



ZIAUDDIN UNIVERSITY
EXAMINATION BOARD

Higher Secondary School Certificate (HSSC)

Examination syllabus

Biology XII

**Based on Provincial revised curriculum
(Sindh)**



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PREFACE

The Ziauddin University Examination Board (ZUEB) was established under **Sindh ACT XLI 2018**, with the primary objective of enhancing the quality of education in Sindh. ZUEB is responsible for administering examinations for the **Secondary School Certificate (SSC)** and **Higher Secondary School Certificate (HSSC)** in alignment with the most recent revisions to the **National Curriculum**, as outlined by the **Directorate of Curriculum Assessment and Research (DCAR), Sindh**. Through its ordinance, ZUEB is mandated to provide examination services for both English, Urdu, and Sindhi medium candidates from private schools across Sindh. This examination syllabus reflects ZUEB's dedication to achieving the educational goals set by the provincial authorities.

In collaboration with subject professors, ZUEB has developed a comprehensive syllabus for each subject. It is important to distinguish between the syllabus and the curriculum. The syllabus serves as a guide for both teachers and students, outlining the key areas of focus within the subject. It provides students with a clear understanding of what is expected of them in their studies and helps them prepare effectively for their exams.

This examination syllabus incorporates all cognitive outcomes derived from the **Provincial Curriculum Statement**, ensuring that assessments are both valid and reliable. While the focus is primarily on the cognitive domain, significant emphasis is placed on the application of knowledge and understanding.

The syllabus is made available to all stakeholders via the ZUEB website to assist affiliated schools in planning their teaching. It is crucial to note that the syllabus, rather than the prescribed textbook, forms the foundation of ZUEB examinations. Additionally, this syllabus supports the development of learning materials for both students and teachers. ZUEB remains committed to supporting students undertaking the SSC and HSSC courses by facilitating their learning outcomes through this detailed syllabus document.

To further assist in the learning process, ZUEB provides a dedicated **e-resource tab** on its website, offering both text-based and video content on various subjects. These 15-20 minute instructional videos, created around key subject concepts, allow students to learn at their own pace and convenience. The videos can be used as a reinforcement tool to revisit lessons already taught or as pre-lesson material. This initiative is an ongoing effort, and new videos will continue to be uploaded.

We encourage all students and educators to make the most of these resources for a more enriched and flexible learning experience.

Sincerely,

Shahbaz Nasim

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Rationale For The Reviewed Provincial Curriculum

The process of revising the National Curriculum 2006 began in August 2004, when the newly elected government of Pakistan initiated education reforms across the country. These reforms included the introduction of a new National Education Policy, a National Education Census, and a revision of curricula (Ministry of Education, 2009).

In practice, the overhaul of the secondary school curriculum began in 2006, leading to a review of the scheme of studies for classes I to XII and the revision of curricula for 25 compulsory subjects.

The 18th Amendment to the Constitution of Pakistan, enacted in 2010, significantly altered the federal-provincial relationship by abolishing the "concurrent legislative list." This amendment granted provinces greater legislative and financial autonomy in sectors such as education and health. The most notable implication of the 18th Amendment for education was the transfer of responsibility for curriculum development, syllabus planning, policy formation, and educational standards to the provinces, marking a significant step forward for education.

In Sindh, the School Education Department tasked a Curriculum Review Team with revising the National Curriculum 2006 for all subjects. The goal was to create a curriculum better suited to the needs of students and teachers while aligning with the principles of the 18th Amendment. Subject-specific curriculum review committees were established to critically examine and align the curriculum's content, both contextually and textually, ensuring coherence across various subjects. The Bureau of Curriculum (BoC) played a crucial role in organizing workshops and meetings in Hyderabad to facilitate the completion of this task. The support of numerous educationists, researchers, and teachers was invaluable in successfully revising the curriculum.

The revised National Curriculum, along with the original version, is available on the DCAR website at http://dcar.gos.pk/BoC_Other_Pages/curriculum_dev.html for easy access.

The Ziauddin University Examination Board (ZUEB) SSC and HSSC syllabi are developed in accordance with the Sindh Revised Curriculum. To date, textbooks for various subjects have been developed based on the revised curriculum.

CHAPTER 15: HOMEOSTASIS

Overview:

In this chapter we will see many delicate interacting and highly coordinated mechanisms that keep the body's internal environment within the extremely precise limits critical to life. Major concepts are as follows

- Homeostasis (01 Periods)
- Osmoregulation (01 Period)
- Excretion (01 Period)
- Urinary system of Man (03 Periods)
- Disorders of Urinary Tract (03 Periods)
- Thermoregulation (01 Period)

Conceptual Linkages:

This chapter is built on;

- Homeostasis (Grade **IX -X**)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- Homeostasis

➤ Understanding

Student will:

- Describe three elements i.e. receptors, control center and effectors which operate homeostatic mechanisms.
- Relate the homeostatic mechanisms with the negative and positive feedback systems.

➤ Skills

(Initiating and Planning)

Student will:

- Investigate why positive feedback mechanisms in humans are sometimes associated with severe health problems.
- List some of the behavioral responses of the animals to maintain homeostasis.

(Interpreting and Communicating)

Student will:

- Draw a flow chart to show negative feedback of homeostatic mechanisms by taking an example of hormone.

2- Osmoregulation

➤ Understanding

Student will:

- Define osmoregulation
- Differentiate between osmoconformers and osmoregulators
- Explain the problems faced by osmoregulators.(hypertonic, hypotonic and isotonic condition)
- Explain the different methods of osmoregulation found in freshwater, marine water and terrestrial habitats.

3- Excretion

➤ Understanding

Student will:

- List various nitrogenous compounds excreted during the process of excretion.
- Explain the nature of excretory products in relation to habitat.

4- Urinary System of Man

➤ Understanding

Student will:

- Explain different organs of urinary system. Describe the structure of kidney and relate it with its function.
- Explain the detailed structure of nephron.
- Explain the processes of glomerular filtration, selective re-absorption and tubular secretion as the events in kidney functioning.
- Explain that concentration of urine is regulated by counter-current and hormonal mechanisms.
- Justify the functioning of kidneys as both excretion and osmoregulation.
- Compare the function of two major capillary beds in kidneys i.e. glomerular capillaries and peritubular capillaries.

5- Disorders of Urinary Tract

➤ Understanding

Student will:

- List urinary tract infections and the bacteria responsible.
- Explain the causes and treatments of kidney stones.
- Outline the causes of kidney failure.
- Explain in detail the mechanism and problems related to dialysis.
- Describe the principles and the problems associated with kidney transplant.

➤ Skills

(Initiating and Planning)

Student will:

- Hypothesize kidney stone by studying the urine test of relevant patients.

6- Thermoregulation

➤ Understanding

Student will:

- Define thermoregulation and explain its needs.
- Classify animals on the basis of the source of body's heat i.e. ectotherms and endotherms.
- Describe the regulatory strategies in man for thermoregulation.

➤ STS Connections

Student will:

- Describe the importance of kidney donation for the benefit of kidney failure patients.
- Name the important kidney transplant centers in his / her province.

CHAPTER 16

SUPPORT AND MOVEMENT

Overview:

The theme of this chapter is to describe how muscles and skeleton support and move the body and to explain disorders of human skeletal and muscles. The knowledge of this chapter will help the student to ponder over the physics and dynamics of our skeleton and its ancillaries.

Following concepts are developed in this chapter;

- Human Skeleton (05 Periods)
- Disorders of Skeleton (02 Periods)
- Muscles (05 Periods)

Conceptual Linkages:

This chapter is built on;

- Support and movement (Grade IX-X)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- Human Skeleton

➤ Understanding

Student will:

- Explain support, movement and locomotion.
- Describe the structure of bone and compare it with that of cartilage.
- Explain the functions of osteoblasts, osteoclasts and osteocytes.
- Identify the main divisions of human skeleton.
- List the bones of appendicular and axial skeleton of man.
- Describe three types of joints i.e. fibrous joints, cartilaginous joints and synovial joints and give example of each.

➤ Skills

(Initiating and Planning)

Student will:

- Relate the bipedal posture of man with his skeleton and musculature.

(Analyzing and Interpreting)

- Identify the bones of the pelvic girdles, pectoral girdle, arms and legs by using the model of human skeleton.

2- Disorders of Skeleton

➤ Understanding

Student will:

- Describe the disorders of human skeleton (disc-slip, spondylosis, sciatica, arthritis) and their causes.
- State different types of fractures (simple, compound and complicated) and describe the repair process of simple fractures.
- Describe the injuries in joints (dislocation and sprain) and their first aid treatment.
- Describe the first-aid treatment for fracture.

