



# KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY

INSTITUTE OF NATURAL SCIENCE

**6B01516– Biology IP**

Catalog of elective disciplines

## CONTENT

№		
1	1. OPTIONAL COMPONENTS OF THE CYCLE OF CORE COURSES	3
2	2. OPTIONAL COMPONENTS OF THE CYCLE OF MAJOR COURSES	8



## 1. OPTIONAL COMPONENTS OF THE CYCLE OF CORE COURSES

### *Optional component 1*

**Course: Individual development of living organisms**

*Intensity of the Course:* 6 academic credits

*Module Code:* **GE 202/1**

*Module Name:* Genetics and Evolution

*Prerequisites:* Structure and functions of plant organisms, *Structure and functions of animals 1*

*Short Description:* Pre-service teachers have a fundamental knowledge of the regularity ontogenetic development of organisms. They also build their understanding of macro- and micromorphological, physiological and biochemical processes, processes occurring in developing organisms, as well as about the factors and mechanisms governing the processes of development at all stages of the ontogenesis of animals and plant organisms.

*Learning Outcomes in EP (LOP):*

*LOP 1-* describe the patterns of reproduction and individual development of organisms;

*LOP 2-* understand the basic laws of the biology of animal reproduction, the main stages of ontogenesis, phases of embryonic development, mechanisms of growth, morphogenesis, and causes of developmental anomalies;

*LOP 3-* describe the morphology of gametes; spermatogenesis, fertilization; crushing, blastulation, gastrulation, neurulation;

*LOP 4-* compare features stages of ontogenesis and phylogeny;

*LOP 5-* use specialized terminology;

*LOP 6-* evaluate the features of the development of biological systems embryonic development of the digestive system, respiratory organs, skeleton, muscles, circulatory and genitourinary systems;

*LOP 7-* describe electrical processes in living organisms, photobiological processes, problems of stability and evolution of biological systems;

*LOP 8 -* use in practice the acquired knowledge about the mechanisms of morphophysiological differentiation of the organism in ontogenesis;

*LOP 9 -* apply the acquired knowledge to solve scientific and practical problems, and to work with embryonic objects.

Post requisites: Human anatomy, Genetics and the basis of breeding

### *Optional component 2*

**Course: Cytology, histology and embryology**

*Intensity of the Course:* 6 academic credits

*Module Code:* **GE 202/2**

*Module Name:* Genetics and Evolution

*Prerequisites:* Structure and functions of plant organisms, *Structure and functions of animals 1*

*Short Description:* Pre-service teachers have fundamental knowledge about the structure and principles of cell life, subcellular components, their structure, and functions, as well as the features of embryonic development. They develop their skills in working with optical devices, histopreparations, and fixed material. They also practice the technique of preparing micropreparations..

*Learning Outcomes in EP (LOP):*

*LOP 1-* compare the structure of cells of living organisms, the functions of organoids;

*LOP 2-* describe morphological features of organoids, subcellular structures, types and morphology of tissues;

*LOP 3-* compare methods of reproduction of living organisms and embryology;

*LOP 4-* put into practice the methods of cytological and histological studies;

*LOP 5-* explain the types and mechanisms of cell division.

Post requisites: Human anatomy, Genetics and the basis of breeding

### *Optional component 3*

**Course: Bioresources of Kazakhstan**

*Intensity of the Course:* 5 academic credits

*Module Code:* BE 201/1

*Module Name:* Biopedagogy and the environment

*Prerequisites:* Structure and functions of plant organisms, *Structure and functions of animals 1*

*Short Description:* Bioresources of Kazakhstan are interconnected with biology, geography and ecology. Pre-service teachers understand the geographical distribution and placement of living organisms and their communities on the territory of Kazakhstan. They determine the most important patterns of the structure and dynamics of the flora and fauna in certain regions.



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

They also compare the main stages of the history and economic development of certain groups and species of useful plants and animals in the Republic of Kazakhstan. Pre-service teachers distinguish the locations of specially protected natural areas of Kazakhstan and assess the role of the state and society in the conservation of landscape and biological diversity

*Learning Outcomes in EP (LOP):*

LOP 1 - systematize the position of the main types of biological resources;

LOP 2- list biological resources on the territory of the Republic of Kazakhstan;

LOP 3- specify categories and criteria of endangered species of biological resources;

LOP 4- determine the importance of the environment in increasing the productivity of Kazakhstan's bioresources;

LOP 5- present modern conceptual approaches to the problem of conservation of biological diversity of Kazakhstan;

LOP 6- name the main ways to increase the productivity of biological resources;

LOP 7- teach the assessment of the role of specially protected natural territories of the Republic of Kazakhstan in preserving and increasing the productivity of biodiversity.

*Post requisites:* Genetics and the basis of breeding, Molecular Biology

*Optional component 4*

**Course: Flora and fauna of the world**

*Intensity of the Course:* 5 academic credits

*Module Code:* BE 201/1

*Module Name:* Biopedagogy and the environment

*Prerequisites:* Structure and functions of plant organisms, *Structure and functions of animals 1*

*Short Description:* The flora and fauna of the world are integrated with botany, zoology, geography, and ecology. Pre-service teachers have knowledge of the biological diversity of flora and fauna in different habitats of the Earth, according to faunal and floral zoning. Pre-service teachers distinguish and evaluate faunal and floral kingdoms. Identify the processes of speciation and the state of species and subspecies of flora and fauna at the global level. Substantiate measures to preserve the natural habitat of plants and animals and propose measures to protect them from overexploitation by humans.

*Learning Outcomes in EP (LOP):*

LOP 1- describe the main faunal complexes: tundra, taiga, forest, steppe, semi-desert, desert, pantropical, paleotropical, and faunal zoning;

LOP 2- separate types of fauna: mainland, island, marine;

LOP 3- identify zoogeographic regions and kingdoms and floristic complexes;

LOP 4- characterize the endangered species of flora and fauna and to focus on the scale and importance of endangered flora and fauna.

