigate or examine systematically/ to attain information by searching in books/ videos/ websites.

HSSC Scheme of Studies³

AKU-EB as a national board offers SSC and HSSC qualifications for both English and Urdu medium schools. The revised HSSC Scheme of Studies issued by the Curriculum Wing was implemented from September 2007. The marks allocated to subjects in the revised National Scheme of Studies have been followed.

HSSC I-II (Classes XI-XII) subjects on offer for examination

HSSC Part-I (Class XI) Science Group (Pre-Medical)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I OR Pakistan Culture-I ^a	100	-	100	Urdu English
Physics-I	85	15	100	English
Chemistry-I	85	15	100	English
Biology-I	85	15	100	English
Total:	455	45	500	

HSSC Part-II (Class XII) Science Group (Pre-Medical)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II OR Pakistan Culture-II ^a	100	-	100	Urdu English
Islamiyat OR Ethics ^b	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Physics-II	85	15	100	English
Chemistry-II	85	15	100	English
Biology-II	85	15	100	English
Total:	555	45	600	

- Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
- For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

³ Government of Pakistan September 2007. *Scheme of Studies for SSC and HSSC (Classes IX-XII)*. Islamabad: Ministry of Education, Curriculum Wing.

HSSC Part-I (Class XI) Science Group (Pre-Engineering)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I OR Pakistan Culture-I ^a	100	-	100	Urdu English
Physics-I	85	15	100	English
Chemistry-I	85	15	100	English
Mathematics-I	100	-	100	English
Total:	470	30	500	

HSSC Part-II (Class XII) Science Group (Pre-Engineering)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II OR Pakistan Culture-II ^a	100	-	100	Urdu English
Islamiyat OR Ethics ^b	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Physics-II	85	15	100	English
Chemistry-II	85	15	100	English
Mathematics –II	100	-	100	English
Total:	570	30	600	

- Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
- For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

HSSC Part-I (Class XI) Science Group (Science General)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I	100	-	100	Urdu
Pakistan Culture-I ^a				English
Any one subject combinations of the following:				
Physics-I	85	15	300	English
Mathematics-I	100	-		English
*Statistics-I	85	15		English
Economics-I	100	-	300	English / Urdu
Mathematics-I	100	-		English
*Statistics-I	85	15		English
Economics-I	100	-	300	English / Urdu
Mathematics-I	100	-		English
Computer Science-I	75	25		English
Physics-I	85	15	300	English
Mathematics-I	100	-		English
Computer Science-I	75	25		English
Mathematics-I	100	-	300	English
*Statistics-I	85	15		English
Computer Science-I	75	25		English
Total:			500	

HSSC Part-II (Class XII) Science Group (Science General)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II OR	100	-	100	Urdu
Pakistan Culture-II ^a				English
Islamiyat OR Ethics ^b	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Any one subject combinations of the following:				
Physics-II	85	15	300	English
Mathematics-II	100	-		English
*Statistics-II	85	15		English
Economics-II	100	-	300	English / Urdu
Mathematics-II	100	-		English
*Statistics-II	85	15		English
Economics-II	100	-	300	English / Urdu
Mathematics-II	100	-		English
Computer Science-II	75	25		English
Physics-II	85	15	300	English
Mathematics-II	100	-		English
Computer Science-II	75	25		English
Mathematics-II	100	-	300	English
*Statistics-II	85	15		English
Computer Science-II	75	25		English
Total:			600	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.

b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

***These subject is offered ONLY in the May examination.**

HSSC Part-I (Class XI) Commerce Group

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I OR Pakistan Culture-I ^a	100	-	100	Urdu English
Principles of Accounting-I	100	-	100	English
Principles of Economics	75	-	75	English
Principles of Commerce	75	-	75	English
Business Mathematics	50	-	50	English
Total:	500	-	500	

HSSC Part-II (Class XII) Commerce Group

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II OR Pakistan Culture-II ^a	100	-	100	Urdu English
Islamiyat OR Ethics ^b	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Principles of Accounting-II	100	-	100	English
Commercial Geography	75	-	75	English
*Computer Studies OR Banking	60 OR 75	15 -	75	English
Business Statistics	50	-	50	English
Total:	600		600	

- a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
- b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