3- Muscles

➤ Understanding

Student will:

- Define muscle and its types.
- Compare smooth muscles, cardiac muscles and skeletal muscles.
- Explain the ultra-structure of the skeletal muscle.
- Explain the sliding filaments model of muscle contraction.
- Describe the action of antagonistic muscles in the movement of knee joint.
- Explain muscle fatigue, cramps and tetany.
- Differentiate between tetanus and muscle tetany.

➤ Skills

(Analyzing and Interpreting)

Student will:

- Compare the structure of skeletal, smooth and cardiac muscles with the help of prepared slides
- Draw a diagram of sarcomere and label its parts.
- Justify how the main functions of the skeleton are to act as a system of rods and levers, which are moved by the muscles.
- Justify why do the muscles pull but do not push.

➤ STS Connections

Student will:

- Name the techniques for joint transplantation.
- Justify why the use of calcium in teenage and twenties can be a preventive action against osteoporosis.
- Relate improper posture to bone/joint problems.

CHAPTER 17

NERVOUS COORDINATION

Overview:

The topic of coordination and control is built upon the basics of nervous and hormonal coordination dealt with earlier at level IX-X. This topic emphasizes the electrochemical reception of stimuli to adjust the internal environment of an organism within narrow limits for homeostasis. The following concepts are developed in this chapter

- Nervous System of Man (06 Periods)
 - Steps involved in Nervous Coordination
 - Neurons
 - Nerve Impulse
 - Transmission of Action Potential between cells
 - Synapse
 - Basic Organization of human Nervous System and Sensory Receptors
- Effects of drugs on Nervous Coordination (02 Periods)
- Disorders of Nervous System and Diagnostic tests (05 Periods)

Conceptual Linkages:

This chapter is built on;

- Coordination and Control (Grade IX-X)

MAJOR CONCEPTS AND LEARNING OUTCOMES

Nervous System of Man

1- Steps Involved in Nervous Coordination

➤ Understanding

Student will:

- Recognize receptors as transducers sensitive to various stimuli.
- Trace the path of a message transmitted to the CNS for processing.
- Identify the three neurons (sensory, intermediate, motor) involved in nervous transmission.
- Identify muscles and glands as the effectors.

➤ Skills**(Initiating and Planning)**

Student will:

Predict from every day experience what various kinds of receptor can be found in human body.

2- Neurons**➤ Understanding**

Student will:

- Describe the detailed structure of a sensory neuron, associative and a motor neuron and relate the specialization in structures with functions.
- Differentiate between myelinated and non-myelinated neurons.
- Explain the process of reflex action and the function of the different types of neurons with the help of a reflex arc.

➤ Skills**(Interpreting and Communication)**

Student will:

- Draw and label the structure of three kinds of neuron.

3- Nerve Impulse**➤ Understanding**

Student will:

- Define nerve impulse.
- Describe the generation and transmission of nerve impulse.
- Name the factors responsible for the resting membrane potential of neuron.
- Evaluate from a graph the phenomena of polarization, depolarization and hyperpolarisation of membrane.
- Compare the velocities of nerve impulse in the axon membrane and in the synaptic cleft.
- Describe the role of local circuits in propagation of nerve impulse node to node (saltatory conduction) of nerve impulse.

4- Synapse

➤ Understanding

Student will:

- Describe the structure of synapse.
- Explain synaptic transmission of nerve impulse.
- Classify neurotransmitters as inhibitory and excitatory and list some common examples.

5- Basic Organization of Human Nervous System

➤ Understanding

Student will:

- Identify the main components of the nervous system.
- Explain briefly the functions of major divisions of brain.
- Describe the architecture of human brain and compare its sectional view with that of the spinal cord.
- Describe cranial and spinal nerves in man.
- Explain the structure, types and functions of autonomic nervous system.
- Explain the structure and functioning of the receptors for smell, taste and touch/pain.

➤ Skills

(Interpreting and Communication)

Student will:

- Draw a labeled diagram of the human brain.
- Identify different components in the diagram of CNS and PNS.

6- Effect of Drugs on Nervous Coordination

➤ Understanding

Student will:

- Define narcotic drugs as agents that interact with the normal nervous activity.
- Compare the use and abuse of drugs with respect to heroine, *Cannabis*, nicotine, alcohol and inhalants like nail polish remover and glue.
- Define and explain the terms; drug addiction and drug tolerance with reference to caffeine and nicotine.

7- Disorders of Nervous System and Diagnostic Tests

➤ Understanding

Student will:

- Classify nervous disorders into vascular, infectious, structural, functional and degenerative disorders.
- Describe the causes, symptoms and treatment one type of each category of disorders outlined above. (e.g., stroke as vascular, meningitis as infectious, brain tumor as structural, headache as functional, and Alzheimer disease as degenerative disorder).
- Explain the principles of the important diagnostic tests for nervous disorders i.e. EEG, CT scan and MRI.

➤ Skills

- **(Interpreting and Communication)**

Student will:

- Conceptualize the activity of brain as an electrical activity, which can be recorded using magnets and tomography.
- Compare the MRI scan of the brain of a sleeping human with that of a fully awake individual.

➤ STS Connections

Student will:

- Justify the way nervous system helps to coordinate complex and intricate movements of hand to play a piano, or write alphabets.
- Ascertain the effect of nerve gas as an inhibitor of acetylcholinesterase.
- Justify that the development of a modern computer is in fact a product of the understanding of the way nervous coordination occurs in complex organisms like humans.
- Describe how this knowledge has helped humans to treat diseases like epilepsy, paralysis.

CHAPTER 18

CHEMICAL COORDINATION

Overview:

The topic of chemical coordination is built upon the basics of hormonal coordination dealt with earlier at level **IX-X**. This topic emphasizes the chemical reception of stimuli to adjust the internal environment of an organism within narrow limits for homeostasis.

The following concepts are developed in this chapter:

- Hormones - The Chemical Messengers (01 Period)
- Endocrine system of Man (03 Periods)
- Feedback Mechanism (01 Period)

Conceptual Linkages:

This chapter is built on;

- Coordination and Control (Grade IX-X)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- Hormones- The Chemical Messengers

➤ Understanding

Student will:

- State the role of hormones as chemical messengers.
- Describe the chemical nature of hormones and correlate it with important hormones.
- Trace the path of the chemical message from its release from the endocrine gland to its action at the target site.
- Explain the two modes of hormone action at the cells of target site.

2- The Endocrine System of Man

➤ Understanding

Student will:

- Locate the following endocrine glands in human body; pituitary, thyroid, parathyroid, thymus, pancreas, adrenal, gonads.
- Name the hormonal secretions of the above-mentioned glands.
- Outline the major functions of the hormones of above mentioned glands and also relate the problems associated with the imbalance of these hormones.
- Explain the neurosecretory role of hypothalamus.

- Describe the functions of the hormones secreted by the endocrine tissue other than the mentioned above.

➤ Skills

(Interpreting and Communication)

Student will:

- State the role of artificially synthesized steroids in sports and their long-term effects on its users.
- Explain on what grounds some companies claim that growth is possible in people having short heights.

3- Feedback Mechanism

➤ Understanding

Student will:

- Outline the concept of Feedback mechanism of hormones.
- Describe positive feedback with reference to Oxytocin and negative feedback with reference to Insulin and Glucagon.

CHAPTER 19

ANIMAL BEHAVIOUR

Overview:

The goal of this chapter is to get the students understand the nature of behavior and distinguish between innate behavior and learning. The development and objectives of the social behaviors in different animals will also be the subjects of this chapter. The major concepts in this chapter are;

- The Nature of Behavior (02 Periods)
- Innate Behavior (04 Periods)
- Learning (03 Periods)
- Social Behavior (02 Periods)

Conceptual Linkages:

This chapter is built on;

- Reproduction (Grade XI-XII)
- Mammals (Grade XI-XII)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- The Nature of Behaviour

➤ Understanding

Student will:

- Define behaviour as the series of activities performed by an organism in response to stimuli.
- Explain relationship between stimuli and behaviour.
- Describe the relationship between heredity and behaviour.
- Explain, through examples, the biological rhythms.

2- Innate Behavior

➤ Understanding

Student will:

- Define innate (inborn) behaviour.
- Describe examples of innate behaviour in terms of taxis shown by unicellular organisms.
- Justify reflexes as a type of innate behavior, by giving examples from man and invertebrates.
- Define instincts and justify these as a type of innate behaviour.

- Justify the fact that each species displays its own characteristic instinctive behaviour through following examples; migration of salmon, dances of bees, construction of hanging nest by birds, construction of intricate web by spider and mating behaviour of stickleback fish.

➤ Skills

(Analyzing and Interpreting)

Student will:

- Give examples to interpret that hormones and brain control instincts.
- (Performing and Recording)
- *Student will:*
- Observe a spider's web as instincts behaviour.