LOP 5- train in planning and organizing activities aimed at protecting existing species, including endangered and endemic plant and animal species.

*Post requisites:* Genetics and the basis of breeding, Molecular Biology

*Optional component 5*

**Course: Human biology**

*Intensity of the Course:* 5 academic credits

*Module Code:* BLO 305/1

*Module Name:* Biology of living organisms

*Prerequisites:* *Structure and functions of animals 1,2*

*Short Description:* During the course, pre-service teachers form a comprehensive understanding of the functioning of the human being as a biological object. They examine the features of the structure and functioning of organ systems, considering ontogenetic and phylogenetic features.

*Learning Outcomes in EP (LOP):*

LOP 1- describe the features of topography and patterns of the structure of the human body at the micro- and macroscopic levels;

LOP 2- understand the relationship of the structure of organs with the functions performed;

LOP 3- systematize knowledge about the structure and function of organs and systems of the human body, their interrelation and mechanisms of regulation;

LOP 4- navigate the structure of the human body, find and determine the location and projection of organs and their parts on the surface of the body;

LOP 5- evaluate the structural and functional parameters of human body development;

LOP 6- design and conduct experiments to study the work of organs and organ systems;



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

**LOP 7-** apply anatomical and physiological knowledge in life, including as a prevention of various diseases.  
**Post requisites:** Human and Animal Physiology

*Optional component 6*

**Course: Human anatomy**

**Intensity of the Course:** 5 academic credits

**Module Code:** BLO 305/2

**Module Name:** Biology of living organisms

**Prerequisites:** Structure and functions of animals 1,2

**Short Description:** Pre-service teachers build their understanding of the basic laws of the structure and function of the body, as well as individual organs and systems of a person. They are able to use correct terminology and develop their skills in working with laboratory devices.

**Learning Outcomes in EP (LOP):**

**LOP 1-** understand the general laws of the structure of the human body, the structural and functional relationships of parts of the body;

**LOP 2-** use conceptual apparatus and specialized terminology;

**LOP 3-** determine the location and relative position of organs in the body;

**LOP 4-** analyze information about the topography, structure of the human body, its systems, organs and tissues and their main functions;

**LOP 5-** describe morphological changes in the studied macroscopic preparations;

**LOP 6-** design and conduct simple experiments to study the work of individual organs and organ systems at school;

**LOP 7-** observe ethical standards when performing experiments.

**Post requisites:** Human and Animal Physiology

*Optional component 7*

**Course: Patterns of inheritance and variability**

**Intensity of the Course:** 5 academic credits

**Module Code:** GE 303/1

**Module Name:** Genetics and Evolution 22 academic credits

**Prerequisites:** Structure and functions of animals 1,2

**Short Description:** Pre-service teachers investigate the patterns of inheritance of traits, chromosomal theory of heredity, non-nuclear inheritance, natural and induced mutation process, fundamentals of genetic engineering, developmental genetics, population and evolutionary genetics, genetic foundations of breeding, and features of human genetics. Pre-service teachers determine the relationship between the influence of genotype and environmental factors on the development of organisms. Pre-service teachers also consider heritability in the population, and the influence of various factors on the genetic structure of the population.

**Learning Outcomes in EP (LOP):**

**LOP 1-** distinguish inheritance patterns in intraspecific and distant hybridization;

**LOP 2-** solve genetic problems of inheritance of traits and interpret the results obtained;

**LOP 3-** explain the role of environmental and hereditary factors in variability;

**LOP 4-** use modern research methods and information and communication technologies to model crosses;

**LOP 5-** analyze the types of inheritance of breeding traits, types of genetic variability arising under the influence of mutagenic factors;

**LOP 6-** explain the role of heredity and variability in the evolution of life on the planet, the main provisions of the chromosomal theory of heredity and the mechanism of inheritance of human diseases;

**LOP 7-** solve genetic problems of inheritance of traits and interpret the results obtained.

**Post requisites:** Evolutionary teaching, Biometrics

*Optional component 8*

**Course: Genetics and the basis of breeding**

**Intensity of the Course:** 5 academic credits

**Module Code:** GE 303/2

**Module Name:** Genetics and Evolution 22 academic credits

**Prerequisites:** Structure and functions of animals 1,2



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

*Short Description:* Genetics includes ideas and methods that play an important role in medicine, agriculture, microbiological industry, as well as in genetic engineering. Pre-service teachers investigate the cytological foundations of heredity, the laws of heredity, and variability of traits at all levels of the organization of living matter. They also analyze the types of inheritance of breeding traits, the role of heredity, and the environment in the formation of the phenotype. Pre-service teachers consider the issues of modification and mutational variability, polyploidy, and distant hybridization. Pre-service teachers also analyze the patterns of transmission and realization of genetic information. Pre-service teachers examine the basics of breeding, genetic engineering, and methods of molecular genetic analysis

