Alikhan Bokeikhan University

Faculty of Information and Technology and Economics

Department of Applied Biology

6B01509 - CHEMISTRY- BIOLOGY

THE CATALOGUE OF ELECTIVE DISCIPLINES

Year of entrance - 2022

(DURATION OF STUDIES: 2 YEARS. FORM OF STUDY: FULL - TIME (SH))

Semey, 2022 y.

Reviewed and approved by the Educational and Methodological Council of the Faculty of Information Technology and Economics

Protocol No. 5 of 20.05.2022

Reviewed and approved at the meeting of the Educational and Methodological Council of the University

Protocol No. 5 of 25.05.2022

Awarded degree: Bachelor of Education in the educational program 6B01509 "Chemistry-Biology"

№	Name of discipline or module	Number of credits	Pre requi-sites	Post requi-sites	Short description of the content, the aims of education, expected results
Basic disciplines					
Elective courses (EC)-					
1	**Cytology and histology**	3	School biology course	Anatomy and morphology of plants	**Aim.** To form students ' ideas about the methods of research of cells and tissues of plants and animals, cell organoids and their structure, classification, structure and function of tissues. **Content.** Fundamentals of cytology and histology, methods of cell research, chemical structure of cells, features of the structure of prokaryotic and eukaryotic cells: cytoplasm, plasma membrane, cytoplasmic organoids, the structure of the cell nucleus, as well as protein biosynthesis, epithelial and connective tissues, muscle tissues, nervous system tissues, histogenesis and methods of preparing fixed preparations of cells and tissues. **Expected results:** Be able to: use microscopes to examine cytological and histological preparations, independently work with drawings and images of cells and tissues; demonstrate knowledge and ability to compare structures, structure, components, functions, development, properties of various cells, tissues; apply theoretical knowledge and skills of using laboratory equipment to solve practical problems and in experimental studies; must master: the technique of preparation of cyto- and histological preparations; material on cell types and main types of tissues; know the following types of laboratory research: basic principles of cell theory; methods of cell and tissue research; structure and functions of cells and cell organoids; differentiation and mechanisms of cellular distribution; methods of studying the structure, classification of tissues in the body.
1	**Immunol-ogy**	3	School biology course	Final State Attestation	**Aim.** Familiarization of students with modern ideas about the structural organization and principles of functioning of the human immune system. **Content.** Immunology as a science. History of development of immunology. The significance of achievements of immunology. Theories of immunity. Formation of innate and acquired immunity. Nonspecific immunity. General organization and organs of immune system. General characteristics of specific (lymphocytic) immunity. Immunocytes. Molecular immunology. Cellular immunology. Immune response and cell interaction. Violations of immunity. Autoimmune processes and diseases. Mechanisms of autoimmune reactions. **Expected results:** Know: key concepts in immunology: antigen, antibody, receptors, cytokines, immunocompetent cells, immune response, immune pathology, mechanisms of autoimmune reactions; must be able to: understand the purpose and objectives, see the practical orientation of immunology, which is crucial for the diagnosis, prevention, treatment of infectious, allergic, immunodeficiency, autoimmune, tumor diseases; must possess: theoretical knowledge about mechanisms of formation of innate and acquired immunity in the human body.
2	**General and molecular genetics**	4	School biology course	Cell biotechnology	**Aim.** To give students an idea about genetics, its problems, the current state and the latest achievements, as well as to develop students ' genetic thinking. **Content.** The history of the development of genetics, the material foundations of heredity and variability, the structure and types of nucleic acids, the types of reproduction of organisms, mono -, di - and polyhybrid crossing, the laws of inheritance of traits, the basics of genetic analysis, the chromosomal theory of heredity, the types and causes of variability of organisms, the structure of the gene, the current state of problems of genetics. **Expected results:** To know: the subject and tasks of general and molecular genetics, the history of its development; the material foundations of heredity and variability, the structure and types of nucleic acids, reproduction of organisms, patterns of inheritance of traits, the basics of genetic analysis, chromosomal theory of heredity, types and