3- Learning

➤ Understanding

Student will:

- Define learning and distinguish between learning and innate behaviour.
- Define habituation and illustrate it through the example of squirrels' adjustment in a park.
- Explain imprinting by narrating the work of Lorenz.
- Differentiate habituation and imprinting as reversible and irreversible learned behaviours.
- Describe classical conditioning by narrating the work of Pavlov on salivary reflex in dogs.
- Describe instrumental conditioning (trial-and-error learning) by narrating the work of Skinner on rats' learning.
- Describe latent learning, through the example of a rat in a maze with no reward.
- Interpret Kohler's work on chimpanzee's insight learning to justify that reasoning and planning are involved in the insight learning.

➤ Skills

(Analyzing and Interpreting)

Student will:

- Relate different examples of learning behaviours of human with habituation, conditioning, latent learning and insight learning.

4- Social Behavior

➤ Understanding

Student will:

- Differentiate between animal aggregations and animal societies.
- Describe social behaviour in terms of hostile and helpful interactions between animals belonging to the same species.
- Describe agonistic behaviour and relate it with the maintenance of social order in terms of territories and dominance hierarchies.
- Explain territorial behaviour by quoting example of the territories of monkeys and gorillas.
- Explain dominance hierarchy by quoting example of the pecking order of chicken.
- Define altruism and illustrate it through the organization of a honeybee society.

➤ STS Connections

Student will:

- State the role of research in neurobiology in the understanding of behaviour.
- Rationalize why the marine snail, *Aplysia*, has proved very helpful in the studies of neurobiology and of behaviour patterns.

SECTION- 4

CONTINUITY IN LIFE

CHAPTER 20 REPRODUCTION

Overview:

Students already have a generalized overview of the concept of reproduction. At this stage students will learn about the human reproductive system in more detail. They will also study about the sexually transmitted diseases and their control. The major concepts are as follows. The major concepts in this chapter are;

- Human Reproductive system (06 Periods)
- Disorders of Reproductive System (02 Periods)
- Sexually Transmitted Diseases (01 Period)

Conceptual Linkages:

This chapter is built on;

- Reproduction (Grade IX-X)
- This chapter leads to;
- Evolution (Grade XI-XII)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- Human Reproductive System

➤ Understanding

Student will:

- Describe the structures of male reproductive system identifying their functions.
- Explain the principal reproductive hormones of human male and explain their role in the maintenance and functioning of reproductive system.
- Explain the structures of female reproductive system and describe their functions.
- Describe the menstrual cycle emphasizing the role of hormones.

➤ Skills**(Initiating and Planning)**

Student will:

- Examine the prepared slides of histology of ovaries and testes of frog and draw its microscopic structures.
- Expose the reproductive system of a dissected frog (dissection would be done by the teacher).

2- Disorders of Reproductive System**➤ Understanding**

Student will:

- Describe the causes of female and male infertility.
- Explain that in-vitro fertilization (test tube babies) is one of the methods to solve the problem of infertility.
- Define miscarriage and state its causes.
- Relate miscarriage with abortion.

3- Sexually Transmitted Diseases**➤ Understanding**

Student will:

- Describe the causes, symptoms and treatment of gonorrhea and syphilis.
- Explain AIDS as a worldwide sexually transmitted disease.

➤ STS Connections

Student will:

- Realize the effect of endocrine disrupting contaminants on the reproductive abilities.
- Become aware of the ethical implications of abortion.
- List the measures that can help to prevent transmission of STDs.

CHAPTER 21

DEVELOPMENT AND AGING

Overview:

This chapter aims at the learning of basic concepts about human development. There would be a brief learning of the concept of aging. The major concepts in this chapter are;

- Human Embryonic Development (10) Periods)
- Control of Development (03 Periods)
- Pregnancy (03 Periods)
- Disorders during Embryonic Development (01 Period)
- Aging (02 Periods)

Conceptual Linkages:

This chapter is built on;

- Reproduction (Grade XI-XII)
- Mammals (Grade XI-XII)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- Human Embryonic Development

➤ Understanding

Student will:

- Explain the process and site of fertilization.
- Describe cleavage and relate it with amount of yolk.
- Explain blastula/blastocyst with emphasis on segmentation cavity.
- Explain the events of gastrulation.
- List the tissues and organs formed from the three germ layers.
- State the events of neurulation.
- Describe the formation of neural crest and list the structures that are derived from neural crest cells.
- Define organogenesis.

➤ Skills

(Analyzing and Interpreting)

Student will:

- Identify the group of vertebrates, through diagrams of different blastula.
- Identify the different stages in chick development through observation of prepared slides.

2- Control of Development

➤ Understanding

Student will:

- Through experimental narration, describe the role of the nucleus and cytoplasm in controlling development.
- Give a brief overview of the work done by Hans Spemann in the discovery of induction.
- Define organizers and differentiate between primary and secondary induction.

3- Pregnancy

➤ Understanding

Student will:

- Describe the events of development in human in terms of first, second and third trimesters.
- Describe in brief the development of twins and quadruplets.
- Describe the structural details of placenta and umbilical cord.
- Differentiate the terms gestation and pregnancy.

➤ Skills

(Initiating and Planning)

Student will:

- Explain why proper nourishment of the mother is imperative during the third trimester of pregnancy.

(Communication)

Student will:

- Draw a table to list the events of human development in the first trimester (first, second and third month), second trimester and third trimester.

4 - Disorders during Embryonic Development

➤ Understanding

Student will:

- Describe the maternal derived abnormalities (rubella, abnormal neural tube, thyroid gland and limb development).
- Relate the major genetic abnormalities in embryos with spontaneous abortion.
- Describe how fetal surgery helps to correct the detected fetal developmental problems.

5 – Aging

➤ Understanding

Student will:

- Define the term aging.
- Rationalize aging as a part of normal development.
- List the genetic and extrinsic factors responsible for aging.
- State the changes (graying, thinning hair, pigmented patches of skin, slowed movements, fading vision, impaired hearing, reduced ability to adapt to stress and decreased resistance to infections) as primary aging.
- State the changes that are the result of environmental, lifestyle factors such as disease, disuse (lack of exercise), and abuse (smoking, obesity, malnutrition, and exposure to ultra-violet light) as secondary aging.
- List some changes that occur at the system and those that occur at cellular level during aging.

➤ STS Connections

Student will:

- Describe how a blastula is divided into two (by using micromanipulator) to produce twins of animals for biological research.
- List some of the diseases due to aging and what medical science is doing to treat those diseases.

CHAPTER 22

CHROMOSOME AND DNA

Overview:

This chapter aims the detailed study of molecular genetics. The metabolic processes involved in gene expression and regulation would be catered in it. The major concepts in this chapter are;

- Chromosomal Theory of Inheritance (03 Periods)
- DNA as the Hereditary Material (02 Periods)
- DNA Replication (02 Periods)
- Gene Expression (04 Periods)
- Regulating Gene Expression (02 Periods)
- Mutation (02 Periods)

Conceptual Linkages:

This chapter is built on;

- Cell and cell division (Grade IX-X)
 - Chromosomes and DNA (Grade IX-X)
 - Biological Molecules (Grade XI-XII)
- This chapter leads to;
- Biotechnology (Grade XI-XII)
 - Evolution (Grade XI-XII)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- Chromosomal Theory of Inheritance

➤ Understanding

Student will:

- Critically analyze the history of chromosomal theory with reference to Correns' work.
- Critically analyze the experiments of T. H. Morgan in support of the above-mentioned theory.
- Annotate the detailed structure of a chromosome.
- Describe the concept of gene and gene locus.
- Explain the concept of alleles as the alternative forms of a gene.

2- DNA as the Hereditary Material

➤ Understanding

Student will:

- Narrate the experimental work of Griffith and Hershey-Chase, which proved that DNA is the hereditary material.

➤ Skills

(Analyzing and Interpreting)

Student will:

- Interpret an experiment in which a radio-isotope labeled DNA can be traced in the progeny of an organism.

3- DNA Replication

➤ Understanding

Student will:

- Describe the three models (Semi-conservative, Conservative and Dispersive) proposed about the mechanism of DNA replication.
- Narrate the work of Meselson and Stahl to justify the semi-conservative replication as the correct method of replication.
- Describe the events of the process of DNA replication.
- Explain DNA stability and variability as two characters of the replicating DNA molecule.

➤ Skills

(Analyzing and Interpreting)

Student will:

- Interpret how DNA conserves one strand, during replication.

4- Gene Expression

➤ Understanding

Student will:

- Describe the central dogma of gene expression.
- Define gene and genetic code.

- Describe the characteristics of genetic code (universal, triplet, non-overlapping, degenerate, punctuated).
- Differentiate between the terms genetic code and codon.
- Explain the mechanism of transcription.
- Explain why the length of transcribed m-RNA molecule (in Eukaryotes) shortens as it enters the cytoplasm for translation.
- Describe the mechanism of protein synthesis.
- State the difference between protein synthesis in prokaryotes and eukaryotes.
- Suggest possible ways in which the synthesized protein can be used within or outside a cell that synthesized it.