*Learning Outcomes in EP (LOP):*

- LOP 1-analyze the types of inheritance of traits;
  - LOP 2-use genetic terms and conventions appropriately, contributing to an understanding of the nature, process, and results of the study;
  - LOP 3-apply in practice methods of hybridological, cytological and population analysis to solve genetic problems for all types of inheritance;
  - LOP 4-design and conduct genetic experiments;
  - LOP 5-process and analyze the measurement results of quantitative features;
  - LOP 6-distinguish the role of heredity and variability in the evolution of life on the planet, the main provisions of the chromosomal theory of heredity and the mechanism of inheritance of human diseases;
  - LOP 7-distinguish the causes and consequences of mutations for the vital activity of living organisms and the evolution of life on the planet;
  - LOP 8-combine the concepts of genetic processes in plants and animals;
  - LOP 9-perform calculations to determine the percentage of crossing between genes and design genetic maps for genes;
  - LOP 10-determine the genotypic structure of populations and the frequency of alleles and genotypes by phenotypic frequencies in populations;
  - LOP 11-distinguish the types of heredity (nuclear – chromosomal and extra-nuclear - cytoplasmic) and their causes;
  - LOP 12-determine the influence of factors on the type of variability;
  - LOP 13-make schemes of crosses according to the form accepted in genetics;
  - LOP 14-draw conclusions about the importance of induced mutations in the selection of microorganisms, plants and animals;
  - LOP 15-apply the knowledge and methods of genetics to solve the problems of breeding organisms;
  - LOP 16 - model and design an intraspecific crossing experiment.
- Post requisites: Evolutionary teaching, Biometrics

*Optional component 9*

**Course: Comparative anatomy and evolution of living organisms**

*Intensity of the Course:* 5 academic credits

*Module Code:* **GE 404/1**

*Module Name:* **Genetics and Evolution 22 academic credits**

*Prerequisites:* *Structure and functions of animals 1,2*

*Short Description:* Pre-service teachers explore the historical process of adaptive transformations of wildlife at different levels of organization – from the macromolecular to the biosphere as a whole. During the course, pre-service teachers analyze comparative anatomical evidence of the evolution of the main types of living organisms. They also pay special attention to the evolution of vertebrates as the most highly organized, studied and economically important group.

*Learning Outcomes in EP (LOP):*

- LOP 1-classify organs by their origin in embryogenesis;
- LOP 2-compare the features of the structure of organs in connection with their functions performed;
- LOP 3-characterize the main stages of the evolution of organ systems;
- LOP 4-distinguish aromorphoses, idioadaptation and degeneration in the stages of evolution;
- LOP 5-understand the adaptive nature of the evolution of organ systems;
- LOP 6-identify the main directions of the evolution of living organisms;
- LOP 7-apply knowledge on the current state of evolutionary theory in the educational process;
- LOP 8-understand the content of the main provisions of the evolutionary theory;
- LOP 9-analyze scientific data to prove the provisions of the evolutionary doctrine;
- LOP 10-integrate the acquired knowledge on comparative anatomy and evolution of living organisms;
- LOP 11-use methods of comparative analysis of various groups of living organisms, considering their systematic position, phylogenetic relationships, ecology and biology;
- LOP 12-analyze the anatomical and morphological structure of organs, considering their functions;
- LOP 13-systematize research results, evaluate their reliability and significance;
- LOP 14 - plan and conduct experiments, and process and analyze research results.



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

*Post requisites:* Ecology of plants, animals and humans

*Optional component 10*

**Course: Evolutionary teaching**

*Intensity of the Course:* 5 academic credits

*Module Code:* **GE 404/2**

*Module Name:* **Genetics and Evolution 22 academic credits**

*Prerequisites:* *Structure and functions of animals 1,2*

*Short Description:* Pre-service teachers investigate the basic laws of the development of the organic world at the macro- and microevolutionary levels, the features of speciation, and the mechanisms of natural selection. During the course, pre-service teachers gain knowledge in explaining the processes occurring in nature, as well as develop their skills in analyzing various data at an interdisciplinary level.

*Learning Outcomes in EP (LOP):*

*LOP 1-*describe the process and significance of the evolutionary process in wildlife;

*LOP 2-*apply knowledge about the basic laws and mechanisms of evolutionary changes in the life of plants and animals in pedagogical activity and in solving practical problems;

*LOP 3-*substantiate the role of the evolutionary idea in the biological worldview;

*LOP 4-*use the skills of interpreting changes occurring in ecosystems;

*LOP 5-*document, correctly formalize links to the used sources of information using the selected citation style;

*LOP 6-*argue the modern evolutionary approach to the study of biological objects;

*LOP 7-* apply the skills of scientific explanation of natural processes in professional activity.

*Post requisites:* Ecology of plants, animals and humans

*Optional component 11*

**Course: Biogeocenology**

*Intensity of the Course:* 4 academic credits

*Module Code:* **BE 401/1**

*Module Name:* Biopedagogy and the environment

*Prerequisites:* *Structure and functions of plant organisms, Structure and functions of animals 1,2*

*Short Description:* Biogeocenology combines a number of disciplines that are related to biology, ecosystem ecology and geography. Pre-service teachers build their understanding of the basic laws of the organization and functioning of biogeocenoses. They are able to prove the essence of the complex of living, inanimate components of nature that are in causal interactions, and justify the totality of complex ecological systems in the biogeosphere. They also conduct studies of the structural components of biogeocenosis considering the forms of species coadaptation in different natural and geographical conditions using the skills of collaboration.

*Learning Outcomes in EP (LOP):*

*LOP 1-*understand the structure and methodology of biogeocenosis processes;

*LOP 2-*characterize the basic principles of the organization and functioning of biogeocenoses;

*LOP 3-*analyze the structural and functional organizations of biogeocenotic systems of various types;

*LOP 4-*evaluate production processes and efficiency of energy flow in food chains of biogeocenoses;

*LOP 5-*analyze the role of components of biogeocenoses as elementary environment-forming structural and functional blocks of the biosphere;

*LOP 6 -* teach conducting safety-based research with phyto- and zoocenosis objects to determine the types and forms of coadaptations in different natural conditions, geographical location, and the impact of environmental factors.