					causes of variability of organisms, the fine structure of the gene, the main molecular cellular mechanisms, the current state of the problems of genetics; be able to: conduct a bibliographic search for literary sources; solve genetic problems for crossing; conduct experiments on the study of heredity and variability; demonstrate knowledge and ability to compare structures, structure, components, functions, development, properties, inheritance and changes in the characteristics of various cells, tissues; have skills: building a second DNA chain, mRNA; determining the amino acid composition of proteins from DNA or mRNA; building a Pennet lattice to solve problems; using the hybridological method of studying the patterns of inheritance of traits; compiling pedigrees; making a forecast of the development of a hereditary disease in a carrier of a pathological gene or a forecast of the birth of a child with a hereditary pathology.
2	**Genetic foundations of plant breeding**	4	School biology course	Introduction to biotechnology	**Aim.** To form modern ideas about the theoretical foundations of plant breeding, the peculiarities of the organization of the plant genome, classical and modern methods of creating genetic diversity, evaluation and selection of breeding material. **Content.** Features of the plant genome. Basic methods of genomic analysis. Functioning of mitochondrial and plastid genomes. Mutational and modification variability in autopolyploids. Polyploid rows. Distant hybridization. Allopolyploidy and the emergence of cultivated plants. Methods of analysis of chromosome homology. Methods of obtaining aneuploids. Similar and homologous mutations. Chlorophilic mutations. Chromosomal and genetically engineered plant breeding. Opportunities and achievements of genetic engineering. **Expected results:** To know: the features of the plant genome, the main methods of genomic analysis, the functioning of mitochondrial and plastid genomes, mutational and modification variability in autopolyploids, polyploid series, distant hybridization, allopolyploidy and the emergence of cultivated plants, methods for analyzing chromosome homeology, Methods for obtaining aneuploids, similar and homologous mutations, chlorophyll mutations, features of chromosomal and genetically engineered plant breeding, opportunities and achievements of genetic engineering; be able to: navigate the modern scientific literature on genetics and plant breeding, analyze the types of inheritance of breeding traits, types of genetic variability arising under the influence of mutagenic factors; possess: skills of working with literature, including periodical scientific literature; skills and methods of research of biological objects; skills of describing plant karyotypes.
3	**Microbiology and virology**	5	School biology course	Room and garden floriculture	**Aim.** To acquaint students with the features of the structure, properties, classification and nomenclature of prokaryotes and microscopic eukaryotes. To show the General biological significance of achievements in the field of Microbiology and Virology, to highlight the role of microorganisms in the development of biotechnology, food industry, agriculture, metallurgy and other industries. **Content.** Microbiology as a science. Comparative characteristics of prokaryotes, eukaryotes, viruses: cellular organization, variety of types of nutrition and respiration, metabolic rate, reproduction energy, gene parasitism. Morphology, anatomy, growth and reproduction of bacteria. Systematics of microorganisms. Ecology of microorganisms. The relationship of microorganisms with plants, animals, and humans. Symbiotic relationships. Parasitism. Morphology, structure and chemical composition of viruses. Classification of viruses. **Expected results:** To know: the basic properties, structure, systematics, ecology of microorganisms; their classification, role in nature and human life; the kingdom of viruses, their use in the production of antiviral vaccines; biological features of microorganisms causing food spoilage; be able to: use literature in the field of microbiology and virology; demonstrate knowledge and ability to compare structures, structure, constituent components, functions, development, properties, inheritance and change of traits and use of various prokaryotic and eukaryotic cells; apply theoretical knowledge and skills of using measuring instruments, laboratory equipment, cytochemical, biochemical methods of studying various environmental objects to solve practical problems and in experimental studies; possess: methods that allow identifying non-permanent elements of microorganisms; isolation of pure cultures of microorganisms and study of their biochemical properties by methods of microbiological studies used to assess environmental objects