➤ Skills

(Initiating and Planning)

Student will:

- Interpret how many types of t-RNA molecules are necessary for a living cell, if the genetic code is a triplet code.

5- Regulating Gene Expression

➤ Understanding

Student will:

- State the importance of the regulation of gene expression.
- Describe the negative control of gene expression by repressor proteins.
- Describe the positive control of gene expression by activator proteins.
- Relate gene expression with introns and exons.

6- Mutation

➤ Understanding

Student will:

- Define mutation and identify various sources of mutation.
- Differentiate between natural and induced mutations and mutagens.
- Justify that most mutations are harmful.
- Rationalize that mutations might be a contributing factor towards evolution.
- Describe the symptoms, causes and possible available treatments of some of the chromosomal mutations. (Down's, Klinefelter's and Turner's syndrome)
- Describe the symptoms, causes and possible available treatments of some of the gene mutations. (Sickle cell anemia, Phenylketonuria)

↗ Skills

(Initiating and Planning)

Student will:

- Make a list of some commonly occurring minor mutations in humans.
- Justify why mutations prevail in a population and are inherited.

↗ STS Connections

Student will:

- Describe the paradoxical nature of DNA, as a tool for geneticists and forensics.
- Describe how various scientists in the field of biotechnology or genetic engineering have used DNA replication.
- Suggest possible ways to save lives or treat genetic diseases (like diabetes) through the knowledge gained under this heading.
- Explain how harmful mutations have been eradicated by nature.

CHAPTER 23

INHERITANCE

Overview:

This topic is built upon Mendelian genetics and carries the concept forward to post-mendelian research.

It also gives an insight into the inherited diseases and their subsequent symptoms and treatment. The following concepts are developed in this chapter:

- Laws of Mendel (02 Periods)
- Incomplete Dominance, Multiple Alleles and Co-dominance (02 Periods)
- ABO Blood Group System (02 Periods)
- Rh Blood Type System and Erythroblastosis foetalis (03 Periods)
- Polygenic Inheritance and Epistasis (02 Periods)
- Gene Linkage and Crossing Over (03 Periods)
- Sex Determination (02 Periods)
- Sex Linkage (05 Periods)

Conceptual Linkages:

This chapter is built on;

- Cell and cell division (Grade IX-X)
- Biological molecules (Grade IX-X)
- Inheritance (Grade IX-X)
- Chromosomes and DNA (Grade IX-X) This chapter leads to;
- Biotechnology (Grade XI-XII)
- Evolution (Grade XI-XII)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- Laws of Mendel

➤ Understanding

Student will:

- Explain the law of Segregation and law of independent assortment, using suitable examples.
- Express limitations in the law of independent assortment and its usefulness.
- State the scope of independent assortment in variation.
- Evaluate that inheritance of genes and their mixing during fertilization is based on mathematical probabilities.

➤ Skills

(Initiating and Planning)

Student will:

- Hypothesize that in a dihybrid inheritance pattern of color and texture of pea seed, the two traits are not inter dependent.

(Performing and Recording)

Student will:

- Solve at least 4 genetic problems, to illustrate the law of segregation and law of independent assortment.
- Evaluate Mendel's likelihood of being baffled by results that would not have conformed to the 9:3:3:1 phenotypic ratio of F₂ self-cross.
- Use the dice to calculate how many times out of 100 throws can you get sixes.

2- Incomplete Dominance, Multiple Alleles and Co-dominance

➤ Understanding

Student will:

- Describe the exceptions to the Mendel's laws of inheritance.
- Explain incomplete dominance and exemplify it through the inheritance of flower color in 4 O' clock plant.
- Explain co-dominance and exemplify it through inheritance of hair colour in cattle
- Differentiate between incomplete dominance and co-dominance.
- Describe multiple alleles and state the alleles responsible for the trait of ABO blood groups.
- Explain the case where two alleles have equal dominance and through the genetics of human blood group of AB.

➤ Skills

(Analyzing and Interpreting)

Student will:

- Collect data from the class or the institution to see how many individuals have AB blood group and construct a pie chart and histogram for the collected data.

3- ABO Blood Group System

➤ Understanding

Student will:

- Name the various human blood group systems.
- Associate multiple alleles with the ABO blood group system.
- Investigate the reasons for O-ve individual as the Universal donor and AB +ve as the Universal recipient.
- Describe the occurrence of some other blood group systems.

➤ Skills

(Interpreting and Recording)

- Build a thematic chart for the blood groups of his/her class fellows and identify the antigens present in blood.
- Test his/ her blood group using Antisera and explain which antigens and antibodies s/he has.
- Assess, based on the findings of his/ her blood test, which blood group s/he can accept or donate for transfusion.

4- Rh Blood Type System and *Erythroblastosis foetalis*

➤ Understanding

Student will:

- Associate the positive and negative blood groups with the presence and absence of Rh factor.
- Justify why Rh incompatibility could be a danger to the developing foetus and mother.
- Explain *Erythroblastosis foetalis* in the light of antigen-antibody reaction.
- Suggest measures to counter the problem of *Erythroblastosis foetalis* before it occurs.

➤ Skills**(Performing and Recording)**

Student will:

- Carry out an agglutination reaction for Rh factor.

5- Polygenic Inheritance and Epistasis**➤ Understanding**

Student will:

- Explain the terms; polygenic and epistasis.
- Describe polygenic inheritance, using suitable examples from plants (grain color in wheat) and animals (skin color in man).
- List at least five polygenic traits discovered in humans.
- Relate polygenic inheritance with epistasis.
- Give one example of epistasis from mammals (coat color inheritance in Labrador retrievers) and one from plants (pigment phenotype in foxgloves) and justify modified Mendelian ratios.

6- Gene Linkage and Crossing Over**➤ Understanding**

Student will:

- Describe the terms gene linkage and crossing over.
- Explain how gene linkage counters independent assortment and crossing-over modifies the progeny.
- Exemplify the concept of gene linkage by quoting the example of wing length and width of abdomen in
- *Drosophila melanogaster*.
- Suggest why linkage could be observed/ evaluated only if the number of progeny is quite large.

➤ Skills**(Interpreting and Recording)**

Student will:

- Evaluate mathematically the ratio of linkage in the progeny.

7- Sex Determination

➤ Understanding

Student will:

- Explain the XX-XY mechanism of sex determination in *Drosophila* and mammals.
- Describe the XX-XO and ZZ-ZW sex determination systems and evaluate by studying the karyotype.
- Identify the difference between homogametic and heterogametic conditions in the karyotype of male and female humans.
- Identify male and female individuals from the karyotype of *Drosophila* and man.
- Solve the genetics problems related to XX-XY, XX-XO and ZZ-ZW sex determination.

➤ Skills

(Interpreting and Recording)

Student will:

- Trace the karyotype of a human being to observe and count the number and shape of chromosomes.
- Differentiate between autosomes and sex chromosomes from the karyotype.

8- Sex Linkage

➤ Understanding

Student will:

- Describe the concept of sex-linkage.
- Explain the inheritance of sex-linked traits (eye color) in *Drosophila*.
- Describe the sex-linked inheritance of male characters due to Y-chromosome and the effect of Hollandric genes.
- Describe sex-influenced and sex-limited traits with common examples from human genetics.
- Describe the X- linked disorders with reference to the patterns of inheritance.
- Name some of the sex-linked disorders of man.
- Critically analyze the inheritance of Haemophilia, colour blindness and muscular dystrophy.

➤ STS Connections

Student will:

- Evaluate incomplete and co-dominance as variations of Mendel's research.
- Derive an idea to get alternatives of blood transfusion. (reference could be made to synthesized plasma and serum).
- Justify why a recessive blood group allele of 'i' is more frequent in population.
- Justify blood donation as a service to suffering humanity.
- Name and explain the techniques employed for embryonic screening e.g., Amniocentesis.
- Suggest ways to save lives through the knowledge gained in this chapter.
- Describe how the field of genetics has progressed to a more applied science.
- Justify the effectiveness of some of the treatments of haemophilia.

CHAPTER 24

EVOLUTION

Overview:

The aim of this chapter is to enable the learners to analyze evolutionary mechanisms, and the processes and products of evolution. They would also be able to evaluate the scientific evidence that supports the theory of evolution. The major concepts in this chapter are;

- The Evolution of the concepts of Evolution (01 Period)
- Evidences of Evolution (03 Periods)
- Evolution of Eukaryotes from Prokaryotes (01 Period)
- Lamarckism (02 Periods)
- Darwinism (03 Periods)
- Neo-Darwinism (03 Periods)

Conceptual Linkages:

- This chapter is built on;
- Biodiversity (Grade IX-X)
- Chromosomes and DNA (Grade XI-XII)
- Inheritance (Grade XI-XII)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- The Evolution of the Concepts of Evolution

➤ Understanding

Student will:

- Describe creationism and the theory of evolution as two contradictory ideas.
- Relate Quranic injunctions to the process of the evolution of man.