*Post requisites:* no

*Optional component 12*

**Course: Ecology of plants, animals and humans**

*Intensity of the Course:* 4 academic credits

*Module Code:* **BE 401/2**

*Module Name:* Biopedagogy and the environment **9 academic credits**

*Prerequisites:* *Structure and functions of plant organisms, Structure and functions of animals 1,2*

*Short Description:* The discipline of plant, animal and human ecology is associated with the disciplines of ecology, botany, zoology, and human anatomy. Pre-service teachers analyze the fundamental concepts of the organism and biological diversity in nature, as well as biogeocenosis as special levels of organization of life. Pre-service teachers evaluate the relationship of organisms and the environment considering the characteristics of the structure and vital activity of organisms in various



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

environmental conditions of the Earth. They teach planning and monitoring of biological objects and the state of their own body under the influence of environmental factors. They also assess the consequences of anthropogenic activities in relation to the natural environment and the health of other people.

*Learning Outcomes in EP (LOP):*

*LOP 1-* determine the type of interaction of different species in the ecosystem and the features of the structure of cells, tissues, organs, organ systems in accordance with the effects of environmental factors and anthropogenic impact;

*LOP 2-* understand the importance of the activity of living organisms in the circulation of ecosystem substances in human life and economy;

*LOP 3-* identify essential features of biological objects and processes and compare them;

*LOP 4-* identify the variability of living organisms under anthropogenic influences and environmental factors;

*LOP 5-* teach safe research to study the adaptations of organisms to the environment and explain their meanings.

*Post requisites:* no

## 2 OPTIONAL COMPONENTS OF THE CYCLE OF MAJOR COURSES

### *Optional component 1*

**Course: Environmental Chemistry**

*Intensity of the Course:* 5 academic credits

*Module Code:* AIS 201/1

*Module Name* **Applied and Integrated Sciences 26 academic credits**

*Prerequisites:* Bioresources of Kazakhstan

*Short Description:* This course is aimed at acquiring knowledge about the basic principles of environmental chemistry and their actions on a local and global scale. During the course, pre-service teachers discuss and predict the effects of pollution on the environment, and use knowledge in physics, chemistry, Earth sciences and biology to scientifically substantiate the processes occurring in the environment. Pre-service teachers analyze the main physical and chemical processes taking place with the participation of pollutants in the atmosphere, hydrosphere and soil. They form a civic position and are responsible for their decisions and actions in the context of Sustainable Development.

*Learning Outcomes in EP (LOP):*

*LOP 1-* describe the properties of simple and complex substances and the patterns of chemical processes;

*LOP 2-* apply basic physico-chemical and chemical methods of analysis in professional activity;

*LOP 3-* conduct chemical and biological experiments and use the results in teaching students;

*LOP 4-* argue the role of the development of natural science knowledge in solving the problems of modern society;

*LOP 5 -* form students' environmental literacy through the integration of basic knowledge in the field of physics, chemistry, Earth sciences and biology in search of solutions to global and local environmental problems;

*LOP 6 -* document information sources using the accepted citation style;

*LOP 7 -* predict possible ways of migration and transformation of chemical compounds in environmental objects and their impact on ecosystems;

*LOP 8 -* evaluate anthropogenic changes in environmental objects.

*Post requisites:* Biochemistry

### *Optional component 2*

**Course: Theoretical foundations of inorganic chemistry**

*Intensity of the Course:* 5 academic credits

*Module Code:* AIS 201/2

*Module Name:* **Applied and Integrated Sciences 26 academic credits**

*Prerequisites:* Bioresources of Kazakhstan

*Short Description:* The course forms pre-service teachers' knowledge of the basic concepts and laws of chemistry, the basics of atomic and molecular theory, the structure of matter, the Periodic law, chemical bonding, laws of the chemical process, the doctrine of solutions, exchange reactions in electrolyte solutions, and redox reactions. Pre-service teachers investigate the basics of chemical thermodynamics, kinetic principles of describing chemical reactions, methods and mechanisms of their acceleration, the doctrine of chemical equilibrium and methods of its displacement, the basics of the theory of solutions, and elements of electrochemistry. The course is practice-oriented: all concepts, laws, and theories, as well as the most important processes, substances and materials are introduced in terms of their practical significance and use in everyday life as well as their role in living and inanimate nature.

*Learning Outcomes in EP (LOP):*

*LOP 1-* predict the possibilities of chemical processes and the factors affecting the equilibrium of chemical reactions and determine the direction of the process under these conditions;



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

LOP 2-classify reactions occurring in aqueous solutions and offer optimal conditions for conducting reversible reactions;

LOP 3-compare the thermodynamic, and redox activity of substances;

LOP 4-apply the academic language of chemical concepts and terms;

LOP 5-formulate the basic laws of chemistry with reasoned judgments;

LOP 6-understand the properties of substances and the mechanism of chemical processes and discuss chemical phenomena with a thermal effect occurring in nature, in a living organism;

LOP 7-apply the acquired theoretical knowledge and skills with general scientific and special disciplines in their teaching activities;

LOP 8-teach conducting experiments using elementary methods of chemical research of substances and compounds for the formation of research skills;

LOP 9 - collect, process and interpret research data.

Post requisites: Biochemistry

*Optional component 3*

Course: **Biochemistry**

Intensity of the Course: 5 academic credits

Module Code: **AIS 302/1**

Module Name: **Applied and Integrated Sciences 26 academic credits**

Prerequisites: *Environmental Chemistry*

*Short Description:* Biochemistry is an integrated discipline and covers a number of natural science disciplines, including chemistry, genetics, microbiology, forensic science, crop production, and medicine. Pre-service teachers investigate chemical processes in living organisms occurring at the molecular level. They determine the causal relationships between the structure of the molecule and its function allowing them to predict the mechanisms of interaction of molecules by analyzing the structure and properties of proteins, nucleic acids, fats, carbohydrates, as well as cellular organelles. Pre-service teachers also consider the processes of cell interaction during growth or disease control and explore the achievements of science in the field of biochemistry. Pre-service teachers plan and conduct research to determine the influence of various factors (temperature, pH, substrate concentration on enzyme activity).

