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Higher and Postgraduate Educational Programs

☐ Project EP ☒ Participant of project EP

OHPE (Developer)

West Kazakhstan University named after Makhambet Utemisov NPJSC

Title of project EP

Co-developers

Kokshetau University named after Sh. Ualikhanov NPJSC South Kazakhstan Pedagogical University named after Ozbekali Z
non-profit limited company "Akhmet Baitursynuly Kostanay Regional University"
Pavlodar Pedagogical University named after Alkey Margulan NPJSC Manash Kozybayev North Kazakhstan University NPJS
non-profit joint-stock company "Shakarim University" non-profit limited company "Atyrau University named after Kh. Dosm
Karaganda Buketov University NPJSC

Date of registration in the Registry

31.05.2024

Registration number

6B01500447

Date of EP passport updating

08.07.2026 21:45

Field of education

6B01 Pedagogical sciences

Direction of personnel training

6B015 Training of teachers in Natural science subjects

Group of educational programs

B013 Teacher training in biology

Educational program

6B01515 Biology (IP)

EP purpose

Training a qualified biology teacher who is able to use innovative technologies, including STEM, CLIL, IT-technolog
activities, possessing pedagogical and subject competencies in the field of conceptual and theoretical knowledge,
research and applying them in science.

EP type

Innovative EP

Level on NQF

6

Level on SQF

6

EP distinctive features

No

Language of education

Russian Kazakh multilingual

Professional Standard for EP

Exists



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№	Name of professional standard
1	Professional standards for teachers of educational organizations

Professional standards (career standards)

Professional standard has been used at developing EP

Professional standard №1

Professional standardПрофессиональные стандарты для педагогов

Approval year2024

CCEA.....

Professions

Profession №1

ProfessionПедагогии колледжей и других органи

Уровень по ОРК6

Labor functionsОсуществление научно-методической деятельности.
Проведение мониторинга образовательных достижений обучающихся.
Осуществление деятельности руководителя учебной группы.
Осуществление учебного процесса с учетом индивидуальных способностей и потребностей обучающихся.

Profession №2

ProfessionУчителя средней школы

Уровень по ОРК6

Labor functionsОсуществление учебно-методической деятельности.
Осуществление учебного процесса.
Осуществление классного руководства.
Оценивание учебных достижений обучающихся.
Приобщение обучающихся к систематическому обучению.

Volume of the credits240

Degree to be conferredBachelor

Period of study4

Date of approval EP on the Academic Council27.04.2026

Date when EP was approved by the Republican Educational and Methodological Board of the Ministry of Science and Higher Education of the Republic of Kazakhstan18.05.2023

Existence of the annex to the license for the direction of personnel training

The license number on the direction of training



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☒ EP accreditation existence

Atlas of new professions

не предусмотрено

Regional standard

не предусмотрено

The formed educational outcomes

Nº	Educational outcome	Code	Reflects the labor function
1	To develop own moral	ON1	Осуществление учебного процесса.
2	To assess situations	ON2	Осуществление классного руководства. Осуществление деятельности руководителя. Приобщение обучающихся к системе ценностей.
3	To use various	ON3	Осуществление научно-методической деятельности.
4	To focus on a	ON4	Осуществление учебного процесса с учетом индивидуальных способностей и потребностей обучающихся.
5	To develop and apply	ON5	Осуществление учебно-методической деятельности. Осуществление учебного процесса. Приобщение обучающихся к системе ценностей. Оценивание учебных достижений обучающихся. Проведение мониторинга образовательных достижений обучающихся. Осуществление деятельности руководителя учебной группы. Осуществление классного руководства. Осуществление учебного процесса с учетом индивидуальных способностей и потребностей обучающихся.
6	To carry out the	ON6	Осуществление учебно-методической деятельности. Осуществление научно-методической деятельности.
7	To build profession	ON7	Осуществление учебного процесса. Осуществление деятельности руководителя учебного процесса. Осуществление классного руководства.
8	To integrate	ON8	Приобщение обучающихся к системе ценностей. Осуществление учебного процесса.
9	To use conceptual	ON9	Осуществление учебно-методической деятельности. Осуществление учебного процесса. Осуществление научно-методической деятельности.
10	To use the fundament	ON10	Осуществление научно-методической деятельности.
11	To analyze the level	ON11	Осуществление учебного процесса. Осуществление научно-методической деятельности.
12	To create and offer	ON12	Осуществление научно-методической деятельности.