3	**Soil microbiology**	5	School biology course	Decorative gardening with the basics of landscape design	**Aim.** Formation of knowledge, skills and abilities in General, soil and agricultural Microbiology, understanding the role of soil microorganisms in agroecological processes. **Content**. History of development of soil microbiology. Main groups of bacteria and actinomycetes found in soils. Participation of soil microorganisms in transformation of substances and energy in biosphere and functioning of biogeocenoses. Soil-forming processes. Ecology and geography of soil microorganisms and issues of soil biodiagnostics. Types of biological connections in the world of soil organisms. Isolation and cultivation of soil microorganisms. **Expected results**: Know: morphology, systematics, physiology and ecology of microorganisms, the role of microorganisms in the transformations of various compounds and chemical elements in the soil; be able to: determine the biological activity of the soil and propose ways to regulate it, use bioindication, biotests; demonstrate knowledge and ability to compare structures, structure, components, functions, development, properties, inheritance and change of signs and use of various prokaryotic and eukaryotic cells; apply theoretical knowledge and skills of using measuring instruments, laboratory equipment, cytochemical, biochemical methods of studying various environmental objects to solve practical problems and in experimental research; possess a culture of thinking, capable of generalization, analysis, perception of information, setting goals and choosing ways to achieve it; ready to cooperate with colleagues, work in a team.
4	**Cell biotechnology**	5	General and molecular genetics	Final State Attestation	**Aim.** To equip the future biotechnologist with modern ideas about the most promising directions of development of cell biotechnology in the world, to show its relationship with achievements in the field of molecular biology, cell and molecular Biophysics, biochemistry, molecular genetics, Microbiology, molecular immunology and bioinformatics. **Content.** Brief history and stages of development of cell biotechnology. Theoretical foundations of cell biotechnology. Genomics, proteomics and bioinformatics. Objects of cell biotechnology. Cells and subcellular macromolecular structures and their use. Somatic hybridization. Cell biotechnology of microbiological systems. Application of cell biotechnology in eukaryotic systems. Cell biotechnology in medicine, agriculture and environmental protection. **Expected results:** Know about: the subject, tasks, history of development, objects, methods of cellular biotechnology, promising directions and trends of its development in the modern world, cellular biotechnology of microbiological systems, genetic engineering, achievements of cellular biotechnology, environmental aspects of biotechnology; be able to: critically analyze scientific experiments; demonstrate knowledge and ability to compare cells, tissues and extracellular structures; apply theoretical knowledge and skills of using laboratory equipment, cito- and biochemical methods of studying various environmental objects to solve practical problems and in experimental research; possess skills of working with specialized laboratory equipment to solve practical problems.
4	**Introduction to biotechnology**	5	Genetic foundations of plant breeding	Final State Attestation	**Aim.** To form a system of knowledge about the scientific and practical aspects of biotechnology, the main criteria for the selection of biological objects and modern methods of creating biological products. **Content.** Subject, goals, objectives and prospects of biotechnology development. Possibilities of its application in pharmacology and medicine, in nature protection and for economic purposes. New directions of biotechnology. Plant and animal objects of biotechnology as sources of biologically active substances. Microorganisms (bacteria and higher protists) as main objects of biotechnology in medicine, agriculture. The use of microorganisms in the mining industry. **Expected results**: Know about: the scientific foundations of biotechnology; the main directions of production of useful substances; the basics of engineering enzymology; methods and capabilities of genetic and cellular engineering; the basics of technological bioenergy and biological processing of raw materials; the use of biotechnology as an alternative in agriculture; the basics of environmental biotechnology; be able to: navigate in modern directions and methods of biotechnology; use knowledge about biotechnology in study of special disciplines; apply the acquired knowledge in the rational use of natural resources and environmental protection; use the obtained data when writing abstracts; possess applied aspects of biology.

