BIOLOGY

FIRST GRADE

I Fundamentals of cytology

Cell biology. Chemical composition of cells, organic and inorganic compounds that participate in the construction of cells. Prokaryotic and eukaryotic cells. Cell membrane. The structure of the cell membrane. Nucleus. The structure of the nucleus. Nuclear membrane and nucleoplasm. Chromosomes, chromatin (organization of chromatin, DNA, histones, RNA, non-histone proteins). Nucleolus. Cytoplasm. Cellular organelles: ribosomes, endoplasmic reticulum, Golgi apparatus, lysosomes, plastids, mitochondria, cytoskeleton. Differences between cells of unicellular and multicellular organisms. Differences between plant and animal cells. Cell cycle. Cell division: amitosis, mitosis, meiosis.

Viruses

Virus structure. DNA and RNA viruses. Bacteriophages. Virus life cycle: lithic or lysogenic cycle.

Prokaryote

Domain of bacteria (Bacteria). General characteristics of bacteria - structure and chemical composition of bacterial cells. Transport of matter in bacteria. Forms and reproduction. Bacteria that cause plant, animal, and human diseases. Division of blue-green bacteria (Cyanobacteria). General features – the structure. Significance of blue-green bacteria in nature.

Eukaryota

II Morphology, systematics, and phylogeny of algae and fungi

Tasks of morphology and systematics and their significance. Taxonomic categories. Examination of higher taxa. Rhodophyta. General features - structure, shape, and meaning of red algae. Division of green algae (Chlorophyta). General features - structure, shapes, and significance of green algae in nature. Division of brown algae (Phaeophyta). General characteristics - structure and significance of brown algae.

III Kingdom of fungi (includes lichens)

General characteristics of fungi - structure. Systematics. Significant fungi in nature and economy. Fungi are pathogens of cultivated plants, domestic animals, and humans. General characteristics of lichens (section Lichenes) - components of lichens, structure. Significance in nature and economy.

IV Morphology, systematics, and phylogeny of plants.

Forming tissues (meristems). Cork, mechanical, absorption, photosynthetic, and conductive. Conducting bundles. Tissues for storage, aeration, and excretion.

Morphology of vegetative organs. Root, the anatomical structure of metamorphosis. Shoot, bud. Tree, metamorphosis, anatomical structure (primary and secondary). Leaf, parts, shapes, leaf rim, compound leaves, ribs, anatomical structure, metamorphoses.

Bryophyta. General features - structure. Systematics and distribution. Significance of moss in nature.

Equisetophyta. General features - structure. Systematics, distribution, and significance.

Polypodiophyta. General features - material (root, stem). Systematics, distribution, and significance.

Division of gymnosperm (Pinophyta). Class of conifers (Pinopsida). General characteristics - root, tree, leaf, reproductive organs, pollination, and fertilization. Seeds. Systematics. Importance.

Division of flowering plants (Magnoliophyta). Reproductive organs: flower (structure, symmetry, pollination, and fertilization), inflorescences (species), seeds, and fruit (types of fruits).

Characteristics of dicotyledons and monocotyledons. Systematics.

Class Dicotyledons (Magnoliopsida). Families: buttercup, beech, birch, cabbage, rose, bean (butterfly), helper, lip beetle. Prevalence and significance.

Class Monocotyledons (Liliopsida). Families: lily and grass. Prevalence and significance.

THIRD GRADE

I Plant physiology

The water regime of plants. Significance of plant life. The cell as an osmotic system. Receiving water across the roots, root pressure. Movement through the plant, transpiration, function of the stomatal apparatus. Photosynthesis. Autotrophic heterotrophic organisms. Significance of photosynthesis for the maintenance of life on Earth. Leaf as a photosynthetic organ, chloroplast structure, photosynthetic pigments.

II Animal physiology

1. Introduction. The subject of studying animal physiology and its connection with other sciences. Anatomical, biochemical and biophysical bases of physiology. Levels of organization of living systems.

2. Dynamic organization of the cell. Cell - the basic functional unit of living organisms. Chemical organization of the cell. Water and inorganic substances and their role in cell functioning. The function of organic substances that enter the cell: carbohydrates, lipids, proteins, nucleic acids, adenosine triphosphate. Intracellular and extracellular environment. Enzymes and their activity. Transport of matter and conversion of energy in the cell. Anabolic and catabolic processes. Protein turnover. Fat trade. Carbohydrate turnover (anaerobic and aerobic metabolism). The function of the cell membrane and transport of molecules across the membrane: diffusion, osmosis, filtration, transport of carrier molecules, Na + and K + pump, endocytosis, and exocytosis. Basic principles of functioning and regulation of living systems. Adaptive characteristics of biological organizations. Relationships between organisms and the environment (regulators and conformists). Biological adaptations: acclimatization and acclimatization. Principles of homeostasis. Negative and positive feedback. Rhythmic function. Nervous and humoral regulation of physiological functions.