2- Evidences of Evolution

➤ Understanding

Student will:

- Explain how biogeography provides an evidence for evolution.
- Describe the evidences of evolution that come from paleontology, comparative anatomy and molecular biology.
- Differentiate between convergent and divergent evolution on the basis of inheritance of the homologous and analogous structures.

➤ Skills

(Initiating and Planning)

Student will:

- Identify questions that arise from concepts of evolution and diversity (e.g., What factors have contributed to the dilemma that pharmaceutical companies face in trying to develop new antibiotics because so many micro-organisms are resistant to existing antibiotics?).

(Analyzing and Interpreting)

Student will:

- Interpret different homologous and analogous structures through observation in plants.

3- Evolution of Eukaryotes from Prokaryotes

➤ Understanding

Student will:

- Describe the theories that have been put forwarded about the mechanism of evolution of eukaryotes from prokaryotes.

4- Lamarckism

➤ Understanding

Student will:

- Justify Lamarck as an early proponent of evolution.
- Describe the theory of inheritance of acquired characters, as proposed by Lamarck.
- Outline the steps of the evolution of the giraffe, as illustrated in Lamarckism.
- State the drawbacks in Lamarckism.

➤ Skills

(Initiating and Planning)

Student will:

- Hypothesize whether Lamarck was criticized in his day for advocating the ideas of evolution or for the mechanism he proposed.

5- Darwinism

➤ Understanding

Student will:

- Briefly describe the observations Darwin made during his voyage on HMS Beagle.
- Explain the theory of natural selection as proposed by Darwin.
- Describe the ideas of Charles Lyell, James Hutton and Thomas Malthus that contributed in the early development of Darwinism.
- Describe the role of Alfred Wallace in motivating Darwin to publish the theory of natural selection.
- Justify, on the grounds that both Wallace's and Darwin's papers were published in the *Journal of the proceedings of the Linnaean Society*, why the theory was attributed to Darwin.

6- Neo-Darwinism

➤ Understanding

Student will:

- Describe the assumptions of the Hardy-Weinberg theorem and relate these to the factors that change the allelic frequencies of the population.
- Explain the concept of genetic drift (neutral selection).
- Define the concept of speciation and explain the mechanisms of speciation (allopatric, parapatric and sympatric speciation).

➤ Skills

(Analyzing and Interpreting)

Student will:

- Solve problems related to gene frequencies using the Hardy-Weinberg equation.

➤ STS Connections

Student will:

- List the vestigial structures found in man and categorize them in homologous or analogous structures.
- Describe and analyze examples of technology that have extended or modified the scientific understanding of evolution (e.g., the contribution of radiometric dating to the palaeontological analysis of fossils).

SECTION- 5

ECOLOGY

CHAPTER 25 MAN AND HIS ENVIRONMENT

This chapter aims at enhancing the level of understanding about the basic concepts of ecology and enabling the students to be well informed of the activities of the very large and growing human population that is threatening the stability of the ecosystems.

The major concepts in this chapter are;

- Biogeochemical Cycle (02 Periods)
- The Flow of Energy (02 Periods)
- Ecological Succession (02 Periods)
- Population Dynamics (04 Periods)
- Human Impacts on Environment (03 Periods)
- Environmental Resources and their Depletion (03 Periods)

Conceptual Linkages:

This chapter is built on;

- Man and His Environment (Grade IX-X)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- Biogeochemical Cycle

➤ Understanding

Student will:

- Define biogeochemical cycles and locate the primary reservoirs of the chemicals in these cycles.
- Describe water cycle in detail.
- Define the terms aquifers and water table.
- Describe nitrogen cycle in detail.
- Define the terms of nitrogen-fixation, nitrification, de-nitrification and ammonification.

2-The Flow of Energy

➤ Understanding

Student will:

- Describe productivity in terms of gross primary productivity and net primary productivity.
- Explain the flow of energy in successive trophic levels.
- Interpret the pyramids of number, biomass and energy.

3- Ecological Succession

➤ Understanding

Student will:

- Define ecological succession as the process through which ecosystems change from simple to complex.
- Describe primary and secondary succession.
- Differentiate between xerarch and hydrarch succession.
- Explain the xerarch succession on a bare rock starting from the small pockets of lichens to the climax vegetations.
- Explain the hydrarch succession in lake starting from aquatic algae into climax vegetation

➤ Skills

(Initiating and Planning)

Student will

- Justify the fact that humans are often responsible for secondary succession.

4- Population Dynamics

➤ Understanding

Student will:

- Describe characteristics of a population, such as growth, density, distribution, carrying capacity, minimum/viable size.
- Explain, using demographic principles, problems related to the rapid growth of human populations and the effects of that growth on future generations (e.g., relate the carrying capacity of the Earth to the growth of populations and their consumption of resources).
- Analyze the role of the department of population welfare, government of Pakistan in controlling the growing population of Pakistan.

➤ Skills**(Initiating and Planning)**

Student will:

- Investigate the effects of human population growth on the environment and the quality of life.

5- Human Impacts on Environment**➤ Understanding**

Student will:

- Relate the need of the nuclear power to the scarcity of fossil fuels.
- State the problems of using nuclear power (surety of safe operation and safe disposal of the wastes).
- Describe the causes of the increasing concentration of carbon dioxide in the world's atmosphere.
- Correlate the increasing CO₂ concentration with the global warming and describe its long term effects.
- Explain the causes and effects of acid rain.
- Describe the composition of the ozone layer and its role in protecting the life on earth.
- State the sources of chlorofluorocarbons and their role in the depletion of ozone.
- Explain the effects of ultraviolet radiation as a serious human health concern.
- Narrate the incidence when one of the four reactors of the Chernobyl nuclear power plant blew up in 1986.

6- Environmental Resources and their Depletion**➤ Understanding**

Student will:

- Distinguish between renewable and non-renewable environmental resources.
- Describe how man is responsible for the depletion of environmental resources.
- Describe the conventional and non-conventional energy resources.
- Analyze the efforts of various government departments and NGOs to educate people for the protection of environmental resources.

➤ STS Connections

Student will:

- Outline the advances in medical care and technology that have contributed to an increase in life expectancy, and relate these developments to demographic issues.
- Justify why science education has become necessary for everyone to understand the basis of man's continued existence and the steps man has to take to save and improve life.
- Investigate the careers related to the study of environmental resources.

SECTION- 6

APPLICATION OF BIOLOGY

CHAPTER 26 BIOTECHNOLOGY

Biotechnology has been projected by many to become as dominant in the present century as electronics, including computers, were in the twenty-first century.

The excitement of this discipline is more than adequately reflected in the popularity of the subject among science students. As a result, a large number of institutions in Pakistan have initiated study programs in Biotechnology. This chapter provides knowledge about the basics of Biotechnology. The major concepts in this chapter are;

- Cloning of Genes (04 Periods)
- DNA Sequencing (03 Periods)
- DNA Analysis (01 Period)
- Genomic Maps (02 Periods)
- Tissue Culture (03 Periods)
- Transgenic Bacteria, Plants and Animals (02 Periods)
- Biotechnology and Healthcare (04 Periods)
- Scope and Importance of Biotechnology (03 Periods)

Conceptual Linkages:

This chapter is built on;

- Biotechnology (Grade IX-X)
- Chromosome and DNA (Grade XI-XII)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- Cloning of Genes

➤ Understanding

Student will:

- Define gene cloning and state the steps in gene cloning.
- Describe the techniques of gene cloning through recombinant DNA technology.
- Explain the role of restriction endonucleases and DNA ligases in gene cloning.

<ul style="list-style-type: none"> • Describe the selection and isolation of the gene of interest. • Explain the properties and the role of vectors in recombinant DNA technology. • State the steps for the integration of DNA insert into the vector. • Briefly state the technique applied for the selection of the vectors that take up the DNA insert. • Describe the steps involved in gene amplification through polymerase chain reaction. • Describe the procedure for the construction of genomic library.
<p style="text-align: center;">2- DNA Sequencing</p> <p>➤ Understanding <i>Student will:</i></p> <ul style="list-style-type: none"> • Brief introduction of the Maxam / Gilbert procedure and the Sanger-Coulson method of DNA sequencing. • Describe the principles of Gel Electrophoresis as being used in gene sequencing. • Introduce the automated DNA sequencing as based on the Sanger-Coulson method.
<p style="text-align: center;">3- DNA Analysis</p> <p>➤ Understanding <i>Student will:</i> Describe the purposes and mechanism of DNA analysis.</p> <p>➤ Skills (Analyzing and Interpreting) <i>Student will:</i></p> <ul style="list-style-type: none"> • Analyze and interpret the DNA of a child by comparing it with that of two individuals in a case of disputed parenthood.
<p style="text-align: center;">4- Genome Maps</p> <p>➤ Understanding <i>Student will:</i></p> <ul style="list-style-type: none"> • Define the terms genome analysis, genome map and genetic markers. • State the history of the human genome project admiring James Watson as its first director. • Describe the goals of the human genome project. • Predict some of the possible benefits that can be derived after the completion of the human genome project.