5	**Human and animal anatomy and physiology**	5	School biology course	Final State Attestation	**Aim.** To equip the future specialist with knowledge about the anatomical structure and patterns of life processes occurring in human and animal organisms. **Content.** Human and animal anatomy and physiology as interrelated sciences. The structure of an animal cell and its difference from a plant cell. Classification and structure of animal tissues. Organs, organ systems. Connection of organ functions with their structure (morphofunctional characteristic). Physiology and regulation of the main organ systems: excitable, central nervous system, sensory, cardiovascular, respiratory, excretory, digestive. Metabolism. **Expected results:** To know: the structure of animal cells, tissues, organs, organ systems; the relationship of organ functions with their structure; physiology and regulation of the main organ systems in humans and animals; to be able to: conduct somatometry, physiometry; apply biological knowledge to explain the processes and phenomena of the vital activity of one's own body and other animals; to possess: morphological and physiological skills assessment of the human body in anthropological research.
5	**Physiology of higher nervous activity**	5	School biology course	Final State Attestation	**Aim.**. The study of the basic principles of higher nervous activity of animals and humans, physiological mechanisms of command, the structure of the behavioral act. **Content.** The doctrine of HNA. Functional organization of the brain. Sensory systems: principles of structure and function. Sensory systems: visual, auditory and their departments. Classification of receptors. HNA . Basic concepts and principles. Unconditional and conditioned reflexes. Memory and various types of classification. Structural and functional foundations of memory. Sleep: meaning and types. Emotions. Their role in the organization of behavior. Features of human HNA. Speech and its functions. Interaction of 1 and 2 signal systems. **Expected results**: To know the mechanisms of the brain, the mechanisms of psychological processes; to possess a sufficient arsenal of the subject; to be able to apply biological knowledge to explain the processes and phenomena of the vital activity of one's own body and other representatives of the animal kingdom, indicating their taxonomic group, anatomical, morphological and environmental features.
6	**Plant taxonomy**	5	School biology course	Educational and field practice (study of plant species composition)	**Aim.** The formation of students ' theoretical and practical knowledge of modern plant taxonomy, instilling in students the skills of independent work with plant objects, the development of interest in research in the field of Floristics and taxonomy. **Content**. General characteristics of lower and higher plants, blue-green algae department, algae departments: green, charovye, euglen, pyrrhophyte, yellow-green, diatom, Fungi department, Lichens department, higher plants, departments: Mossy, Rhiniophytes, Plaunate, Horsetail, Fern-like, Gymnosperms department, Angiosperms department, classes: Dicotyledonous, Monocotyledonous., general characteristics, the most important directions of evolution. Herbarization and identification of plant species. **Expected results**: To know: the diversity of the plant world, spatial distribution, structure, evolution, systematic groups of plants; taxonomic categories used in modern taxonomy; lower and higher plants as the main educators of modern vegetation cover; the volume of systematic groups, geographical distribution of plants, the role of plants in ecological systems; the practical significance of the properties of plants of various groups; be able to: distribute plants by groups; to use in practice the economic properties of plant representatives; to analyze the proposed plant objects based on knowledge of anatomical, morphological and physiological characteristics of the plant organism, the principles of their systematic classification, as well as the dependence of their structure and functions on the conditions of existence; to be able to make dichotomous keys; to possess the skills: to identify plants belonging to systematically complex groups; microscopy, dissection, sketches, work with herbarium; distribution of plants by groups
6	**Flora of Kazakhstan**	5	School biology course	Educational and field practice (study of plant	**Aim.** Formation of a complex of knowledge about the peculiarities of the flora of the Republic of Kazakhstan and East Kazakhstan region, ways and patterns of their formation, systematic, ecological and structural diversity of plants, as well as characteristics of their role in biocenoses, economic significance and protection. **Content.** Features of climate, soil and flora distribution of the RK and EK region, introduction of tree and shrub flora, cultural flora and weeds, methods of floristic

				species compo-sition)	research, systematic analysis of the RK and EK region's flora, biomorphic and phytocenotic analysis of flora, ecological groups of plants, analyzes of endemism, relict status, objects of the Red Book. Herbarization and identification of plant species. **Expected results:** To know: the terminology of the discipline, the peculiarities of the flora of the Republic of Kazakhstan and East Kazakhstan region, modern approaches to the analysis of flora, the principles of geobotanical and floristic zoning, the main systematic and ecological groups of plants, the peculiarities of the protection of the flora of the Republic of Kazakhstan and the region in the reserve, national park, nature reserves; to be able to: apply knowledge in floristic research, make notes of flora and their analysis, learn rare and protected plant species of the Republic of Kazakhstan, in collections, in drawings, in nature; to analyze the proposed plant objects based on knowledge of the anatomical, morphological and physiological characteristics of the plant organism, the principles of their systematic classification, as well as the dependence of their structure and functions on the conditions of existence; to possess: methods of floristic research, techniques for describing plant communities, methods for determining the range of the species, knowledge and skills for professional handling of botanical objects.
7	**Physical and colloidal chemistry**	5	Chemis try of element s	Applie d chemist ry	**Aim.** Acquisition of theoretical knowledge in physical and colloidal chemistry for further in-depth study of disciplines of the profiling cycle necessary for successful realization of professional activity of the bachelor. **Content.** The emergence of physical and colloidal chemistry as independent disciplines. Fundamentals of the doctrine of the structure of matter. Fundamentals of chemical thermodynamics. Chemical kinetics. Chemical equilibria. Solutions. Phase equilibria. Status diagrams. Electrochemical processes. Surface phenomena. Dispersed systems, their stability and coagulation. Obtaining and purification of dispersed systems by various methods. Separate classes of dispersed systems. **Expected results**: To know: the emergence of physical and colloidal chemistry as independent disciplines; the basics of the doctrine of the structure of matter; the basics of chemical thermodynamics; chemical kinetics and chemical equilibria; solutions; phase equilibria and state diagrams; electrochemical processes and surface phenomena; dispersed systems; obtaining and purification of dispersed systems by various methods; to be able to: determine the thermodynamic characteristics of chemical reactions and equilibrium concentrations of substances; determine the direction of the process under given initial conditions; to determine the compositions of coexisting phases in binary heterogeneous systems; to make kinetic equations for simple reactions; to perform calculations using the basic relations of thermodynamics of surface phenomena and calculations of the main characteristics of dispersed systems; to calculate the energy parameters of adsorption; to obtain and purify colloidal solutions; to generalize and process experimental information in the form of laboratory reports; to possess: skills of calculating thermal effects and equilibrium constants of chemical reactions; methods for calculating chemical equilibrium, measuring adsorption and specific surface area, viscosity; possess basic chemical laws, theories, patterns and chemical transformations for use in real chemical processes encountered in the educational process; use computational methods to solve various chemical tasks.
7	**Polymer chemistry**	5	School chemist ry course	Final State Attestat ion	**Aim.** The study of the basics of chemistry and physics of polymers and their role in human life. **Content.** Polymer chemistry as a science, the objects of research of which are polymers of synthetic and natural origin. Their classification, nomenclature and features of chemical structure. Synthetic organic, organoelement, inorganic and natural polymers. Types of polymerization and copolymerization: radical, cationic, anionic and ion-coordination, emulsion. Features of these polymerization processes. Inhibitors and regulators of polymerization. Polycondensation: equilibrium and nonequilibrium. Chemistry and physics of polymers and polymer composite materials. **Expected results**: To know: modern ideas about the structure and properties of high-molecular compounds used in the production of gunpowder, solid rocket fuel and polymer composite materials; theoretical foundations of the synthesis of polymers and their chemical transformations; basic physico-chemical processes occurring in the