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№	Name of discipline	Short description of discipline	Cycle
1	Fundamentals of Scientific Research	The goal is to form knowledge about the principles, technologies, practical methods and techniques of conducting scientific research based on modern achievements of scientists. Forms the basic foundations of scientific culture and ethics, flexible perception of scientific texts, skills of effective application of acquired knowledge in planning and organizing research work, the ability to analyze and summarize research results.	GED
2	Ilyastanu	The purpose of the discipline is to develop a deep-thinking personality with high aesthetic taste, appreciating literature, art, traditions, culture and language of the Kazakh people through a deep and comprehensive study of the works of Ilyas Zhansugurov. Forms an understanding of the importance of the works of Ilyas Zhansugurov in the development of the Kazakh literary language; skills of intellectual and creative thinking, the ability to cherish the values of national and spiritual heritage.	GED
3	Fundamentals of Financial Literacy	The course "Fundamentals of Financial Literacy" is aimed at gaining knowledge and skills in the field of personal finance management. Also, as part of the course, students will learn how to use in practice all kinds of tools in the field of finance, save and increase savings, plan a budget competently, learn how to analyze financial information and navigate financial products to choose an adequate investment strategy	GED
4	Basics of Law and Anti-Corruption Culture	The aim is to familiarize students with the main branches and institutions of law, the basics of an anti-corruption culture, as well as the laws of the emergence, development and functioning of the state and law. The course forms the skills of an anti-corruption culture and a high level of theoretical knowledge about the main functions of law in the state and society, its impact on the development of law-based state, civil society.	GED
5	Ecology and Life Safety Basics	Purpose – to form knowledge on the basics of ecology and life safety, allowing to analyze environmental processes, assess the socio-ecological consequences of anthropogenic activities, methods and technologies of protection in emergency situations. Develops skills to assess the impact of environmental factors on human health; predict environmental processes for planning and implementing measures to improve life safety; make decisions in adverse environmental and emergency situations, taking into account the possible consequences of accidents, catastrophes, natural disasters.	GED
6	Economics and Entrepreneurship	The purpose is to familiarize students with the economic problems of modern society, the formation of economic thinking and gaining knowledge in the field of theoretical foundations and practical skills in the field of entrepreneurship. It is focused on the formation of students' comprehensive understanding of the laws of the functioning of the economy, obtaining business education aimed at acquiring applied competencies in various fields of entrepreneurial activity, reveals the features of creating and successfully running their own business.	GED
7	Fundamentals of Artificial Intelligence	The discipline is aimed at studying the basic concepts, methods and algorithms that underlie the creation and application of artificial intelligence. As part of this course, students will learn the theoretical foundations of machine learning, neural networks, natural language processing algorithms, and computer vision. They will also get acquainted with the ethical, social and legal aspects of the application of artificial intelligence in various areas of life.	BD
8	Human and Animal Physiology	Pre-service teachers build their understanding of the laws of functioning of the human body and animals in interaction with the environment. They are able to analyze information about the relationship of regulatory systems and the mechanisms that support homeostasis of the internal environment. Pre-service teachers who demonstrate competence can: compare the main physiological processes occurring in humans and animals; understand the regulatory mechanisms of homeostasis in humans and animals; analyze theoretical knowledge about the functions of body systems; apply basic methods of experimental physiological research; determine the causes of physiological shifts in the main parameters of body's activity under various environmental factors; evaluate the functional state of various body systems; apply physiological knowledge in life, including as a prevention of various diseases; organize educational research activities of students.	BD

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9	Assessment and Development	Pre-service teachers have a thorough understanding of the meaning of assessment in learning process and are able to provide constructive assessment in ethical manner in different phases of learning processes and engage learners in assessment. Pre-service teachers identify, differentiate, and use different assessment technologies, principles, stages, and assessment tools in their own field of expertise (including formative and summative assessment and self-and peer- assessment, etc). They can critically evaluate and analyze their understanding and practices concerning assessment and develop them further. Pre-service teachers who demonstrate competence can: use and apply a variety of methods and tools of assessment and feedback (formative and summative assessment); apply pedagogical principles in defining and recognizing competence levels of learners; understand the importance and support the development of students' self- and peer-assessment skills.	BD	
10	Age and Physiological Features of the Development of Children	Pre-service teachers are familiar with the formation of psyche, its functioning, and the patterns of development. Pre-service teachers can observe the development of their students, and accordingly, plan and implement age-appropriate learning processes considering individual needs of students. Pre-service teachers act creatively and appropriately in different situations and support learning and well-being of the learners. Pre-service teachers who demonstrate competence can: recognize the individual starting points of different students, their learning potential and specific support needs; consider the individual needs of their students for specific support, guidance, teaching and assessment; introduce various methodological solutions for inclusion and for providing specific support.	BD	
11	Latin in Biology	Studies the basic concepts of the theory and practice of speech communication, the development of communication skills and speech skills when reading scientific texts in the specialty; read and write Latin and Latinized Greek biological terms, promote the conscious use of future specialists of the international scientific biological Latin-Greek terminology.	BD	
12	Teaching Methods and Technologies Biology	Future biology teachers have a comprehensive understanding of biology teaching strategies and methodologies and can apply them in planning, teaching and assessment in innovative ways that are appropriate to specific pedagogical situations, school conditions and students' capabilities. Future biology teachers are able to create appropriate inclusive, physical and online learning environments at different stages of the educational process. Future biology teachers understand and can apply copyright and data protection rules when planning their teaching materials. Future biology teachers have the necessary knowledge of didactics, biology teaching technologies and methods of motivating students, being able to provide the necessary pedagogical support to students.	BD	
13	Educational Science and Key Theories of Learning	Pre-service teachers explore the basics of educational science such as the conceptions of man leading to various learning theories and pedagogical models. Based on their understanding of the theoretical concepts, pre-service teachers are able to make appropriate pedagogical choices for various learning situations. Pre-service teachers who demonstrate competence can: distinguish between concepts of human and their importance for understanding learning and the design of an educational process; differentiate between learning theories and their importance for understanding learning and the design of an educational process; apply learning theories and pedagogical models suitable for versatile learning processes.	BD	