5- Tissue Culture

➤ Understanding

Student will:

- Define following terms related to plant tissue culture; explants, callus, micro-propagation, plantlets, somatic embryogenesis, somaclonal variation.
- Explain tissue culture and differentiate between the organ culture and cell culture.
- Differentiate between the callus culture and suspension culture techniques.
- Briefly Describe the anther culture, ovary culture, meristem culture and embryo culture techniques.
- Briefly describe the techniques used for, applications and limitations of animal tissue culture.

6- Transgenic Bacteria, Plants and Animals

➤ Understanding

Student will:

- State the objectives of the production of transgenic bacteria, transgenic plants and transgenic animals.
- Describe different methods applied for the introduction of DNA into plant and animals cells/ embryos.
- Describe the role of biotechnology in the production of insect, virus and herbicide resistant plants.
- State the notable human gene transfers in different animal species and describe their potential applications and future prospects.
- State the role of transgenic bacteria in making biotechnology products.
- List some of the ecological concerns surrounding transgenic bacteria.
- Describe the ways in which genetic engineering improves farm animals.

7- Biotechnology and Healthcare

➤ Understanding

Student will:

- Describe how biotechnologists are able to combat health problems by producing vaccines.

- State the role played by biotechnology in disease diagnosis (DNA/RNA probes, monoclonal antibodies).
- Describe what products biotechnologists obtain for use in disease treatment.
- Explain the current methods employed for gene therapy (*in-vitro* and *in-vivo* methods).
- Explain with example gene therapies in the detection and treatment of some genetic diseases.
- Explain the role of successful gene therapy for cystic fibrosis.

8- Scope and Importance of Biotechnology

➤ Understanding

Student will:

- List the hazards and social/ ethical implications of using gene technology in human.

➤ STS Connections

Student will:

- Describe the application of polymerase chain reaction.
- State the importance and limitations of DNA analysis in forensic medicine and paleontology.
- Justify why the human genome project is regarded as the most ambitious project ever undertaken by man.
- Describe the major findings that have arisen from the human genome project.
- Predict the applications of genetic engineering in crop improvement.
- Describe the role of genetic screening.
- Justify the need for genetic counseling.
- Describe briefly the accomplishments of the renowned genetic engineers working in private and public institutions in his/ her province.
- Suggest measures s/he would take to solve related problems by using knowledge gained in this chapter.
- Describe and analyze examples of technology that have extended or modified the scientific understanding of the genetic engineering.
- Investigate careers that require an understanding of biotechnology and genetic engineering.

CHAPTER 27

BIOLOGY AND HUMAN WELFARE

The theme of this chapter is to make the learners well aware of the role of biological sciences for human welfare. They will also be given the fundamental know how of the various fields and it would help them in the choice of career. The major concepts in this chapter are;

Vaccination and Integrated Disease Management (03 Periods)

Animal Husbandry (01 Period)

Latest Techniques applied to enhance Crop and Fruit yield (03 Periods)

Home Gardening (01 Period)

Role of Microbes in Human Welfare (02 Periods)

Conceptual Linkages:

This chapter is built on;

- Plant Physiology (Grade XI-XII)
- Biotechnology (Grade XI-XII)

MAJOR CONCEPTS AND LEARNING OUTCOMES

1- Vaccination and Integrated Disease Management

➤ Understanding

Student will:

- Explain what is meant by integrated disease management
- Describe vaccination and its importance.
- List some common viral diseases against which vaccination are required e.g. polio, measles, influenza and hepatitis.
- Describe the role of vaccines in preventing polio, measles, hepatitis and tetanus.
- State the schedule of the vaccination against polio, measles, hepatitis and tetanus.

2- Animal Husbandry

➤ Understanding

Student will:

- Describe animal husbandry and the role of life stock in national economy (milk, meat, eggs, wool and other miscellaneous products).
- List the outstanding milk producing breeds of cows and buffaloes.

3- Latest Techniques applied to enhance Crop and Fruit Yield

➤ Understanding

Student will:

- Describe different methods adopted for plant improvements (acclimatization, selection, hybridization and back crosses etc).

➤ Skills

(Analyzing and Interpreting)

Student will:

- Correlate the role of biotechnology and genetic engineering in crop improvement.

4- Home Gardening

➤ Understanding

Student will:

- Explain home gardening and its importance.
- Identify some seasonal vegetable and fruit plants suitable for home gardening.

5- Role of Microbes in Human Welfare

➤ Understanding

Student will:

- Explain the role of microbes in household food processing, industrial production, sewage treatment and energy generation.

➤ STS Connections

Student will:

- Justify the importance of vaccination campaign observed worldwide to curb the diseases.
- List the objectives of the institutions of the federal health department and UNO working for integrated disease management.
- Assess the impact of livestock in boosting up the national economy.

GRADE 12 BIOLOGY
PBA Sample Questions

1. Which of the following best describes the correct sequence and function of components involved in the homeostatic feedback system?

- A. Effectors detect environmental changes and signal the receptors, which instruct the control center to act.
- B. The control center detects changes, receptors send responses, and effectors execute decisions.
- C. Receptors detect changes, the control center processes the information, and effectors respond to restore normalcy.
- D. Effectors analyze internal changes, receptors respond, and the control center restores balance.

Correct answer: C

2. Which of the following accurately describes a challenge related to osmoregulation in different animal habitats?

- A. Freshwater animals lose salts due to exosmosis.
- B. Marine animals risk dehydration despite water intake.
- C. Terrestrial animals retain excess salts due to perspiration.
- D. Marine animals excrete water to avoid salt imbalance.

Correct answer: B

3. A patient with kidney failure undergoes hemodialysis. During the process, his purified blood is pumped back into his vein through a surgically created fistula. Which of the following best explains why this method is preferred over direct repeated venipuncture?

- A. It allows easier diffusion of nitrogenous waste from the dialyzing fluid into the blood.
- B. It helps in maintaining the osmotic pressure of blood during dialysis.
- C. It minimizes the use of anticoagulants during the dialysis process.
- D. It provides a durable and reliable vascular access for repeated dialysis sessions.

Correct answer: D

4. An elderly patient complains of stiffness and pain in the knees. X-ray shows that the cartilage in his joints has worn down due to years of repeated stress. Based on this observation, which form of arthritis is he most likely suffering from?

- A. Rheumatoid arthritis – caused by the immune system attacking the synovial membrane
- B. Ankylosing spondylitis – arthritis of the spine, usually lower back
- C. Gout – due to deposition of uric acid crystals in joints
- D. Osteoarthritis – caused by breakdown of joint cartilage from repeated stress

Correct answer: D

5. A soccer player falls awkwardly onto her shoulder during a game, resulting in severe pain and an obvious deformity. She can't move her arm normally. What's the most likely injury?

- A. Partial tearing of ligaments causing slight misalignment of a joint.
- B. Complete separation or change in position of bones in a joint, often causing severe pain and instability.
- C. Inflammation of the synovial membrane causing swelling and stiffness in a joint.
- D. Gradual wearing down of cartilage in a joint over time due to aging.

Correct answer: B

6. In the diagram below, identify the type of shoulder injury shown in **the middle one**.



- A. Normal anatomy
- B. Anterior dislocation
- C. Posterior dislocation
- D. Arthritis-related joint deformation

Correct answer: B

7. A doctor is studying a tissue sample from the heart under a microscope. Which type of muscle is she most likely observing?



- A. Muscle X only
- B. Muscle Y only
- C. Muscle X and Y
- D. Muscle X and Z

Correct answer: A

8. A researcher is studying the structure of different muscle types. She observes a type of muscle cell that is spindle-shaped and lacks striations. Which type of muscle is she most likely studying?



- A. Muscle P only
- B. Muscle Q only
- C. Muscle R only
- D. Muscle P and R

Correct answer: C

9. A neurologist is studying the effects of a rare condition that causes an increase in the diameter of nerve fibers. What effect would this condition likely have on nerve impulse conduction?

- A. Decrease conduction speed
- B. No effect on conduction speed
- C. Increase conduction speed
- D. Cause action potentials to become irregular

Correct answer: C

10. A patient has a damaged myelin sheath around their nerve fibers. Which effect would this likely have on nerve impulse conduction?

- A. Action potentials would travel faster
- B. Action potentials would travel at the same speed
- C. Action potentials would jump between nodes more efficiently
- D. Action potentials would travel more slowly and less efficiently

Correct answer: D

11. A person is sitting on a couch, and the weight of their body is pressing down on their buttocks. Which type of mechanoreceptor is primarily responsible for detecting this type of sustained pressure?