					manufacture of polymer composite materials; standard methods for determining the properties of gunpowder, solid rocket fuels, polymer materials; be able to: to conduct research on the properties of polymer materials, gunpowders, solid rocket fuels according to standard methods; possess: experience in choosing methods for conducting complex tests of polymers, polymer composite materials and products based on them; possess basic chemical laws, theories, patterns and chemical transformations for explanation and use in real chemical processes occurring in the educational process; use computational methods to solve various chemical tasks of an educational and scientific-laboratory nature; possess methods of safe use of chemical materials, taking into account their physical and chemical properties.
8	**Plant physiology**	5	Anatomy and morphology of plants	Final State Attestation	**Aim.** Formation of knowledge about the General laws and specific mechanisms underlying the physiological processes occurring in plant organisms and substantiation of practical techniques aimed at improving plant productivity. **Content.** Plant physiology as a science. Features of the structure and chemical composition of a plant cell, its differences from animal cell; totipotency of plant cell, its use in plant biotechnology; plant cell physiology; carbon nutrition of plants: pigments, photosynthesis chemistry, composition, functions of photosystems I, II; plant respiration: energy exchange; water exchange; mineral nutrition; growth and development, phytohormones. **Expected results:** To know: the subject, tasks and history of plant physiology; totipotency of plant cells; carbon nutrition of plants; water metabolism of plants; evaporation of water by plants, fundamentals of plant resistance to drought; mineral nutrition, physiological basis of fertilizer application; plant respiration; components of the respiratory chain; mechanism of oxidative phosphorylation; plant growth and development, phytohormones; physiological basis protection and stability of plants; be able to: conduct a bibliographic search for literary sources; clearly carry out the plan of experiments with plant objects; to work with living plants, compare and find differences between control and experimental plants; to conduct experiments on the removal of physiological indicators of plants; to formalize the results obtained using graphic images and compare indicators; to generalize and draw conclusions; to analyze the proposed plant objects; to have the skills: conducting experiments to study the basic physiological processes; determining osmotic pressure, intensity transpiration, photosynthesis, respiration; isolation of chlorophyll and determination of its quantity and physico-chemical properties; determination of the influence of various mineral elements on the growth and development of plants.
8	**Physiology of steppe plants**	5	Anatomy and morphology of plants	Final State Attestation	**Aim.** Formation of knowledge about the peculiarities of the functioning of physiological processes occurring in plant organisms of the main groups of steppe plants - succulents, halophytes, petrophytes. **Content.** Features of the structure of vegetative and generative organs of the main groups of steppe plants - succulents, halophytes, petrophytes. Bioecological features of their physiological processes (respiration, photosynthesis, water metabolism, mineral nutrition, growth and development) and adaptation mechanisms due to lack of water, high salinity and stony soils. The main representatives of succulents, halophytes and petrophytes. **Expected results:** To know: features of the structure of vegetative and generative organs of the main groups of steppe plants - succulents, halophytes, petrophytes; bioecological features of their physiological processes (respiration, photosynthesis, water metabolism, mineral nutrition, growth and development) and adaptation mechanisms due to lack of water, high salinity and stony soils; the main representatives of succulents, halophytes and petrofitov; be able to: conduct a bibliographic search for literary sources; clearly carry out the plan of experiments with plant objects; to work with living plants of the steppe zone, to compare and find characteristic features of steppe plants; to conduct phenological observations; to analyze the proposed plant objects based on knowledge of anatomical, morphological and physiological characteristics of the plant organism growing in the steppe; to have skills: conducting experiments to study the basic physiological processes in the vegetative and generative organs of steppe plants.