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14	Psychology in Education and Concepts of Interaction and Communication	Pre-service teachers are familiar with the modern psychological theories and models, as well as personality functioning and individual properties. They can apply the knowledge in their teaching in diverse educational contexts. Pre-service teachers support positive development of learners by fostering dialogue, interaction, and communication in the educational process. They are able to communicate, interact, and collaborate with pupils' families as well as in various other partnership networks and create new relationships suitable for the development of their own pedagogical activity. Pre-service teachers who demonstrate competence can: understand the basic concepts and terms of educational psychology, and the main practical applications of psychological knowledge; understand the patterns, facts, and phenomena of cognitive and personal development of a person in the processes of education and upbringing; apply an integrated approach to design, implementation, evaluation, and development of educational environments; understand the concept of continuous learning as a part of the process of cognitive and personal development of a person. apply basic communication and interaction concepts and theories at the individual, community, and network levels; select the methods of communication and interaction that are most appropriate to facilitate learning in various forms (offline, online, blended, hybrid); recognize the patterns of group dynamics and act in ways that promote community development and well-being.	BD
15	Structure and Functions of Animals 1	Pre-service teachers investigate the laws of the animal world development from the simplest unicellular forms to highly organized taxa (arthropods, mollusks, arthropods). They examine the features of morphophysiological organizations, phylogeny, embryogenesis, physiology, and reproduction. They also research their geographical distribution, the role in ecosystems and the practical significance of the main types and classes of invertebrates, as well as the importance of biodiversity conservation as a leading factor in ecosystem sustainability. During the course, pre-service teachers build their understanding of the importance of zoology in the formation of a scientific worldview. Pre-service teachers who demonstrate competence can: describe anatomical, morphological, physiological, ecological features of invertebrates using special terminology; identify primitive and progressive features of invertebrate structure based on comparative analysis; determine the taxonomic affiliation and classify invertebrates; conduct surveillance of biological objects; carry out cameral processing of zoological material, to produce micro- and macro-preparations of invertebrates; mount systematic and biological collections; apply the acquired knowledge and skills during the experiment, organization and planning of educational activities of students; participate in discussions and negotiations about the scientific problems of the evolution of the animal kingdom; describe the structure and role of invertebrates in ecosystems in written and oral form; analyze, generalize and systematize scientific information in the field of invertebrate zoology; sketch and design the results of their work; Substantiate phylogenetic relationships between organisms.	BD



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16 Structure and Functions of aAnimals 2

Pre-service teachers investigate modern information about the systematics of vertebrates – their diversity, characteristics of organization, lifestyle, biology, ecology, phylogeny and fauna of vertebrates of Kazakhstan, as well as the role in ecosystems, theoretical and practical significance of the main taxonomic groups of vertebrates in nature and human life. They understand the principles of conservation of biological diversity and nature conservation. Pre-service teachers plan and conduct monitoring studies to identify the causes of changes in the number of vertebrates and the influence of various factors (food supply, reproduction, competition, migration, etc.). Pre-service teachers who demonstrate competence can: describe anatomical, morphological, physiological, ecological features of vertebrates using special terminology; identify primitive and progressive features of vertebrate structure based on comparative analysis; determine the taxonomic affiliation and classify vertebrates; carry out cameral processing of zoological material, work with collectible materials; apply the acquired knowledge and skills during the experiment, organization and planning of educational activities of schoolchildren; use modern educational technologies in various areas of their professional activities work with light microscopes, sketching and formatting the results of work; design the conduct of theoretical and experimental research, recommendations for the design of the results of scientific work; collect field materials (collections, fixation of biomaterial, etc.), statistical processing and interpretation of research data; analyze scientific materials on zoology and mathematical processing of the results of field and experimental studies; synthesize information, summarizing the results of all types of its analysis; formulate a reasoned and detailed conclusion on the research issue; Evaluate the strengths and weaknesses of the study, prove the truth or falsity of working hypotheses; document reliable sources of the information used with links to sources, following the established (selected) citation system (Arastil or others.); prepare a report on the results of the study, an appendix to the report and an analytical report containing information, conclusions and recommendations; use scientific vocabulary and scientific constructions of the natural-technical profile, professional and electronic dictionary of basic biological terms, writing and presentation of articles, messages and reports related to the scientific interests of students (scientific report, message, theses, poster report, abstract, abstract).

BD

17 Research, Development, and Innovation

To stay up-to-date and be able to continuously develop themselves and their work, pre-service teachers acquire new research-based knowledge and conduct practice-based research in an ethical manner in various networks concerning the development of education and teacher profession, innovative approaches to learning, as well as learning and guidance of students. Pre-service teachers adopt development-oriented mindset and are able to develop, update and apply innovative teaching approaches and technologies in the context of ongoing changes in society and the educational environment. Pre-service teachers design a small-scale research project to familiarize themselves with research-based development of their work as teachers. They identify their research topic/questions, conduct the literature review and design the methodology for the data collection and analysis, including ethical aspects of research. After the course, pre-service teachers are able to develop and update their pedagogical activities based on ethically conducted research and development and carry out or participate in research projects. They are also able to present their research and development results using various professional forms and channels. Pre-service teachers who demonstrate competence can: evaluate their own professional activities and work environment to find areas for improvement; apply a research-based approach to their professional activities and carry out independent research work; consider and apply ethical aspects of research procedures; apply critical thinking in data collection and utilization for the development of initial teacher education; participate in scientific design research and / or develop cooperation between universities and stakeholders; document their own research activities and present the results using various forms of communication