*Learning Outcomes in EP (LOP):*

LOP 1 - understand the structure and functions of bioorganic substances in living organisms;

LOP 2 - establish causal relationships between the metabolism in a living organism and the biochemical functions of cellular organelles;

LOP 3 - draw conclusions on the relationship between the structures of bioorganic molecules and their function in living organisms;

LOP 4 - determine the ways of transformation of nutrients;

LOP 5 - compare the features of the course of biochemical reactions in the human body, animals and plants, such as the biosynthesis of vital compounds;

LOP 6-apply chemical knowledge and methods in their teaching activities;

LOP 7 - give a scientific justification of the proposed assumption (formulation of the hypothesis) and design an experiment to determine the influence of various factors (temperature, pH, substrate concentration on enzyme activity);

LOP 8 - conduct a safe experiment to investigate the chemical structure, properties and function of carbohydrates, fats, proteins and nucleic acids;

LOP 9 - collect, process and interpret research data;

LOP 10 - document reliable sources of information used following the established (selected) citation system (ARA style or others.);

LOP 11 - evaluate the strengths and weaknesses of the study, such as the limitations of data and the sources of errors and inaccuracies of the experiment;

LOP 12 - formulate a reasoned and detailed conclusion on the research topic and make a structured and clear report on all stages of the study;

LOP 13 - use scientific language, subject terminology and conventions appropriately and correctly.

Post requisites: Human and Animal physiology

*Optional component 4*

Course: **Bioorganic chemistry**

Intensity of the Course: 5 academic credits

Module Code: **AIS 302/1**



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

**Module Name: Applied and Integrated Sciences 26 academic credits**

*Prerequisites: Environmental Chemistry*

*Short Description:* During the course, pre-service teachers examine the issues and problems of bioorganic chemistry and develop their skills in obtaining and identifying organic substances in a living organism. During lectures and laboratory classes, pre-service teachers analyze the relationship between the structure of organic substances and their biological functions, and conduct laboratory studies of the structure, properties and functions of biologically important natural (biopolymers, vitamins, hormones, antibiotics) and synthetic compounds (drugs, pesticides, etc.). Pre-service teachers practice skills in working with devices and materials and choose ways and methods of conducting individual and group research. They solve creative tasks and offer new non-standard solutions to problems. They also demonstrate practical application of the results of a biological experiment for their professional development, and evaluate experimental and calculated data, as well as prepare research reports and pass an exam.

*Learning Outcomes in EP (LOP):*

*LOP 1*-classify organic compounds by nomenclature when composing names and writing formulas of biologically active substances;

*LOP 2*-conduct experiments to study the chemical structure and properties of biologically important substances;

*LOP 3*-demonstrate the skills of conducting a biological experiment using chemical, physical, physico-chemical, mathematical and biological methods;

*LOP 4*-evaluate the importance of biopolymers, enzymes, hormones, vitamins, signaling substances, antibiotics, and others in the vital activity of living organisms;

*LOP 5*-conduct small projects: formulation of hypotheses and conclusions, planning, assessment of strengths and weaknesses, preparation of a report;

*LOP 6*-collect, process and interpret research data on design and laboratory work;

*LOP 7*-use scientific language, subject terminology and conventions appropriately;

*LOP 8*-offer creative non-standard solutions to problems in the field of bioorganic chemistry;

*LOP 9*-apply the results of biological research for their professional development;

*LOP 10*-organize project activities of students to develop their interdisciplinary and research competencies.

*Post requisites:* Human and animal physiology

*Optional component 5*

**Course: Biophysics and bioinformatics**

*Intensity of the Course:* 6 academic credits

*Module Code:* AIS 303/1

**Module Name: Applied and Integrated Sciences 26 academic credits**

*Prerequisites: Methodology of biological research*

*Short Description:* The course focuses on the use of theoretical knowledge and practical skills in biology in integration with physics and computer science, applying basic knowledge in the field of molecular biology and genomics, as well as the basics of statistics and mathematics. During lectures, practical and laboratory classes, pre-service teachers analyze the impact of natural phenomena (photobiological, electrical, sound, etc.) on living organisms, the principles of structured bioinformatics to reveal the essence of biological phenomena, a database search algorithm (BLAST), and the basics of gene mapping. During the course, pre-service teachers develop their interdisciplinary competencies (BTEAM) to solve creative tasks as well as their practical skills in biological physics in solving problems of biomedicine, and biomechanics. The course promotes the development of pre-service teachers' practical skills in working with databases of biological data (DNA, RNA, proteins), and modeling biological processes. Pre-service teachers can write a good scientific report and use biophysical and bioinformatic methods to solve research issues, working independently and in groups. At the end of the course, pre-service teachers defend the project and the scientific report, and pass the exam.

*Learning Outcomes in EP (LOP):*

*LOP 1*- describe the application of biomechanical processes in robotics and medicine;

*LOP 2*- analyze the physical foundations of the study of heart automatics using an electrocardiogram, the functioning of muscle tissue (electrophysiology);

*LOP 3*- evaluate the thermodynamic feature of biological systems and electrical processes in living organisms, problems of stability and evolution of biological systems;

*LOP 4*- investigate the effects of electromagnetic and sound waves on the organism of living beings;

*LOP 5*- simulate photobiological processes, ultrastructure of the cell and cell membrane, etc.;

*LOP 6*- explain how information is transferred from genes to proteins in living organisms;

*LOP 7*- describe the technology of the neurocomputer interface, the system of information exchange between the brain and the computer;

*LOP 8*- apply modern methods of obtaining, analyzing, storing, organizing and visualizing biological data;

*LOP 9*- evaluate the advantages and disadvantages of using computer systems and tools for solving biological problems;



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

LOP 10- use of the most important databases and software (for example, OMIM, PubMed, UniProt, Cosmic, BioMart) for the extraction, analysis and interpretation of data at the level of DNA, RNA and protein;

LOP 11- perform BLAST-search, alignment of DNA and protein sequences;

LOP 12- critically interpret the results, visualize the protein and evaluate the differences created by sequence variations;

LOP 13- create computer modeling of the genome (gene mapping), and phylogenetic trees on databases of biodata.