***This subjects are offered ONLY in the May examination.**

HSSC Part-I (Class XI) Humanities Group

Subjects	Marks	Medium
English Compulsory-I	100	English
Urdu Compulsory-I OR Pakistan Culture-I ^a	100	Urdu English
Any three of the following Elective Subjects	300	
1. Civics-I	(100	English / Urdu
2. Computer Science-I (75+25 practical)	each)	English
3. Economics-I		English / Urdu
4. *Education-I		English / Urdu
5. *Geography-I (85+15 practical)		English / Urdu
6. *Islamic Studies-I		English / Urdu
7. *Islamic History-I		English / Urdu
8. Literature in English-I		English
9. Mathematics-I		English
10. *Psychology-I (85+15 practical)		English / Urdu
11. *Statistics-I (85+15 practical)		English
12. *Sociology-I		English / Urdu
13. Urdu Literature-I		Urdu
14. *Fine Arts-I		English
Total:	500	

HSSC Part-II (Class XII) Humanities Group

Subjects	Marks	Medium
English Compulsory-II	100	English
Urdu Compulsory-II OR Pakistan Culture-II ^a	100	Urdu English
Islamiyat OR Ethics ^b	50	English / Urdu
Pakistan Studies	50	English / Urdu
Any three of the following Elective Subjects	300	
1. Civics-II	(100	English / Urdu
2. Computer Science-II (75+25 practical)	each)	English
3. Economics-II		English / Urdu
4. *Education-II		English / Urdu
5. *Geography-II (85+15 practical)		English / Urdu
6. *Islamic Studies-II		English / Urdu
7. *Islamic History-II		English / Urdu
8. Literature in English-II		English
9. Mathematics-II		English
10. *Psychology-II (85+15 practical)		English / Urdu
11. *Statistics-II (85+15 practical)		English
12. *Sociology-II		English / Urdu
13. Urdu Literature-II		Urdu
14. *Fine Arts-II		English
Total:	600	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.

b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

*These subjects are offered **ONLY** in the May examination.

List of Practicals

Class XI

S. No.	SLO No.	Objective	Apparatus/Slide/Material	Chemical
Topic 2: Biological Molecules				
1.	2.4.2	Performing Benedict's test for reducing sugar and confirmation of the presence of starch through iodine test	Bunsen burner, test tubes, test tube stand, test tube holder, dropper, tripod stand, wire gauze, graduated pipettes, beaker	Solutions of glucose, starch, Benedict's solution, iodine solution
2.	2.5.2	Confirmation of the presence of lipids through emulsion test	Test tubes	A fat source (coconut oil/peanuts), ethyl alcohol, distilled water
3.	2.6.5	Confirmation of the presence of proteins through Biuret test	Bunsen burner, test tubes, test tube stand, test tube holder, dropper, tripod stand, wire gauze, graduated pipettes, beaker	5% sodium hydroxide solution, 1% copper sulphate solution
Topic 3: Enzymes				
4.	3.4.1	Performing amylase test on starch with boiled amylase and un-boiled amylase in separate test tubes and confirmation through iodine test	Bunsen burner, test tubes, test tube stand, test tube holder, dropper, tripod stand, wire gauze, graduated pipettes, beaker	Starch, amylase solution, iodine solution
Topic 4: The Cell				
5.	4.4.1	Preparation and examination of the slides of animal cells (frog epithelial cells and rectal ciliates of frog) and plant cells (onion epidermal and leaf epidermis)	Microscope, glass slide, nichrome wire, blade, cover slip and dropper	Any dye

S. No.	SLO No.	Objective	Apparatus/Slide/Material	Chemical
Topic 6: Kingdom Prokaryote				
6.	6.2.4	Staining bacteria using Gram staining technique	Microscope, glass slide, nichrome wire, Bunsen burner, cover slip, dropper	Crystal violet, iodine, safranin, alcohol, distilled water, immersion oil
7.	6.10.1	Study of nostoc from fresh or preserved material	Specimen of nostoc	-
Topic 7: Kingdom Protista				
8.	7.3.1 7.4.1	Observation and drawing of representative members of each group of protists	Slide of amoeba, euglena, plasmodium, paramecium, chlorella, ulva, spirogyra and microscope	-
Topic 8: Kingdom Fungi				
9.	8.1.1 8.2.1	Study of mushroom from fresh or preserved material and prepare temporary slides of fungi	Specimen of mushroom Preserved sample/culture of rhizopus, yeast and penicillium Microscope, glass slide, nichrome wire, Bunsen burner, cover slip, dropper	Any dye