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18	Inclusive Educational Environment	Pre-service teachers have the ability to consider the diversity of learners and identify their individual needs in the learning / teaching process. Pre-service teachers support students’ learning and inclusion in the educational process by using suitable ICT, teaching and assistive technologies. Pre-service teachers maintain students’ well-being from psychological and ethical perspective in collaboration with the community (teachers, students, parents/guardians) considering the context of students’ life and learning. Pre-service teachers who demonstrate competence can: identify the individual educational needs that affect participation and learning in a diverse group of students; use ICT and assistive technologies to support students’ learning and inclusion in the educational process. teach values and attitudes beneficial to collaboration and inclusivity; support collaboration in the community (teachers, students, parents/guardians).	BD
19	Molecular Biology	Pre-service teacher analyze the molecular organization of viruses, the structure, properties and functions of biopolymers, the molecular organization of the genome of prokaryotes and eukaryotes, the structure of pro- and eukaryotic genes, and the mechanisms of their implementation using modern and classical research methods. Pre-service teachers form an understanding of the mechanisms of storage, reproduction, transmission, and realization of genetic information at the level of biomolecules. Pre-service teachers investigate the molecular basis of genetic recombination, the structure, processing and functions of various types of RNA, and protein-nucleic interactions. They also examine the molecular mechanisms of cell cycle regulation, carcinogenesis and programmed cell death, as well as basic principles of application of modern molecular genetic methods and technologies in science and medicine. Pre-service teachers who demonstrate competence can: distinguish the features of the structures, properties and functions of biopolymers; put into practice modern molecular genetic methods and technologies of laboratory research at the molecular level; identify the mechanisms of gene expression, ways of regulating their action, replication, recombination and DNA repair; solve problems on the molecular mechanisms of inheritance and variability and simulate the processes of matrix synthesis; use special reference material, and electronic genetic databases; understand the structural and functional organization of hereditary material at the gene, chromosomal and genomic levels; analyze the relationship between the structure of genes and the mechanisms of their implementation; determine the relationship of life-defining processes occurring in the cell at the molecular level; evaluate the application of molecular genetic methods and technologies in science and medicine; use modern and classical methods for conducting scientific research.	BD
20	Teaching Planning and Individualization of Learning	Pre-service teachers are familiar with the curriculum in their area of teaching and the guiding pedagogical principles and cross-cutting development themes of a specific level of education, such as entrepreneurship and sustainable development. Pre-service teachers possess the necessary skills of individualization of teaching, considering the diversity of students and their inclusion to the learning process, as well as the use of teaching technologies, based on pedagogical and independent research. Pre-service teachers who demonstrate competence can, understand the main principles and requirements of the curriculum in their area of teaching and apply them in planning and conducting educational activities; identify factors and conditions that affect students’ learning; apply in practice the principles of inclusion as well as individualized teaching and guidance (adapting curricula, developing differentiated lessons) by considering the needs of the students and support the development of their personality and self-esteem, including career guidance.	BD



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21	Diversity of Plant Organisms	Pre-service teachers classify plants using knowledge about the main features, characteristics, spatial distribution, ecology, and diversity. They are able to describe their life forms, introduction, and phylogeny of life, as well as investigate the centers of origin and the practical significance of plant organisms. While studying the course, pre-service teachers acquire skills in working with plant determinants, herbarium, and collection materials. Pre-service teachers who demonstrate competence can: carry out a complete morphological description of plants, considering the specifics of the structural organization of representatives of different departments; determine the taxonomic position of higher plants based on the analysis of their anatomical and morphological features; explain the role of plant biological diversity in ecosystems; make a characteristic of the main departments of higher plants, present modern views on the evolution and phylogeny of the main systematic groups; conduct biological excursions to nature with pre-service teachers in different biotopes and at different times of the year; select literature on a specific topic, document information sources using the selected citation style; work with plant determinants; distinguish by the characteristics of families, genera, plant species, name them in accordance with the international nomenclature; plan the scientific and research activities of schoolchildren; produce visual aids (herbariums, wet preparations, collections); apply knowledge of plant biology in the formation of stable plant groupings created in artificial conditions; plan, organize and conduct experiments in the educational activities of students; process and formalize the results of experiments and observations; analyze and evaluate the results of laboratory and field studies.	BD
22	Structure and Functions of Plant Organisms	The purpose of this course is to improve the following areas of subject competence: Competence area for Cognitive skills development (1) , Competence area for Development of practical and research skills (6) , Competence area for Interdisciplinary interactions development (9) Pre-service teachers build fundamental knowledge in the field of botany, anatomy, and morphology of plants, and are able to use correct terminology. They develop their skills in working with optical devices, herbarium and fixed material, and understand the technique of preparing micro-preparations. Pre-service teachers who demonstrate competence can: recognize the structural features of plant cells and tissues; compare and describe anatomical and morphological features of vegetative and generative organs of plants; show the complex nature of the interaction between plants and other representatives of the organic world in the biogeocenosis when creating a whole and stable structure; understand the methods of reproduction and cycles of reproduction of plants; reveal the role of plants in nature and human life; generalize the acquired knowledge and skills about the structure of plants, their variability in the process of adaptation to external conditions; discuss the plant world as the most important component of the biosphere; conduct research in the organization and planning of educational activities of students.	BD
23	Plant Physiology	Pre-service teachers explore the structure, functions, physiology, and biochemistry of the plant cell. They also examine the features of the processes of photosynthesis, respiration, water metabolism, mineral nutrition, metabolism and transport of organic substances in plants, as well as plant growth and development. Pre-service teachers investigate the changes of physiological processes in various environmental conditions caused by abiotic, biotic, and anthropogenic influences. Pre-service teachers who demonstrate competence can: understand the chemistry and organization of photosynthesis, mineral nutrition of plants, water metabolism, mechanisms of transport of metabolites in the plant; distinguish various natural phenomena from the point of view of plant physiology; determine the main stages of plant ontogenesis; evaluate the resistance of plants and cells to abiotic and biotic stressors; conduct observations and experimental studies; simulate physiological processes in laboratory and field conditions, analyze and explain the results obtained; apply theoretical knowledge of physiological processes in practice.	BD

