TOPICS FOR THE DIPLOMA EXAM
Field of study: BIOLOGY, range: applied biology
First-cycle full-time studies

1. Life macromolecules
Classification, structure and functions of nucleic acids, proteins, carbohydrates and lipids. Methods of isolation and detection.

2. Enzymes
Catalytic properties and mechanisms of enzyme activity regulation in an isolated system and a cell.

3. **Metabolism – definition and organization**
The outline of carbohydrates, lipids and nitrogen metabolism: location of metabolic pathways in the cell, control and integrating points, key metabolites. Metabolic signals (ATP/ADP, NAD+/NADH and NADP/NADPH, feedback regulation). Production of energy in the cell under anaerobic and aerobic conditions.

4. Photosynthetic plant productivity
Physiological and ecological aspects of photosynthesis. Structure and function of photosynthetic membranes, carbon dioxide binding in photosynthesis, C3 and C4 photosynthesis.

5. Comparison of prokaryotic and eukaryotic cell
Cell morphology and structure, cell envelopes, extracellular matrix (ECM), organelles and intracellular structures.

6. Cell cycle – phases and control
Structure of the cell nucleus. Karyokinesis and cytokinesis. Stages of mitosis and meiosis. Control of the cell cycle (checkpoints, participation of cyclins and cyclin-dependent kinases).

7. Structure and functioning of the genome
Structure of genes and regulation of gene expression in Prokaryota and Eukaryota. Replication, transcription, translation and genetic code. Genetic variability of organisms. Mutations and mutagenic factors. Repair of DNA damage. Molecular markers.

8. The role of the nervous and endocrine systems in coordinating the body's functions
Nerve impulses and hormonal signals. Membrane and intracellular receptors, major signal transduction pathways. The role of glial cells.

9. Mechanisms determining the proper immune response
Types of immunity, innate and adaptive immunity. Mechanisms of immune response against virus, bacteria and parasite. Regulation of immune response. The role of vaccinations.

10. Plant and animal organs as multi-tissue structures
Characteristics of plant and animal organs on selected examples.

11. Morphological and anatomical characteristics of plant taxonomic groups
Functions and importance of bryophytes in ecosystems. Comparison of gymnosperms and angiosperms. Comparison of monocotyledonous and dicotyledonous plants. Structure and importance of the gametophyte in particular systematic groups of plants.

12. Morphological and trophic diversity of fungi and their importance in ecological systems
Structure of the fungal cell and various forms of the fungal body organization (examples). The specificity and variety of reproduction. Chemistry and fungal nutrition – trophic groups of fungi (examples).

13. Taxonomic features and diversity of invertebrates representing the main systematic categories
Taxonomic features of the selected phylum, class or order of invertebrates based on the characteristics of developmental biology and features of functional morphology (structure and functioning of organs and systems of organs). Characteristics of the diversity of invertebrate animals of the selected systematic category at the genetic, species and habitat-ecosystem level.

14. Taxonomic characteristics and diversity of vertebrates representing the main systematic categories
Taxonomic features of the selected subphylum, class or order of vertebrates based on features of developmental biology and features of functional morphology (structure and functioning of organ systems). Characteristics of the diversity of vertebrate animals of the selected systematic category at the genetic, species and habitat-ecosystem level.

15. Adaptation of organisms to the living environment
Morphological, physiological, functional and behavioral adaptations to the environment; examples: adaptations to aquatic, terrestrial, polar, tropical and desert environments.

16. Population dynamics and population size regulation
Population processes (reproduction, mortality, migrations). Population dynamics – models. Factors determining the size of the population. Control of population size independent on population density. Control of population size dependent on population density.

17. Interspecies interactions
Strength of interactions: facultative, obligatory. Types of interactions: antagonistic and non-antagonistic; exploiting and non-exploiting. Co-evolutionary relationships (predator-prey, herbivore-plant, parasite-host). Metabiosis – microbial cooperation.

18. The flow of energy and the circulation of matter in nature
Rules related to energy transformations in ecological systems. Autotrophy, heterotrophy – ways of using energy. Energy budget of autotrophs and heterotrophs. Food chains and webs in ecosystems. Biogeochemical cycles.

19. The role of microorganisms in the functioning of natural and anthropogenically changed ecosystems
Principles of Microbial Ecology: basic ecological concepts and terms; the occurrence of microorganisms in ecological complexes of aquatic and terrestrial ecosystems; the causes of the diversity of microorganisms and the mechanisms of its maintenance, the role in the circulation of elements and energy flow, anthropogenic disturbances in the functioning of microbiocenoses, eutrophication - causes, consequences; influence of biomanipulation on the structure of microbiocenoses, molecular ecology, extremophiles and their role in biosphere.

20. The main mechanisms of evolution
Natural selection, genetic drift, polyploidization, sexual selection. Ecological mechanisms of natural selection (differentiated reproduction and mortality, environment limits, the importance of environmental factors). Types of natural selection and their relationship with the

environment: stabilizing, directional and disruptive selection. Adaptations. Genetic drift as a mechanism of evolution. Polyploidization as a mechanism of evolution. Sexual selection – types and mechanisms of sexual selection. Natural selection units: gene, individual, group, meme. Group selection as a mechanism of evolution. The theory of gradualism and Stephen Gould's theory of point equilibrium. The neutralist theory of Motoo Kimura's evolution and its importance in phylogenesis.

21. Species concepts

Morphological and genetic features: Morphological Species Concepts – MSCs, Genotypic ClusterSC, CohesionSC. Reproductive isolation: BiologicalSC. Mechanism of speciation: EcologicalSC, EvolutionarySC. Evolutionary history of organisms: PhylogeneticSC. Speciation as a process of acquiring of reproductive isolation. Hybridization and its importance in the process of evolution. Classical and molecular methods of identifying organisms.

22. Contemporary problems of nature and environment protection

Causes and effects of environmental degradation. Environmental monitoring. Bioindication – types of bioindicators. Methods of protecting genetic, taxonomic and ecosystem diversity. The concept of sustainable development (eco-development).

23. Environmental research methods

Design and implementation of environmental studies (selection of the target ecological system, selection of target information, sampling, methods of plant cover description (species, aggregation, communities, phytocomplexes), methods of assessing the abundance and numbers of invertebrates and vertebrates. Data analysis – keystone species, indicator species (bioindycators), umbrella species and their usefulness in applied ecology.

24. Molecular biology methods used in genomic and proteomic research

Characterization and application of hybridization methods (e.g. PCR, real-time PCR, dot-blot, Southern, Northern, Western blot) and enzyme immunoassay methods (e.g. ELISA, fluorescent immunohistochemistry and immunocytochemistry).

25. Methodology of empirical research

The role of statistics as a research tool in biological sciences. Planning and organization of research – experimental design, replication and repetition, randomization. Measurements in biological sciences – measuring scales. Principles of inference in scientific research – hypothesis, I type of error, inference based on point and interval estimation