MAIN DISCIPLINES					
Elective courses (EC)					
1	**Room and garden floriculture**	5	Microbiology and virology	Educational practice (the organization of the school decorative and teaching and experimental site)	**Aim.** To form ideas about indoor and garden plants, their classification, biology and care. **Content.** Biological bases of floriculture; classification, origin of flower plants; indoor floriculture; variety of indoor plants, certification; placement of flowers in premises; agrotechnics of growing flower plants of open, closed ground; design of green spaces; floristics, design; flower beds in the design of the site; arrangement of flower beds and rocky areas; educational and experimental site: organization, structure. **Expected results**: To know: the main groups of indoor and garden plants, the peculiarities of their organization, diversity, ecological, aesthetic and practical role; principles of plant placement; rules of plant care; the main diseases of indoor plants; to be able to: make a plant passport, design projects for flower beds and flower beds, flower beds; prepare soil mixtures; transplant and transfer plants; make fertilize and feed plants; propagate plants by seeds and vegetatively; describe your own observations or experiments, distinguish in them the purpose, conditions and results obtained; possess the skills of drawing up the simplest recommendations for the maintenance and care of indoor and other cultivated plants; plant propagation; certification of indoor and garden plants, as well as the organization of an educational and experimental site; thus, possess the applied aspects of biology.
1	**Decorative gardening with the basics of landscape design**	5	Soil microbiology	Educational practice (the organization of the school decorative and teaching and experimental site)	**Aim.** Formation of complex of knowledge about organizational, scientific and methodical bases of modern decorative gardening and the used technologies, readiness to the creative approach at the decision of practical tasks on greening of inhabited territories and economic objects. **Content.** General issues of decorative gardening; ornamental plants of open ground in landscape design; landscape as an object of landscape art; landscape composition; classification of green spaces; decorative herbaceous plants in the system of urban and rural landscapes; principles of landscaping of settlements; modern garden and park design; current trends in modern landscape design. **Expected results**: Know: a zoned assortment of decorative woody plants for landscaping territories of various functional purposes and interiors; agrotechnical techniques used at different stages of green construction; be able to: recognize the main types of woody, shrubby, floral and herbaceous crops used in decorative gardening by morphological characteristics of plants, fruits, seeds; - use drawing and artistic tools and materials; create a landscape project, develop design and estimate documentation, select plants for landscaping objects; own: methods of production of planting material and maintenance of ornamental plantings; ability to build, design and read drawings, to constructively draw natural forms and landscape elements, to compose landscape compositions; possess applied aspects of biology..
2	**Modern methods of teaching biology**	4	Methodology of teaching biology	Industrial (pedagogical) practice	**Aim.** Introduction to the theoretical and methodological aspects of the technological approach in education; teaching methods of modeling the educational process of biology through the use of modern teaching technologies; formation of motivational orientation of students to innovative activities in the organization of the educational process in biology. **Content.** The concept of teaching technology; the variety and possible classifications of teaching technologies; the meaning and search activity of a specialist in the design of teaching technology; modern training; the technology of problem-based, modular, project-based, case-study, interactive, information and communication training in biology lessons; the technology of developing critical thinking in biology lessons; test technology in biology lessons. **Expected results**: To know: modern methods and technologies of multicultural, differentiated and developmental education in the biology course; to be able to: use a variety of forms, techniques, methods and means of teaching biology within the framework of the updated education system of basic general education and secondary general education; to use standard, applied, modern pedagogical methods and technologies in accordance with the set goals and objectives when planning and conducting classes in high school and college; possess: forms and methods of teaching biology, including those beyond the scope of training sessions: project