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24	Pedagogical Research	This course provides pre-service teachers with a theoretical foundation on pedagogical research. Pre-service teachers possess skills to seek and critically select theoretical knowledge from various reliable sources, utilize research findings in the development their pedagogical thinking and practice, and adopt willingness to promote research-based learning and education as well as their own continuing development and professional growth. Pre-service teachers who demonstrate competence can: recognize the nature of pedagogy and its basic terminology; identify the central areas of research in pedagogy and understand the difference between everyday thinking and scientific knowledge; follow the changes in the field of education and consider how they influence own work as a teacher.	BD
25	Human Anatomy	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. Pre-service teachers who demonstrate competence can: understand the general laws of the structure of the human body, the structural and functional relationships of parts of the body; use conceptual apparatus and specialized terminology; determine the location and relative position of organs in the body; analyze information about the topography, structure of the human body, its systems, organs and tissues and their main functions; describe morphological changes in the studied macroscopic preparations; design and conduct simple experiments to study the work of individual organs and organ systems at school; observe ethical standards when performing experiments.	BD
26	Human Biology	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. Pre-service teachers who demonstrate competence can: describe the features of topography and patterns of the structure of the human body at the micro and macroscopic levels; understand the relationship of the structure of organs with the functions performed; systematize knowledge about the structure and function of organs and systems of the human body, their interrelation and mechanisms of regulation; 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; evaluate the structural and functional parameters of human body development; design and conduct experiments to study the work of organs and organ systems; apply anatomical and physiological knowledge in life, including as a prevention of various diseases.	BD
27	Flora and Fauna of the World	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. Pre-service teachers who demonstrate competence can: describe the main faunal complexes: tundra, taiga, forest, steppe, semi-desert, desert, pantropical, paleotropical, and faunal zoning; separate types of fauna: mainland, island, marine; identify zoogeographic regions and kingdoms and floristic complexes; characterize the endangered species of flora and fauna and to focus on the scale and importance of endangered flora and fauna. train in planning and organizing activities aimed at protecting existing species, including endangered and endemic plant and animal species.	BD



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28	Biogeocenology	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. Pre-service teachers who demonstrate competence can: understand the structure and methodology of biogeocenosis processes; characterize the basic principles of the organization and functioning of biogeocenoses; analyze the structural and functional organizations of biogeocenotic systems of various types; evaluate production processes and efficiency of energy flow in food chains of biogeocenoses; analyze the role of components of biogeocenoses as elementary environment-forming structural and functional blocks of the biosphere; 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.	BD
29	STEM education in biology	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. Pre-service teachers who demonstrate competence can: · 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; · design STEM learning, considering the diversity of students; · apply various methods and technologies of pedagogical diagnostics used in evaluation of the quality of results and content of the educational process; · perform consistent, planned actions to improve the practice of teaching and STEM learning; · develop their research skills, direct them to improve the quality of education and their functional literacy; · develop a plan for the implementation of research on the practice of teaching STEM learning; · conduct systematic evaluation of the results during STEM training; · evaluate the strengths and weaknesses of STEM education.	BD
30	Digital technologies in biology	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. Pre-service teachers who demonstrate competence can: · use various forms of interactive electronic educational content; · use IT technologies in the organization of project activities; · structure, integrate and present information in teaching activities, considering life and educational context of students; · plan effective teaching using IT technologies; · develop digital educational resources on biology.	BD
31	Scientific Foundations of Natural Science	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. Pre-service teachers who demonstrate competence can: · understand the natural science method of cognition, the main ideas and achievements of natural science, determining influence on the development of technology; · navigate modern scientific concepts and information of natural science; · understand the applied significance of the most important achievements in the field of natural sciences; · critically analyze the phenomena, perception and interpretation of natural science; · apply natural science knowledge in their professional activities.	BD

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32	Bioresources of Kazakhstan	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. 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. Pre-service teachers who demonstrate competence can: systematize the position of the main types of biological resources; list biological resources on the territory of the Republic of Kazakhstan; specify categories and criteria of endangered species of biological resources; determine the importance of the environment in increasing the productivity of Kazakhstan's bioresources; present modern conceptual approaches to the problem of conservation of biological diversity of Kazakhstan; name the main ways to increase the productivity of biological resources; teach the assessment of the role of specially protected natural territories of the Republic of Kazakhstan in preserving and increasing the productivity of biodiversity.	BD
33	Applied Biology with the Basics of Soil Science	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 who demonstrate competence can: · classify soil by mechanical composition; · analyze the relationship of soil science with biological, chemical and other sciences; · conduct safe experiments to study the influence of various factors on soil formation, the influence of living organisms on soil formation; · identify morphological, biological and economic features of cultivated plants; · assess the soil-ecological and bioecological condition of the territory of Kazakhstan; · practice the skills of cultivating soil microorganisms, microscoping preparations of cells of living organisms; · design experiments to determine the composition and properties of the soil (physical, physico-mechanical, rheological); · investigate the use of organic and mineral fertilizers in crop production; · plan and carry out projects: formulation of hypotheses and conclusions, assessment of strengths and weaknesses, preparation of a report; · collect, process and interpret research data on design and laboratory work; · use scientific language, subject terminology and conventions appropriately.	BD