- A. Meissner's corpuscles
- B. Merkel's disks
- C. Pacinian corpuscles
- D. Ruffini's endings

Correct answer: C

12. Heroin, a narcotic drug derived from morphine, primarily exhibits which combination of effects?

- A. Mild euphoria, altered vision, and judgment
- B. Euphoric rush, anti-anxiety, and pain relief
- C. Increased alertness, insomnia, and hyperactivity
- D. Appetite suppression, dehydration, and muscle cramps

Correct answer: B

13. Which hormone is correctly matched with its chemical category?

- A. Insulin – Steroid hormone
- B. Epinephrine – Amino acid derivative hormone
- C. Melatonin – Peptide hormone
- D. Testosterone – Peptide hormone

Correct answer: B

14. A 40-year-old patient visits a doctor with complaints of rapid weight gain, high blood pressure, and frequent mood swings. Laboratory tests reveal abnormally high levels of cortisol in his blood. Based on this information, which condition is the patient most likely suffering from?

- A. Addison's disease – caused by low secretion of adrenal cortex hormones
- B. Diabetes mellitus – caused by deficiency of insulin
- C. Hypothyroidism – caused by insufficient thyroxin levels
- D. Cushing's syndrome – caused by over secretion of cortisol

Correct answer: D

15. Which statement about thyroid hormones is correct?

- A. T4 contains more iodine atoms and is more potent than T3
- B. T3 contains three iodine atoms and is more potent than T4
- C. Calcitonin increases metabolic rate
- D. T4 is secreted in smaller amounts than T3

Correct answer: B

16. Which statement best distinguishes innate behaviour from learning behaviour?

- A. Innate behaviour is acquired from society; learning behaviour is inherited at birth.
- B. Innate behaviour is permanent and reflexive; learning behaviour is modifiable through experience.
- C. Innate behaviour requires more time to adapt; learning behaviour requires no adaptation time.
- D. Innate behaviour is more common in long-lived animals; learning behaviour is more common in short-lived animals.

Correct answer: B

17. Which statement correctly differentiates habituation from imprinting?

- A. Habituation is irreversible; imprinting is reversible.
- B. Habituation is reversible; imprinting is irreversible.
- C. Both habituation and imprinting are reversible forms of learning.
- D. Both habituation and imprinting are innate behaviours.

Correct answer: B

18. A vasectomy is a surgical procedure that cuts or blocks the vas deferens, preventing sperm from mixing with seminal fluid. However, men who undergo this procedure still produce a normal amount of semen. Which gland(s) contribute most to the volume of semen in these individuals?

- A. Testes and male gametes
- B. Prostate gland and bulbourethral glands
- C. Seminal vesicles and prostate gland
- D. Bulbourethral glands

Correct answer: C

19. A 32-year-old female presents with a history of increasingly painful periods and pain during intercourse. A laparoscopic investigation reveals the presence of endometrial tissue on her ovaries and the outer surface of her uterus, causing significant scarring. Based on these findings, which of the following is the most likely primary cause of her reported difficulty in conceiving?

- A. A hormonal imbalance preventing the regular release of a mature egg.
- B. A physical blockage preventing the egg and sperm from meeting.
- C. An inflammatory condition creating a hostile pelvic environment and structural abnormalities.
- D. An age-related decline in the quality and quantity of her remaining eggs.

Correct answer: C

20. A 30-year-old man with low testosterone levels is prescribed a medication that stimulates Leydig cells in the testes. Which hormone is the medication likely mimicking?

- A. Testosterone
- B. Follicle-Stimulating Hormone (FSH)
- C. Inhibin
- D. Luteinizing Hormone (LH)

Correct answer: D

21. A patient complains of facial numbness along with difficulty in regulating tear and saliva secretion. On examination, the neurologist concludes that the disorder involves a peripheral ganglion associated with both sensory and autonomic pathways. Which structure is most likely affected?

- A. Dorsal root ganglia
- B. Cranial nerve ganglia
- C. Adrenal medulla
- D. Schwann cells

Correct answer: B

22. Hammerling's experiment with *Acetabularia* demonstrated the role of the nucleus in determining cellular characteristics. Suppose you were to transplant the nucleus from an *Acetabularia* cell with a large, umbrella-shaped cap into the enucleated cell of an *Acetabularia* species with a small, star-shaped cap. What type of cap would you expect the recipient cell to develop?

- A. Large, umbrella-shaped cap
- B. Small, star-shaped cap
- C. A mix of both shapes
- D. No cap development

Correct answer: A

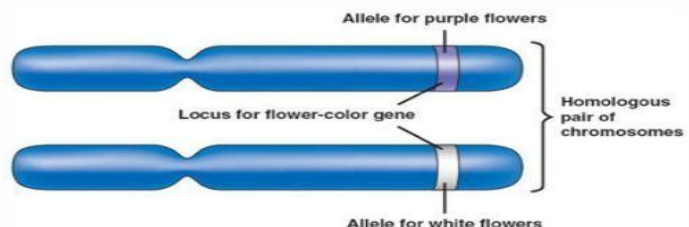
23. In T.H. Morgan's experiments with *Drosophila melanogaster*, which observation supported the concept of sex-linked inheritance?

- A. Equal numbers of red- and white-eyed flies in all generations
- B. White-eyed females never appeared in any cross
- C. All white-eyed offspring in the F₂ generation were male
- D. Eye color ratio exactly followed a 3:1 Mendelian pattern

Correct answer: C

24. A geneticist is studying a specific gene associated with a genetic disorder. She wants to identify the exact location of this gene on the chromosome. What term describes this specific location?

- A. Allele
- B. Gene locus
- C. Genotype
- D. Karyotype



Correct answer: B

25. A researcher grows *E. coli* for several generations in a medium containing heavy nitrogen ^{15}N , then transfers them to a medium containing light nitrogen ^{14}N and allows them to replicate once. If the DNA is extracted and centrifuged in a CsCl gradient, what band pattern should the researcher expect?

- A. A single intermediate-density band
- B. Two distinct bands, one heavy and one light
- C. A single light-density band
- D. Two bands, one intermediate and one light

Correct answer: A

26. A wheat plant has the genotype **AaBBcc**. Based on Nilsson-Ehle's findings, what would be the most likely grain colour of this plant?

- A. White
- B. Light red
- C. Pink
- D. Moderately dark red

Correct answer: B

27. A normal woman (carrier of the haemophilia gene) marries a normal man. What is the probability that their son will have haemophilia?

- A. 50%
- B. 25%
- C. 0%
- D. 75%

Correct answer: A

28. A fossil of *Archaeopteryx* shows the presence of feathers, a beak, wings, teeth, and a long vertebral tail. Which conclusion can be drawn from these observations?

- A. It was purely a modern bird.
- B. It was purely a reptilian species.
- C. It was an example of convergent evolution.
- D. It was a transitional form showing both avian and reptilian features.

Correct answer: D

29. A scientist wants to determine whether a newly discovered bacterial gene is similar to any known disease-causing genes in other species. To do this, she needs the exact arrangement of nucleotides in the gene so she can compare it with existing sequences in a database. Which process should she use?

- A. Restriction Enzyme Digestion
- B. Gel Electrophoresis
- C. Plasmid Vector Cloning
- D. DNA Sequencing

Correct answer: D

30. A public health worker in a rural area is planning a vaccination drive to protect children under five from a viral disease that spreads through contaminated water and causes symptoms like fever, nausea, and abdominal pain. Which vaccine should be prioritized for administration?

- A. MMR vaccine
- B. Hepatitis-B vaccine
- C. Oral polio vaccine (OPV)
- D. Diphtheria toxoid (DT) vaccine

Correct answer: C

DEFINITIONS OF COGNITIVE LEVELS

Remember

Remembering is the act of retrieving knowledge and can be used to produce things like definitions or lists. The student must be able to recall or recognise information and concepts. The teacher must present information about a subject to the student, ask questions that require the student to recall that information and provide written or verbal assessment that can be answered by remembering the information learnt.

Question Stems

- Can you name all the ...?
- Describe what happens when ...?
- How is (are) ...?
- How would you define ...?
- How would you identify ...?
- How would you outline ...?
- How would you recognise...?
- List the ... in order.
- What do you remember about ...?
- What does it mean?
- What happened after?
- What is (are) ...?
- What is the best one?
- What would you choose ...?
- When did ...?
- Where is (are) ...?
- Which one ...?
- Who spoke to ...?
- Who was ...?
- Why did ...?

Understand

The next level in the taxonomic structure is Understanding, which is defined as the construction of meaning and relationships. Here the student must understand the main idea of material heard, viewed, or read and interpret or summarise the ideas in their own words. The teacher must ask questions that the student can answer in their own words by identifying the main idea.