*Post requisites: STEM education in biology*

*Optional component 6*

**Course: Scientific foundations of natural science**

*Intensity of the Course:* 6 academic credits

*Module Code:* AIS 303/2

*Module Name:* **Applied and Integrated Sciences**

*Prerequisites:* *Methodology of biological research*

*Short Description:* The course forms pre-service teachers' knowledge about the modern natural-scientific world view and the methods of natural sciences. They also develop their skills in applying the acquired knowledge to explain the phenomena of the surrounding world, and the perception of natural-scientific information.

*Learning Outcomes in EP (LOP):*

LOP 1- understand the natural science method of cognition, the main ideas and achievements of natural science, determining influence on the development of technology;

LOP 2- navigate modern scientific concepts and information of natural science;

LOP 3- understand the applied significance of the most important achievements in the field of natural sciences;

LOP 4 -critically analyze the phenomena, perception and interpretation of natural science;

LOP 5- apply natural science knowledge in their professional activities.

*Post requisites: STEM education in biology*

*Optional component 7*

**Course: Biometrics**

*Intensity of the Course:* 5 academic credits

*Module Code:* **AIS 404/1**

*Module Name:* **Applied and Integrated Sciences**

*Prerequisites:* *Genetics and the basis of breeding*

*Short Description:* Pre-service teachers have basic knowledge in the field of mathematics and natural sciences and apply methods of mathematical analysis and modeling, as well as theoretical and experimental research in the field of biology. During the course, pre-service teachers acquire the basics of practical knowledge and skills in the field of biometrics understanding its relationship with other sciences.

*Learning Outcomes in EP (LOP):*

LOP 1-use the knowledge of mathematical statistics, the principle and various methods of analysis in professional activity;

LOP 2-apply statistical processing methods in practice;

LOP 3-identify trends in the patterns of the studied objects;

LOP 4-perform correct statistical processing of experimental data;

LOP 5-organize experimental work and analyze the observations and the results of the experiments;

LOP 6-work with biological objects in natural and laboratory conditions;

LOP 7-make reports, reviews, analytical maps and explanatory notes;

LOP 8-present and critically analyze the information received to present the results of field and laboratory biological studies.

*Post requisites: Ecology of plants, animals and humans*

*Optional component 8*

**Course: Experimental biology**

*Intensity of the Course:* 5 academic credits

*Module Code:* **AIS 404/2**

*Module Name:* **Applied and Integrated Sciences**

*Prerequisites:* *Genetics and the basis of breeding*

*Short Description:* Pre-service teachers analyze the principles and structure of the organization of a scientific activity, the methodology of scientific knowledge, and the methods of setting goals and objectives for the scientific research. The discipline



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

is aimed at developing pre-service teachers' skills in conducting experimental research, as well as processing and analyzing the results.

*Learning Outcomes in EP (LOP):*

*LOP 1-* apply scientific methods in their professional activity;

*LOP 2-* understand and solve problems in new or unfamiliar situations in contexts and within broader (or interdisciplinary) fields related to the field being studied;

*LOP 3-* adapt modern scientific achievements to their educational process;

*LOP 4-* collect, process and interpret research data;

*LOP 5-* formalize the research results into various forms of scientific products;

*LOP 6-* conduct a scientific discussion using the evidence based on the results of theoretical and experimental research.

*Post requisites:* Ecology of plants, animals and humans

*Optional component 9*

**Course: Microbiology with the basics of biotechnology**

*Intensity of the Course:* 5 academic credits

*Module Code:* AIS 303/1

*Module Name:* **Applied and Integrated Sciences 26 academic credits**

*Prerequisites:* Bioresources of Kazakhstan, Biochemistry

*Short Description:* During the course, pre-service teachers examine morphology, physiology, biochemistry, genetics and systematics of microorganisms. They also investigate the principles of using bacterial, yeast, animal and plant cell cultures, metabolism and biosynthetic capabilities in genetic engineering and biotechnological production by using knowledge of chemistry and physics. After the course, pre-service teachers have a good basic knowledge of the prospects for the development of biotechnology: the methods of obtaining recombinant DNA and DNA cloning, the use of plasmids, the stages of microclonal reproduction, and the use of enzymes in various fields. The knowledge gained serves as the basis not only for individual laboratory work and small group studies in microbiology and biotechnology, but also for all other research in biology. Completion of the course includes a report on laboratory work and an exam.

*Learning Outcomes in EP (LOP):*

*LOP 1-* compare morpho-physiology, biochemistry, genetics of microorganisms with the use of modern molecular genetic methods;

*LOP 2-* use disinfection and sterilization methods when working with biotechnological objects, and preparing nutrient media and coloring by using the Gram method to identify microorganisms;

*LOP 3-* check the parameters of growth and development of microbial cultures, and correctly identify microorganisms by cultural and morphological characteristics;

*LOP 4-* evaluate the use of living organisms in biotechnological production: production of microbial protein, enzyme preparation, biogas, bioethanol;

*LOP 5-* practice the skills of cultivation and cloning of living organisms, experimentation of microclonal reproduction, microscopy of preparations of cells of living organisms;

*LOP 6-* analyze the ethical issues of the use of GMOs, the principles of genetic engineering manipulations, and the importance of molecular genetic approaches in taxonomy, medicine and criminology;

*LOP 7-* investigate the influence of various factors (temperature, pH, nutrient content) on the growth and development of microorganisms, the use of enzymes (pectinase, protease, etc.), the influence of antiseptic and disinfectants;

*LOP 8-* design experiments for obtaining a cumulative and pure culture of microorganisms, obtaining callus tissues by microclonal reproduction;

*LOP 9-* conduct a safe experiment to study the microflora of water, air, and dairy products;

*LOP 10-* organize small projects: formulation of hypotheses and conclusions, planning, assessment of strengths and weaknesses, preparation of a report;

*LOP 11-* collect, process and interpret research data on design and laboratory work;

*LOP 12-* use scientific language, subject terminology and conventions appropriately.