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34	Microbiology with the Basics of Biotechnology	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. Pre-service teachers who demonstrate competence can: · compare morpho-physiology, biochemistry, genetics of microorganisms with the use of modern molecular genetic methods; · use disinfection and sterilization methods when working with biotechnological objects, and preparing nutrient media and coloring by using the Gram method to identify microorganisms; · check the parameters of growth and development of microbial cultures, and correctly identify microorganisms by cultural and morphological characteristics; · evaluate the use of living organisms in biotechnological production: production of microbial protein, enzyme preparation, biogas, bioethanol; · practice the skills of cultivation and cloning of living organisms, experimentation of microclonal reproduction, microscopy of preparations of cells of living organisms; · 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; · 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; · design experiments for obtaining a cumulative and pure culture of microorganisms, obtaining callus tissues by microclonal reproduction; · conduct a safe experiment to study the microflora of water, air, and dairy products; · organize small projects: formulation of hypotheses and conclusions, planning, assessment of strengths and weaknesses, preparation of a report; · collect, process and interpret research data on design and laboratory work; · use scientific language, subject terminology and conventions appropriately.	BD
35	Ecology of Plants, Animals and Humans	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 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. Pre-service teachers who demonstrate competence can: 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; understand the importance of the activity of living organisms in the circulation of ecosystem substances in human life and economy; identify essential features of biological objects and processes and compare them; identify the variability of living organisms under anthropogenic influences and environmental factors; teach safe research to study the adaptations of organisms to the environment and explain their meanings.	BD
36	Design of STEM education	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. Pre-service teachers who demonstrate competence can: · link science and STEM subjects with real life challenges or situations; · identify practice-oriented problem situations; · build project/phenomena-based learning processes in which students make observations, identify problems and find solutions independently and with their peers; · conduct experimental research with mathematical and IT modeling; · design STEM lessons for students' academic and extracurricular activities in an inclusive environment.	BD



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37	Conceptual Biology Training	During the course, pre-service teachers analyze the methodology of implementing new interdisciplinary approach in school's biology education. Pre-service teachers systematize the basic learning material and adapt it to the biology course at school, considering the age and individual characteristics of students. Pre-service teachers plan, conduct, and analyze lessons, and use various learning technologies, and digital educational resources. They form a holistic perception of the world (not fragmented) integrating knowledge from various academic disciplines. Pre-service teachers who demonstrate competence can: · analyze knowledge from specific scientific disciplines in biology; · identify patterns in natural phenomena and formulate meaningful relationships between them; · make connections between biology, humanities and other sciences; · use conceptual learning tools.	PD
38	Content-language integrated learning (CLIL) in biology	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. Pre-service teachers who demonstrate competence can: · identify language problems of students; · use communicative and interactive tasks that contribute to a better understanding of biology studied in a foreign language; · apply error correction strategies that encourage the correct use of a spoken foreign language; · use activities in the classroom that contribute to both studying biology and developing foreign language skills; · use authentic educational material.	PD
39	Academic letter	During the course, pre-service teachers develop their academic writing skills, registration of all types of written works, in accordance with existing requirements. They become proficient in communication and teamwork technologies, as well as communication strategies. They also investigate the features of academic writing, ways of correct writing and execution various types of written work in accordance with the principles of academic integrity. Pre-service teachers demonstrating competence can: · prepare and execute the submitted works in accordance with the existing requirements: a scientific essay, an experimental research report, a description and results of project activities, etc. · document the sources of information on one of the citation systems to comply with intellectual property rights; · work with databases of scientific publications, bibliographic sources, make references to the sources used.	PD
40	Theoretical Foundations of Inorganic Chemistry	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. Pre-service teachers who demonstrate competence can: 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; classify reactions occurring in aqueous solutions and offer optimal conditions for conducting reversible reactions; compare the thermodynamic, and redox activity of substances; apply the academic language of chemical concepts and terms; formulate the basic laws of chemistry with reasoned judgments; 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; apply the acquired theoretical knowledge and skills with general scientific and special disciplines in their teaching activities; teach conducting experiments using elementary methods of chemical research of substances and compounds for the formation of research skills; collect, process and interpret research data.	PD

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41	Research and project activities in biological education	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. Pre-service teachers who demonstrate competence can: · set goals and define tasks in the organization of scientific and project research; · carry out information-analytical and information-bibliographic work with the involvement of modern information technologies; · creatively find solutions for new problems and situations; · mentor students during research project; · competently present the results of research and project activities.		PD
42	Methodology of biological research	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. Pre-service teachers who demonstrate competence can: · use methods of conducting biological research in their professional and research activities; · work with scientific and laboratory equipment, use them during research; · 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; · organize and conduct experimental work with biological objects, processing and presenting the results of this work; · teach research methods in various types of learning environments.		PD
43	Modern approaches to the organization of a biological experiment	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. Pre-service teachers who demonstrate competence can: · apply modern approaches to the organization of biological experiments and apply them in their professional and research activities; · work with scientific and laboratory equipment, use them during biological experiments; · 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; · organize and conduct experimental work with biological objects, processing and presenting the results of this work.		PD