					activities, laboratory experiments, field practice, desk processing, etc.; possess knowledge of regulatory and legal documents in the field of education, instructional documentation, skills and abilities to develop current educational and organizational documentation for the implementation of educational concepts of educational institutions programs.
2	**Methods of organization of extracurricular work in biology**	4	Methodology of teaching biology	Industrial (pedagogical) practice	**Aim.** Formation of ideas about the theoretical foundations of extracurricular work in biology and the use of acquired knowledge and skills to solve professional problems. **Content.** The content and organization of extracurricular work in biology; forms, types of extracurricular work; ways, means of improving the effectiveness of extracurricular work; extracurricular, extra schoolar work; research work in biology; methods of organizing, conducting circles, electives, elective courses; methods of organizing, conducting various forms and types of extracurricular work. **Expected results:** To know: the content and organization of extracurricular work in biology; forms, types of extracurricular work; ways, means of improving the effectiveness of extracurricular work; extracurricular, extracurricular work; research work in biology; methods of organizing, conducting circles, electives, elective courses; methods of organizing, conducting various forms and types of extracurricular work; be able to: develop educational plans for the organization of extracurricular work in biology; to select the components of the educational environment for the implementation of innovative educational tasks through the implementation of extracurricular, extracurricular and extracurricular work in biology; to possess: skills in the application of forms, methods of organizing extracurricular work as an integral component of professional improvement of the teacher; to possess knowledge of regulatory and legal documents in the field of education, skills in the development of current educational and organizational documentation for the implementation of educational concepts using extracurricular a job in biology.
3	**Innovative technologies for teaching chemistry**	5	Methodology of teaching chemistry	Industrial (pedagogical) practice	**Aim.** To form students' systems of theoretical and practical knowledge, skills and abilities to solve educational problems of the professional pedagogical activity of a chemistry teacher, as well as the ability to reasonably choose and effectively use educational technologies, methods and means of teaching, including ICT, to ensure the planned level of personal and professional development of students. **Content.** Innovative technologies in modernization of chemistry education in educational organizations. Use of information and communication, design and research technologies, technologies for development of critical thinking, network technologies in teaching chemistry at school. eLearning in chemistry training. Characteristics of software tools for implementing network interaction. Characteristics of Internet resources for teaching chemistry. The possibilities of the Internet in educational chemistry teacher activities. **Expected results:** To know: innovative technologies in the modernization of chemistry teaching in educational institutions; the use of information and communication, design and research technologies, technologies for the development of critical thinking, network technologies in teaching chemistry at school; the methodology of using eLearning in teaching chemistry; to know the possibilities of the Internet in the educational activities of chemistry teachers and for teaching chemistry; to be able to: selection and use of educational technologies and teaching methods in accordance with the objectives of their professional pedagogical activity; to make a choice of educational resources on information portals; to use computer tools for organizing pedagogical activities; to design a training session within the framework of variable formats of organizing the educational process; to possess: to possess modern educational technologies and technologies for conducting training sessions; modern computer tools; techniques for implementing interactive interaction in an open information educational space.
3	**Methods of organizing extracurricular work in chemistry**	5	Methodology of teaching chemistry	Industrial (pedagogical) practice	**Aim.** Formation of ideas about the theoretical foundations of extracurricular work in chemistry and the use of acquired knowledge and skills to solve professional problems. **Content.** The content and organization of extracurricular work in chemistry; forms, types of extracurricular work; ways, means of improving the effectiveness of extracurricular work; extracurricular, extraschoolar work; research work in chemistry; methods of organizing, conducting circles, electives, elective courses; methods of organizing, conducting various forms and types of extracurricular work. Safety precautions when working with chemicals.