S. No.	SLO No.	Objective	Apparatus/Slide/Material	Chemicals
Topic 9: Kingdom Plantae				
10.	9.1.4	Study the morphology of male and female plant of marchantia	Specimen of male and female plant of marchantia	-
11.	9.4.2	Study the morphology of male and female cones of pinus	Specimen of male and female cones of pinus	-
12.	9.5.1	Describing the flowers of <i>Rosa indica</i> , <i>Cassia fistula</i> , <i>Acacia nilotica</i> , <i>Solanum nigrum</i> / <i>Datura alba</i> and <i>Avena sativa</i> / <i>Clitoria ternatea</i>	Flowers of <i>Rosa indica</i> , <i>Cassia fistula</i> , <i>Acacia nilotica</i> , <i>Solanum nigrum</i> / <i>Datura alba</i> and <i>Avena sativa</i> / <i>Clitoria ternatea</i>	-
Topic 10: Kingdom Animalia				
13.	10.4.1 10.5.1 10.6.1 10.7.1 10.8.1 10.9.1 10.10.1 10.11.1 10.14.1 10.14.4 10.14.6 10.14.8 10.14.11	Study the specimen/model of invertebrates and vertebrates	Specimen of sycon, hydra/obelia, liver fluke/planaria, tapeworm, roundworm, earthworm, leech, crab, butterfly/ wasp, spider, mussel, snail/ slug, brittle star/ sea star Specimen/ model of fish, frog/toad, lizard/snake, bird and mouse/dog/squirrel	-

S. No.	SLO No.	Objective	Apparatus/Slide/Material	Chemicals
Topic 11: Bioenergetics				
14.	11.2.2	Extraction of the leaf pigments and their separation by paper chromatography	Test tubes with stopper, test tube stand, test tube holder, pestle and mortar, pins, chromatography paper or filter paper, droppers, tripod stand, Bunsen burner, beaker, glass, wool, funnel, forceps	Pigment solution, 80% acetone, 90% acetone-petroleum, ether mixture (1:9), ethyl alcohol
Topic 13: Gaseous Exchange				
15.	13.2.1	Examination of goat/sheep lungs	Goat/sheep lungs, dissecting tray, pointer	-
Topic 14: Transport				
16.	14.2.1 14.5.2	Microscopic observation of the slide of L.S. of a dicotyledonous stem, identifying and drawing vessel element, vessel and phloem sieve tubes	Slide of L.S. of dicotyledonous stem, microscope, needle/ pointer	-
17.	14.6.6	Dissection of the heart of goat/ sheep and describing its internal structure	Goat/ sheep heart, dissecting tray, pointer	-
18.	14.7.7	Measuring blood pressure by using sphygmomanometer	Sphygmomanometer, stethoscope	-
19.	14.9.3	Recognizing phagocytes and lymphocytes while observing prepared slides	Slides of phagocytes and lymphocytes	-

Class XII

S. No.	SLO No.	Objective	Apparatus/Slide/Material	Chemicals
Topic 16: Support and Movement				
1.	16.1.1	Locating annual rings in the log of a tree and calculation of the age of a plant by counting number of annual rings	Log of a tree	-
2.	16.2.4	Demonstration of phototropism, geotropism and thigmotropism in plants	Wooden box, potted plant	-
3.	16.4.2	Identification of the bones of the pelvic girdles, pectoral girdle, arms and legs by using the model of human skeleton	Model of human skeleton	
4.	16.5.3	Preparation of temporary slides of skeletal, smooth and cardiac muscles of frog	Slides, cover slips, forceps, microscope, specimen of frog	
Topic 18: Reproduction				
5.	18.6.7	Identification of different parts of the reproductive system of a dissected female frog (dissection would be done by the teacher)	Specimen of reproductive system of a female frog, dissecting tray, pointer	

S. No.	SLO No.	Objective	Apparatus/Slide/Material	Chemicals
6.	18.6.9	Examination of the prepared slides of histology of ovaries and drawing its structures	Slide of histology of ovaries, microscope	-
Topic 19: Growth and Development				
7.	19.5.2	Identification of the different stages in chick development using photomicrographs	Photomicrographs of stages of development in chick	-
Topic 22: Variation and Genes				
8.	22.2.2	Evaluation of the inheritance of genes and their mixing during fertilization as based on mathematical probabilities	Dice, note book, pencil	-
9.	22.2.2	Study of continuous variations in the height in man and recording the result as histogram	Drawing paper, pencil, ruler	-
10.	22.4.1	Data collection from the class to see how many individuals have AB blood group and construction of a pie chart and histogram for the collected data	Drawing paper, pencil, ruler	-
11.	24.3.1	Interpretation of different homologous organs and analogous structures through observation in plants and animals	Variety of plants and animals	-
12.	25.3.5	Investigation of food chains and food web of a pond ecosystem	Samples for different food chains and food webs	-