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44	Bioorganic Chemistry	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. Pre-service teachers who demonstrate competence can: · classify organic compounds by nomenclature when composing names and writing formulas of biologically active substances; · conduct experiments to study the chemical structure and properties of biologically important substances; · demonstrate the skills of conducting a biological experiment using chemical, physical, physico-chemical, mathematical and biological methods; · evaluate the importance of biopolymers, enzymes, hormones, vitamins, signaling substances, antibiotics, and others in the vital activity of living organisms; · conduct small projects: formulation of hypotheses and conclusions, planning, assessment of strengths and weaknesses, preparation of a report; · collect, process and interpret research data on design and laboratory work; · use scientific language, subject terminology and conventions appropriately; · offer creative non-standard solutions to problems in the field of bioorganic chemistry; · apply the results of biological research for their professional development	PD
45	Biophysics and Bioinformatics	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. Pre-service teachers who demonstrate competence can: · describe the application of biomechanical processes in robotics and medicine; · analyze the physical foundations of the study of heart automatics using an electrocardiogram, the functioning of muscle tissue (electrophysiology); · evaluate the thermodynamic feature of biological systems and electrical processes in living organisms, problems of stability and evolution of biological systems; · investigate the effects of electromagnetic and sound waves on the organism of living beings; · simulate photobiological processes, ultrastructure of the cell and cell membrane, etc.; · explain how information is transferred from genes to proteins in living organisms; · describe the technology of the neurocomputer interface, the system of information exchange between the brain and the computer; · apply modern methods of obtaining, analyzing, storing, organizing and visualizing biological data; · evaluate the advantages and disadvantages of using computer systems and tools for solving biological problems; · 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; · perform BLAST-search, alignment of DNA and protein sequences; · critically interpret the results, visualize the protein and evaluate the differences created by sequence variations; · create computer modeling of the genome (gene mapping), and phylogenetic trees on databases of biodata.	PD



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46 Biochemistry

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). Pre-service teachers who demonstrate competence can: · understand the structure and functions of bioorganic substances in living organisms; · establish causal relationships between the metabolism in a living organism and the biochemical functions of cellular organelles; · draw conclusions on the relationship between the structures of bioorganic molecules and their function in living organisms; · determine the ways of transformation of nutrients; · compare the features of the course of biochemical reactions in the human body, animals and plants, such as the biosynthesis of vital compounds; · apply chemical knowledge and methods in their teaching activities; · 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); · conduct a safe experiment to investigate the chemical structure, properties and function of carbohydrates, fats, proteins and nucleic acids; · collect, process and interpret research data; · document reliable sources of information used following the established (selected) citation system (ARA style or others.); · evaluate the strengths and weaknesses of the study, such as the limitations of data and the sources of errors and inaccuracies of the experiment; · formulate a reasoned and detailed conclusion on the research topic and make a structured and clear report on all stages of the study; · use scientific language, subject terminology and conventions appropriately and correctly.

PD

47 Genetics and the Basis of Breeding

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. Pre-service teachers who demonstrate competence can: analyze the types of inheritance of traits; use genetic terms and conventions appropriately, contributing to an understanding of the nature, process, and results of the study; apply in practice methods of hybridological, cytological and population analysis to solve genetic problems for all types of inheritance; design and conduct genetic experiments; process and analyze the measurement results of quantitative features; 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; distinguish the causes and consequences of mutations for the vital activity of living organisms and the evolution of life on the planet; combine the concepts of genetic processes in plants and animals; perform calculations to determine the percentage of crossing between genes and design genetic maps for genes; determine the genotypic structure of populations and the frequency of alleles and genotypes by phenotypic frequencies in populations; distinguish the types of heredity (nuclear – chromosomal and extra–nuclear – cytoplasmic) and their causes; determine the influence of factors on the type of variability; make schemes of crosses according to the form accepted in genetics; draw conclusions about the importance of induced mutations in the selection of microorganisms, plants and animals; apply the knowledge and methods of genetics to solve the problems of breeding organisms; model and design an intraspecific crossing experiment.