Question Stems

- Can you clarify...?
- Can you illustrate ...?
- Condense this paragraph.
- Contrast ...
- Does everyone think in the way that ... does?
- Elaborate on ...
- Explain why ...
- Give an example
- How can you describe...?
- How would you clarify the meaning...?
- How would you compare ...?
- How would you differentiate between ...?
- How would you describe...?
- How would you generalise...?
- How would you identify ...?
- Is it valid that ...?
- Is this the same as ...?
- Outline ...
- Select the best definition...
- State in your own words...
- This represents ...
- What are they saying?
- What can you infer from ...?
- What can you say about ...?
- What could have happened next?
- What did you observe?

	<ul style="list-style-type: none"> • What does this mean? • What expectations are there? • What information can you infer from...? • What is the main idea of ...? • What restrictions would you add? • What seems likely? • What seems to be ...? • What would happen if ...? • What might happen if ...? • Which are the facts? • Which statements support ...?
<p>Apply</p> <p>The third level in Bloom's taxonomy, Applying, marks a fundamental shift from the pre-Bloom's learning era because it involves remembering what has been learnt, having a good understanding of the knowledge, and applying it to real-world exercises, challenges or situations. Students must apply an abstract idea in a concrete case to solve a problem or relate it to prior experience. The teacher must provide opportunities for students to use theories and problem-solving techniques in new situations and review and check their work. Assessment questions should be provided that allow students to define and solve problems.</p> <p>Question Stems</p> <ul style="list-style-type: none"> • Can you group by characteristics such as ...? • Choose the best statements that apply... • Clarify why ... • Do you know of another instance where ...? • Draw a story map... • Explain why a character acted in the way that he did... • From the information given, can you develop a set of instructions about ...? • How would you develop ...? • How would you change ...? • How would you demonstrate...? 	<p>Analyse</p> <p>Analysing is the cognitive level where students can take the knowledge they have remembered, understood and applied, then delve into that knowledge to make associations, discernments or comparisons. Students should break down a concept or idea into parts and show relationships between these parts. Teachers must give students time to examine concepts and their requisite elements. Students are required to explain why they chose a solution.</p> <p>Question Stems</p> <ul style="list-style-type: none"> • Can you distinguish between ...? • Can you explain what must have happened when ...? • Determine the point of view, bias, values, or intent underlying the presented material... • Discuss the pros and cons of ... • How can you classify ... according to ...? • How can you compare the different parts? • How can you sort the different parts...? • How is ... connected to ...? • How is ... similar to ...? • How would you categorise...? • How would you explain...?

<ul style="list-style-type: none"> • How would you develop? • How would you explain ...? • How would you modify ...? • How would you present...? • How would you solve ... ? • Identify the results of ... • Illustrate the ... • Judge the effects of ... What would result ...? • Predict what would happen if ... • Tell how much change there would be if ... • Tell what would happen if ... • What actions would you take to perform ...? • What do you think could have happened next? • What examples can you find that ? • What other way would you choose to ...? • What questions would you ask of ...? • What was the main idea ...? • What would the result be if ...? • Which factors would you change if ...? • Who do you think...? • Why does this work? • Write a brief outline ... • Write in your own words ... 	<ul style="list-style-type: none"> • What could the ending have been if ... had taken place? • State the point of view of ... • What are some of the problems of ...? • What assumptions ...? • What can you infer about...? • What can you point out about ? • What conclusions ...? • What do you see as other possible outcomes? • What does the author assume? • What explanation do you have for ...? • What ideas justify the conclusion? • What ideas validate...? • What is the analysis of ...? • What is the function of ...? • What is the problem with ...? • What motive is there? • What persuasive technique is used? • What statement is relevant? • What was the turning point? • What were some of the motives behind ...? • What's fact? Opinion? • What's the main idea? • What's the relationship between? • Which events could not have happened? • Why did ... changes occur? • Why do you think ?
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BLOOM'S TAXONOMY WITH EXAMPLES

Conclusion

If you are a teacher looking for ways to engage your students in learning, this LIST of questions might be interesting for your classroom practice. Bloom's Taxonomy question stems can help elicit higher-order thinking skills and promote critical thinking among learners at different taxonomy levels. These question stems can also encourage students to think about their knowledge through reflection before answering questions.

ACTION WORDS FOR COGNITIVE LEVELS

Knowledge	Understand	Apply	Analyze	Evaluate	Create
					
define	explain	solve	analyze	reframe	design
identify	describe	apply	appraise	criticize	compose
describe	interpret	illustrate	judge	evaluate	create
label	paraphrase	modify	support	order	plan
list	summarize	use	compare	compare	combine
name	classify	calculate	decide	classify	formulate
state	compare	change	discriminate	contrast	invent
match	differentiate	choose	recommend	distinguish	hypothesize
recognize	discuss	demonstrate	summarize	infer	substitute
select	distinguish	discover	assess	separate	write
examine	extend	experiment	choose	explain	compile
locate	predict	relate	convince	select	construct
memorize	associate	show	defend	categorize	develop
quote	contrast	sketch	estimate	connect	generalize
recall	convert	complete	grade	differentiate	integrate
reproduce	demonstrate	construct	measure	divide	modify
tabulate	estimate	dramatize	predict	order	organize
tell	express	interpret	rank	prioritize	prepare
Copy	identify	manipulate	score	survey	produce

discover	indicate	paint	select	calculate	rearrange
duplicate	infer	prepare	test	conclude	rewrite
enumerate	relate	teach	argue	correlate	adapt
listen	restate	act	conclude	deduce	anticipate
observe	select	collect	consider	devise	arrange
omit	translate	compute	critique	diagram	assemble
read	ask	explain	debate	dissect	choose
recite	cite	list	distinguish	estimate	collaborate
record	discover	operate	editorialize	evaluate	facilitate
repeat	generalize	practice	justify	experiment	imagine
retell	group	simulate	persuade	focus	intervene
visualize	illustrate	transfer	rate	illustrate	make
	judge	write	weigh	organize	manage
	observe			outline	originate
	order			plan	propose
	report			question	simulate
	represent			test	solve
	research				support
	review				test
	rewrite				validate
	show				

HSSC PART II EXAMINATION MARKS BREAKUP GRID FOR EXAMINATION 2025

GROUP: PRE-MEDICAL

SUBJECT	THEORY	PBA	TOTAL
ENGLISH	100	-	100
URDU NORMAL / SINDHI NORMAL	100	-	100
PAKISTAN STUDIES	50	-	50
PHYSICS	85	15	100
CHEMISTRY	85	15	100
BIOLOGY	85	15	100
TOTAL	505	45	550

GROUP: PRE-ENGINEERING

SUBJECT	THEORY	PBA	TOTAL
ENGLISH	100	-	100
URDU NORMAL / SINDHI NORMAL	100	-	100
PAKISTAN STUDIES	50	-	50
PHYSICS	85	15	100
CHEMISTRY	85	15	100
MATHEMATICS	100	--	100
TOTAL	520	30	550

GROUP: GENERAL SCIENCE

SUBJECT	THEORY	PBA	TOTAL
ENGLISH	100	-	100
URDU NORMAL / SINDHI NORMAL	100	-	100
PAKISTAN STUDIES	50	-	50
PHYSICS	85	15	100
COMPUTER SCIENCE	75	25	100
MATHEMATICS	100	--	100
TOTAL	510	40	550

GROUP: COMMERCE

SUBJECT	THEORY	PBA	TOTAL
ENGLISH	100	-	100
URDU NORMAL / SINDHI NORMAL	100	-	100
PAKISTAN STUDIES	50	-	50
ECONOMICS	75	-	75
P.O.C	75	-	75
ACCOUNTING	100	--	100
BUSINESS MATHEMATICS	50		50
TOTAL	550	---	550

GROUP: HUMANITIES

(Any Three Electives)

SUBJECT	THEORY	PBA	TOTAL
ENGLISH	100	-	100
URDU NORMAL / SINDHI NORMAL	100	-	100
PAKISTAN STUDIES	50	-	50
COMPUTER SCIENCE	75	25	100
ISLAMIC STUDIES	100		100
MATHEMATICS	100	-	100
SOCIOLOGY	100	--	100
ECONOMICS	100		100
EDUCATION	100		100
CIVICS	100		100
NURSING	85	15	100
TOTAL	550	---	550

GROUP: MEDICAL TECHNOLOGY

SUBJECT	THEORY	PBA	TOTAL
ENGLISH	100	-	100
URDU NORMAL / SINDHI NORMAL	100	-	100
PAKISTAN STUDIES	50	-	50
MICROBIOLOGY	85	15	100
CHEMICAL PATHOLOGY & SEROLOGY	85	15	100
ELEMENTARY CHEMISTRY & CHEMICAL PATHOLOGY	85	15	100
TOTAL	505	45	550