*Post requisites:* Research, Development, and Innovation

*Optional component 10*

**Course: Applied biology with the basics of soil science**

*Intensity of the Course:* 5 academic credits

*Module Code:* AIS 303/2

*Module Name:* **Applied and Integrated Sciences 26 academic credits**



**KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY**  
**INSTITUTE OF NATURAL SCIENCE**  
**6B01516– Biology IP**  
Catalog of elective disciplines

*Prerequisites:* Bioresources of Kazakhstan, Biochemistry

*Short Description:* During the course, pre-service teachers examine the topics of soil science, agrochemistry, and crop production: the process of soil formation, soil morphology, structure and properties of soil, tillage, chemistry of agriculture, and cultivated plants. The course consists of lectures and laboratory classes, during which pre-service teachers develop their skills in working with laboratory equipment, materials, tools in the organization of educational and research activities. They also develop their interdisciplinary competencies during laboratory work and small scientific projects. Pre-service teachers critically choose the methods and techniques of research, academically conduct and evaluate experimental and calculated data, prepare research reports and pass the exam.

*Learning Outcomes in EP (LOP):*

*LOP 1*-classify soil by mechanical composition;

*LOP 2*-analyze the relationship of soil science with biological, chemical and other sciences;

*LOP 3*-conduct safe experiments to study the influence of various factors on soil formation, the influence of living organisms on soil formation;

*LOP 4*-identify morphological, biological and economic features of cultivated plants;

*LOP 5*-assess the soil-ecological and bioecological condition of the territory of Kazakhstan;

*LOP 6*-practice the skills of cultivating soil microorganisms, microscoping preparations of cells of living organisms;

*LOP 7*-design experiments to determine the composition and properties of the soil (physical, physico-mechanical, rheological);

*LOP 8*-investigate the use of organic and mineral fertilizers in crop production;

*LOP 9*-plan and carry out projects: formulation of hypotheses and conclusions, assessment of strengths and weaknesses, preparation of a report;

*LOP 10*-collect, process and interpret research data on design and laboratory work;

*LOP 11*-use scientific language, subject terminology and conventions appropriately.

*Post requisites:* Research, Development, and Innovation

*Optional component 11*

*Course:* **STEM education in biology**

*Intensity of the Course:* 5 academic credits

*Module Code:* **RB 402/1**

*Module Name:* **Research in Biology**

*Prerequisites:* Research, Development, and Innovation

*Short Description:* During the course, pre-service teachers practice pedagogical methods and technologies based on the activation and intensification of students' educational activities, diagnostics, and assessment in biology teaching using STEM approach. Pre-service teachers master the subject content through projects in which scientific knowledge and design, information technology and mathematical calculations are naturally integrated. Pre-service teachers explore the methodology of the organization of STEM learning, discuss the stages, apply various research methods in the practice of teaching STEM learning, and design STEM research. Pre-service teachers form their skills in integrating research into teaching practice in various types of learning environments

*Learning Outcomes in EP (LOP):*

*LOP 1*-carry out the selection of pedagogical STEM-learning technologies and effectively implement them in the practice of teaching school academic disciplines in the classroom and in extracurricular activities;

*LOP 2*-design STEM learning, considering the diversity of students;

*LOP 3*-apply various methods and technologies of pedagogical diagnostics used in evaluation of the quality of results and content of the educational process;

*LOP 4*-perform consistent, planned actions to improve the practice of teaching and STEM learning;

*LOP 5*-develop their research skills, direct them to improve the quality of education and their functional literacy;

*LOP 6*-develop a plan for the implementation of research on the practice of teaching STEM learning;

*LOP 7*-conduct systematic evaluation of the results during STEM training;

*LOP 8*-evaluate the strengths and weaknesses of STEM education.

*Post requisites:* Ecology of plants, animals and humans

*Optional component 12*

*Course:* **Digital technologies in biology**

*Intensity of the Course:* 5 academic credits

*Module Code:* **RB 402/2**

*Module Name:* **Research in Biology 2**



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

*Prerequisites: Research, Development, and Innovation*

*Short Description:* Pre-service teachers investigate the possibilities of using digital equipment and software in the educational process in biology, and plan effective ways of teaching using IT technologies, including in distance learning. They also create digital educational resources in biology.

*Learning Outcomes in EP (LOP):*

*LOP 1-* use various forms of interactive electronic educational content;

*LOP 2-* use IT technologies in the organization of project activities;

*LOP 3-* structure, integrate and present information in teaching activities, considering life and educational context of students;

*LOP 4-* plan effective teaching using IT technologies;

*LOP 5-* develop digital educational resources on biology.

*Post requisites: Ecology of plants, animals and humans*

*Optional component 13*

**Course: Design of STEM education**

*Intensity of the Course:* 5 academic credits

**Module Code: RB 402/3**

**Module Name: Research in Biology 20 academic credits**

*Prerequisites: Research, Development, and Innovation*

*Short Description:* Pre-service teachers analyze the design features of STEM learning based on the applied nature of the real world challenges, learning through problem solving and critical thinking, and the integration of different content into the educational process. The course builds pre-service teachers' abilities to use new technological opportunities in biology, as well as to design and adapt STEM education considering the diversity of students.