3. Review and categorization of organic systems. Functional features of the nervous system: receptor-effector system. Receptors. Nerve cell and nerve impulse. Synapse. Effectors: transverse striated muscles. Innervation of transverse-striated muscles. Mechanism of muscle contraction. Work: static and dynamic. Fatigue and rest. Adapting to work and rest. Smooth muscles and heart muscles. Glandular effectors (exocrine and endocrine glands). Nervous system evolution: diffuse, ganglion, and tubular nervous system. The function of the central nervous system. The concept of the nerve center. Central synapse. Transmission of nerve impulses by central synapses. Functional organization of the central nervous system. Reflexes. Divergence and convergence. Reciprocal innervation. Chain connections and reverberation. Central inhibition. Vegetative nervous system. Spinal cord function. Elongated marrow and its centers. The role of the midbrain in the regulation of posture and movement. Cerebellum and regulation of body balance in space. Brain function. Forebrain function and localization of functions in the forebrain cortex. Limbic system and behavior. Higher nervous activity. Conditional and unconditional reflexes. Learning memory and their physiological mechanisms. Physiology and mechanism of sleep.

Physiology of sensory organs. Skin as a sensory organ. Sense of taste. Sense of smell. Sense of hearing and balance. Eyesight.

Physiology of body fluids: hydrolymph, hemolymph, blood, and lymph. Blood functions. Properties and composition of blood. Blood coagulation. Blood groups. Immune system: cells of the immune system. Natural immunity. Cellular and humoral immunity. Body fluid circulation system. Evolution of the body fluid circulation system: open and closed circulation systems. Functional characteristics of the vertebrate heart. Cardiac automatism. Cardiac cycle and its phases. Laws of blood flow in blood vessels. Blood pressure. Arterial pulse. Blood flow in capillaries and veins. Neurohumoral regulation of the cardiovascular system. Lymph and lymph flow.

Respiratory system. Significance of respiration for the organism. Evolution and ways of gas exchange between organisms and the external environment. Ventilation of the lungs and pulmonary volumes of humans. Mechanism of inhalation and exhalation - respiratory cycle. Transport of gases by blood. Neurohumoral respiratory regulation.

Digestive and food absorption system. Types of food digestion in the animal world: intracellular, membrane, and extracellular digestion. Digestion of food in the digestive tract: digestion of food in the oral cavity, stomach, and small intestine. Composition and importance of pancreatic juice in the process of digestion. Composition, properties, and importance of digestion and absorption of nutrients. Mechanisms of absorption of digested nutrients: monosaccharides, amino acids, and fatty acids. Diet: Vitamins and their importance for the organism.

Energy turnover and thermoregulation. Basal metabolism. Method for measuring energy turnover: direct and indirect calorimetry. Body temperature and thermogenesis. Ectotherms and endotherms. Temperature limits of life. Thermoregulation. Evolution of thermoregulation.

Excretory system - osmoregulation. Basic principles of osmoregulation. Osmoregulation of invertebrates and vertebrates. Renal function in osmoregulation and excretion of end products of metabolism. Nephron - the basic functional unit of the kidney. Glomerular filtration, the concentration of urine (Henle loop function). Humoral regulation of urinary excretion.

Endocrine system. Hormones and their specific effects. Pituitary hormones. Thyroid hormones and their function. Parathyroid function. Endocrine pancreatic hormones. Hormones of the adrenal cortex and marrow. Full gland function. Male sex hormones. Female sex hormones. A woman's monthly full cycle. Neuroendocrine regulation of gonadal function.

FOURTH GRADE

I Fundamentals of molecular biology

Subjects of the study of molecular biology. Molecular basis of biological processes. The interdisciplinarity of molecular biology. Molecular basis of inheritance. Nucleic acids and their basic structure. Structure and function of DNA as a molecular basis for the preservation and transmission of genetic information. DNA replication. RNA structure. Types of RNA functions. Protein biosynthesis. Genetic code, transcription, translation, and protein biosynthesis. The role of ribosomes in protein biosynthesis. Genes. Definition of genes at the molecular level. Molecular explanation of the relationship between genes, proteins, and gene products of genotypic properties. Biochemical basis of development and differentiation of organisms. Genetic engineering. Possibilities of intervening and changing hereditary material.

II Biology of animal development

Germ cells (gametes): Oogenesis; Spermatogenesis. Fertilization: External and internal fertilization; Oviparity, ovoviparity, viviparity. Types of ova and method of division of ova. Early stages of embryogenesis: embryonic induction; cell determination and differentiation. Growth of cells, organs, and organisms. Embryonic envelopes. Postembryonic development: Metamorphosis and regeneration. Aging. Ontogenetic development. Prenatal period: pre embryonic, embryonic, and fetal period. Birth and neonatal period. Juvenile period. Adult period.

III Inheritance mechanisms.

Organization and mechanism of transfer of genetic material. Fundamental laws of inheritance. Mendel's law of inheritance. Dominant and recessive gene expression, phenotype, genotype, monohybrid and hybrid crossbreeding, incomplete dominance, the genetic basis of ABO blood group systems. Inheritance of quantitative traits. Chromosomal basis of inheritance. Recombination. Changes in genetic material. Gene mutations - origin, frequency, and effect. Chromosomal aberrations in humans. Influence of the environment on causing hereditary changes. Ionizing radiation as a cause of subsequent changes. Genetic control development. Cloning. Genetic structure of populations. Hardy-Weinberg principle. Genetic variability. Artificial selection and breeding of plants and animals. Human genetics. Examples of inheritance patterns: autosomal recessive, autosomal dominant, and gender-related inheritance. Genealogical trees. Hereditary diseases. Genetic conditioning of human behavior.

NOTE: In the biology test, botany questions will cover 15% of the total number of questions (5 out of 30 questions).

Belgrade, October 30th, 2020. University of Belgrade – Faculty of Pharmacy