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48	Genetic Research Technology	The course is aimed at mastering modern methods of molecular genetics, bioengineering and bioinformatics. It covers work with DNA, genome editing (CRISPR/Cas), molecular diagnostics, and data analysis for applications in molecular genetics, genetic engineering, agrobiotechnology, and medicine. Future teachers who demonstrate competence can: · identify and implement the priorities of their own activities and ways to improve them based on self-assessment; - conduct laboratory research using modern biomedical technologies; - perform fundamental and applied scientific research aimed at developing and improving diagnostic methods for pathological processes and technologies; - use knowledge of genomics and bioinformatics to explain the most important biochemical processes occurring in living organisms, both normally and when pathologies occur; navigate issues related to the analysis of nucleic acids and proteins. Possess: - modern methods of processing and interpreting genetic information in scientific research.	PD
49	General Chemistry	Considers sections: Atomic-molecular doctrine. Basic chemical concepts and laws. Classification and nomenclature of inorganic compounds. Atomic structure. Chemical bonds. Energy and direction of chemical processes. The rate of chemical reactions. Chemical equilibrium. Solutions. Theory of electrolytic dissociation. Oxidation-reduction reactions. Electrode process.	PD
50	Application of Artificial Intelligence in Biometrics	This course explores the integration of machine learning and computer vision algorithms for automatic identification and authentication, along with physiological and behavioral characteristics (fingerprints, face, voice, gait) for automated and highly accurate identification. The course combines computer vision, big data analysis, and information security to create highly accurate intelligent systems. Pre-service teachers who demonstrate competence can: · use the knowledge of mathematical statistics, the principle and various methods of analysis in professional activity; · apply statistical processing methods in practice; · identify trends in the patterns of the studied objects; · perform correct statistical processing of experimental data; · organize experimental work and analyze the observations and the results of the experiments; · work with biological objects in natural and laboratory conditions; · make reports, reviews, analytical maps and explanatory notes; · present and critically analyze the information received to present the results of field and laboratory biological studies.	PD
51	Fundamentals of Applied Behavior Analysis	Course goal — to develop the ability, grounded in Applied Behavior Analysis (ABA), to critically analyze data-based functions of behavior; design and implement individualized interventions in inclusive educational settings; and evaluate their effectiveness, safety, and ethical soundness. Develops skills to: operationalize behavior; collect and analyze data (incl. ABC); identify behavioral functions; design and apply behavior support plans; teach functionally equivalent alternative behavior; manage crisis situations; and assess outcomes.	PD
52	Environmental Chemistry	During the course, pre-service teachers build their knowledge about the basic principles of environmental chemistry on a local and global scale. Pre-service teachers give scientific substantiations of the processes occurring in the environment using knowledge in the field of physics, chemistry, Earth sciences and biology. They also apply methods of analysis of physico-chemical processes involving pollutants in the atmosphere, hydrosphere, and soil. During the course, pre-service teachers develop their civic position to realize the responsibility of their decisions and actions. Pre-service teachers demonstrating competence can: form an understanding of the basic principles of environmental chemistry; form their own moral and civic position for their decisions and actions; apply knowledge in the field of physics, chemistry, Earth sciences and biology for scientific substantiation of processes occurring in the environment; assess anthropogenic changes in environmental objects.	PD



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53	Individual Development of Living Organisms	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. Pre-service teachers who demonstrate competence can: describe the patterns of reproduction and individual development of organisms; 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; describe the morphology of gametes; spermatogenesis, fertilization; crushing, blastulation, gastrulation, neurulation; compare features stages of ontogenesis and phylogeny; use specialized terminology; evaluate the features of the development of biological systems embryonic development of the digestive system, respiratory organs, skeleton, muscles, circulatory and genitourinary systems; describe electrical processes in living organisms, photobiological processes, problems of stability and evolution of biological systems; use in practice the acquired knowledge about the mechanisms of morphophysiological differentiation of the organism in ontogenesis; apply the acquired knowledge to solve scientific and practical problems, and to work with embryonic objects.	PD
54	Comparative Anatomy and Evolution of Living Organisms	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 Pre-service teachers who demonstrate competence can: classify organs by their origin in embryogenesis; compare the features of the structure of organs in connection with their functions performed; characterize the main stages of the evolution of organ systems; distinguish aromorphoses, idioadaptation and degeneration in the stages of evolution; understand the adaptive nature of the evolution of organ systems; identify the main directions of the evolution of living organisms; apply knowledge on the current state of evolutionary theory in the educational process; understand the content of the main provisions of the evolutionary theory; analyze scientific data to prove the provisions of the evolutionary doctrine; integrate the acquired knowledge on comparative anatomy and evolution of living organisms; use methods of comparative analysis of various groups of living organisms, considering their systematic position, phylogenetic relationships, ecology and biology; analyze the anatomical and morphological structure of organs, considering their functions; systematize research results, evaluate their reliability and significance; plan and conduct experiments, and process and analyze research results.	PD
55	Patterns of Inheritance and Variability	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. Pre-service teachers who demonstrate competence can: distinguish inheritance patterns in intraspecific and distant hybridization; solve genetic problems of inheritance of traits and interpret the results obtained; explain the role of environmental and hereditary factors in variability; use modern research methods and information and communication technologies to model crosses; analyze the types of inheritance of breeding traits, types of genetic variability arising under the influence of mutagenic factors; 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; solve genetic problems of inheritance of traits and interpret the results obtained.	PD

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56	Cytology, Histology and Embryology	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. Pre-service teachers who demonstrate competence can: compare the structure of cells of living organisms, the functions of organoids; describe morphological features of organoids, subcellular structures, types and morphology of tissues; compare methods of reproduction of living organisms and embryology; put into practice the methods of cytological and histological studies; explain the types and mechanisms of cell division.	PD
57	Evolutionary Teaching	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. Pre-service teachers who demonstrate competence can: describe the process and significance of the evolutionary process in wildlife; 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; substantiate the role of the evolutionary idea in the biological worldview; use the skills of interpreting changes occurring in ecosystems; document, correctly formalize links to the used sources of information using the selected citation style; argue the modern evolutionary approach to the study of biological objects; apply the skills of scientific explanation of natural processes in professional activity.	PD
58	Application of Artificial Intelligence in Experimental Biology	This course focuses on the use of machine learning and computer vision algorithms for the automation, analysis, and modeling of biological experiments, as well as for analyzing large sets of biological data. It covers protein structure prediction, genomic data processing and analysis, protein structure prediction, microscopic image recognition, modeling of cellular processes, and processing of laboratory experiment results using neural networks. Pre-service teachers demonstrating competence can: apply research results in pedagogical and professional activities; understand and solve problems in new or unfamiliar situations in contexts and within broader (or interdisciplinary) areas related to the field of study; adapt modern science achievements to educational process; collect, process, and interpret research data; formalize results of research work into various forms of scientific production; use quantity and quality methods for scientific research arrange discussion with evidence from theoretical and experimental research.	PD