*Learning Outcomes in EP (LOP):*

*LOP 1-* link science and STEM subjects with real life challenges or situations;

*LOP 2-* identify practice-oriented problem situations;

*LOP 3-* build project/phenomena-based learning processes in which students make observations, identify problems and find solutions independently and with their peers;

*LOP 4-* conduct experimental research with mathematical and IT modeling;

*LOP 5-* design STEM lessons for students' academic and extracurricular activities in an inclusive environment.

*Post requisites: Ecology of plants, animals and humans*

*Optional component 14*

**Course: Modern approaches to the organization of a biological**

*Intensity of the Course:* 5 academic credits

**Module Code: RB 203/1**

**Module Name: Research in Biology 20 academic credits**

*Prerequisites: Bioresources of Kazakhstan*

*Short Description:* Pre-service teachers analyze modern approaches to the organization of experiments in the field of biological sciences, the stages of conducting and the aspects of organizing and planning of experiments, the methods of data processing, and the ways of presenting the results. Special emphasis is placed on molecular genetic approaches to the organization of experiments. The course is aimed at developing pre-service teachers' skills in conducting biological experiments by using modern approaches and experiments in their professional and research activities.

*Learning Outcomes in EP (LOP):*

*LOP 1-* apply modern approaches to the organization of biological experiments and apply them in their professional and research activities;

*LOP 2-* work with scientific and laboratory equipment, use them during biological experiments;

*LOP 3-* determine and formulate a research hypothesis, draw up an experiment plan, select methods, and on the basis of this conduct theoretical and applied research in the field of biology;

*LOP 4-* organize and conduct experimental work with biological objects, processing and presenting the results of this work.

*Post requisites: Ecology of plants, animals and humans*

*Optional component 15*



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

**Course: Methodology of biological research**

*Intensity of the Course:* 6 academic credits

*Module Code:* RB 203/2

*Module Name:* **Research in Biology 20 academic credits**

*Prerequisites:* Bioresources of Kazakhstan

*Short Description:* Pre-service teachers analyze the methodology of organizing scientific research in the field of biology, the stages of research, the variety of research methods in biology, the methods of processing data, and the ways of presenting the results. The course is aimed at developing pre-service teachers' skills in working with scientific equipment and conducting theoretical and applied research.

*Learning Outcomes in EP (LOP):*

LOP 1- use methods of conducting biological research in their professional and research activities;

LOP 2- work with scientific and laboratory equipment, use them during research;

LOP 3- determine and formulate a research hypothesis, draw up an experiment plan, select methods, and on the basis of this conduct theoretical and applied research in the field of biology;

LOP 4- organize and conduct experimental work with biological objects, processing and presenting the results of this work;

LOP 5- teach research methods in various types of learning environments.

*Post requisites:* Ecology of plants, animals and humans

*Optional component 16*

**Course: Research and project activities in biological education**

*Intensity of the Course:* 5 academic credits

*Module Code:* **RB 203/3**

*Module Name:* **Research in Biology 20 academic credits**

*Prerequisites:* Bioresources of Kazakhstan

*Short Description:* Pre-service teachers analyze the methodology of project activity in education, the method of projects in a modern school, the practice of educational design, the organization and stages of project activity of students, as well as the collaboration between a teacher and students. The discipline is aimed at developing pre-service teachers' skills within the framework of research and project activities.

*Learning Outcomes in EP (LOP):*

LOP 1- set goals and define tasks in the organization of scientific and project research;

LOP 2- carry out information-analytical and information-bibliographic work with the involvement of modern information technologies;

LOP 3- creatively find solutions for new problems and situations;

LOP 4- mentor students during research project;

LOP -5- competently present the results of research and project activities.

*Post requisites:* Ecology of plants, animals and humans

*Optional component 17*

**Course: Academic letter**

*Intensity of the Course:* 5 academic credits

*Module Code:* RB 403/1

*Module Name:* **Research in Biology**

*Prerequisites:* Research, Development, and Innovation

*Short Description:* Pre-service teachers analyze the features of academic writing, and the ways of correct writing and execution of written types of work in accordance with the principles of academic integrity. The discipline is aimed at the formation of pre-service teachers' writing skills, as well as skills in designing all types of written works in accordance with existing requirements.

*Learning Outcomes in EP (LOP):*

LOP 1-use the knowledge gained within the discipline for writing, registration of all types of written works, in accordance with the requirements;

LOP 2-work with databases of scientific publications, bibliographic sources, and make references to the sources;

LOP 3-use citations correctly in compliance with the referencing system at use;

LOP 4-present information to the audience, interact with the audience, and competently build communication based on the goals and situation of communication.

*Post requisites:* Ecology of plants, animals and humans



KAZAKH NATIONAL WOMEN'S TEACHER TRAINING UNIVERSITY  
INSTITUTE OF NATURAL SCIENCE  
**6B01516– Biology IP**  
Catalog of elective disciplines

*Optional component 18*

**Course: Content-language integrated learning in biology**

*Intensity of the Course:* 5 academic credits

**Module Code: RB 206/1**

**Module Name: Research in Biology**

*Prerequisites: Research, Development, and Innovation*

*Short Description:* Pre-service teachers explore the basic approaches, techniques and forms used in content-language integrated learning (CLIL) in biology. During the course, pre-service teachers acquire knowledge of biology, while improving their foreign language knowledge and skills.

*Learning Outcomes in EP (LOP):*

*LOP 1-*identify language problems of students;

*LOP 2-*use communicative and interactive tasks that contribute to a better understanding of biology studied in a foreign language;

*LOP 3-*apply error correction strategies that encourage the correct use of a spoken foreign language;

*LOP 4-*use activities in the classroom that contribute to both studying biology and developing foreign language skills;

*LOP 5-*use authentic educational material.

*Post requisites: Ecology of plants, animals and humans*