					Expected results: To know: the content and organization of extracurricular work in chemistry; forms, types of extracurricular work; ways, means of improving the effectiveness of extracurricular work; extracurricular, extracurricular work; research work in chemistry; methods of organizing, conducting circles, electives, elective courses; methods of organizing, conducting various forms and types of extracurricular work; safety when working with chemicals; be able to: develop educational plans for the organization of extracurricular work in chemistry; to select the components of the educational environment for the implementation of innovative educational tasks through the implementation of extracurricular, extracurricular and extracurricular work in chemistry; to possess: the skills of using forms, methods of organizing extracurricular work as an integral component of professional improvement of the teacher; to possess safety techniques when working with chemicals; possess knowledge of regulatory and legal documents in the field of education, skills in developing current educational and organizational documentation for the implementation of educational concepts using extracurricular work in chemistry.
4	**Methodology for calculating tasks in chemistry**	5	Methodology of teaching chemistry	Industrial (pedagogical) practice	**Aim.** To develop the creative abilities of students and teach them to use the basic laws and concepts of inorganic chemistry in solving experimental, computational and other problems of increased complexity, to teach students to solve problems in several alternative ways, the choice of the most elegant solutions. Formation of students ' knowledge and skills to teach students to solve chemical problems. **Content.** Role of tasks calculating in process of teaching chemistry in school. Main types of chemical calculations in chemistry program. Physical quantities in chemistry. Main types of chemical calculations are based on: formulas, equations, mixtures of substances, solutions, reaction product yield. Combined tasks on mixtures and solutions of substances. Verification and evaluation of solution of computational problems in chemistry. Methodology for composing computational problems in chemistry. **Expected results:** Possess methodological techniques for solving problems of varying degrees of complexity in the main sections of chemistry; possess methodological techniques for solving Olympiad problems; be able to solve complex creative problems of a theoretical and applied nature; be able to solve problems using a computer and a personal computer; possess a technique for using multimedia tools to teach students how to solve chemical problems; be able to create conditions and design solutions to problems and exercises of increased complexity; use standard, applied, modern pedagogical methods and technologies in accordance with the set goals and objectives when planning and conducting classes in high school and college.
4	**Methods of conducting a school chemical experiment**	5	Methodology of teaching chemistry	Industrial (pedagogical) practice	**Aim.** To form a holistic view of the preparatory stages and methodology of the school chemical experiment. **Content.** Chemistry room and its equipment; chemical experiment in the system of organizational forms of training; methods of chemical experiment; technique and methodology of chemical experiment in the study of the main sections of chemistry; methods of conducting basic demonstration experiments and laboratory work in the study of the main sections of chemistry. Safety precautions when working with chemicals. **Expected results**: To know: the scheme of construction and methodology of conducting a chemical experiment at school; the technique and methodology of chemical experiment in the study of the main sections of chemistry; to be able to: organize and conduct basic demonstration experiments and laboratory work; to use standard, applied, modern pedagogical methods and technologies in accordance with the goals and objectives when planning and conducting classes in secondary school and college; possess: methodological techniques for conducting a school chemical experiment; possess knowledge of regulatory and legal documents in the field of education, educational and instructional documentation, skills and abilities to develop current educational and organizational documentation for the implementation of educational concepts of training programs for conducting chemical experiments.
5	**Applied chemistry**	5	Physical and colloid	Modern chemistry and	**Aim.** To form the basic concepts of chemical production, familiarity with the theoretical foundations of chemical technology, the main components of chemical processes, as well as consideration on this basis of some technologies for the

			al chemistry	chemical safety	production of some of the most important chemical products (acids, ammonia, urea, ethylene, polymer materials. **Content.** Modern requirements for chemical production. Chemistry and energy. Raw materials. Water in the chemical industry. Thermal processing of solid fuels. Processing of natural combustible gases and oil. Production of hydrogen, nitrogen, oxygen and acids. General information about metallurgy. Technology of basic organic synthesis. High-molecular compounds and their application. **Expected results**: To know: the main technological processes of production of the most important chemical products in industrial and laboratory conditions, the main devices and devices of chemical technology, safety requirements, industrial sanitation and environmental standards of chemical products production; to be able to: solve typical problems in applied chemistry; to make structural formulas of polymers and ways of their synthesis; to possess: skills of synthesis, isolation and purification of chemicals in laboratory conditions, skills of determination of physical and mechanical properties.
5	**Chemical synthesis**	5	General and inorganic chemistry	Nanotechnology in chemistry	**Aim.** To form ideas about methods and techniques of synthesis of inorganic substances. **Content.** General theoretical foundations of chemical synthesis: concept of chemical synthesis, basic laws and control of chemical processes, methods of separation, concentration and purification of inorganic substances, reactions in gas, liquid and solid phases. Synthesis of main classes of inorganic compounds (oxides, hydroxides, acids, salts). Synthesis of organic compounds. Substitution reactions in aliphatic and aromatic series. Reactions of condensation, oxidation and reduction of organic compounds. **Expected results**: To know: basic methods of synthesis of simple substances and inorganic compounds in gas, liquid and solid phases, basic methods of separation, concentration and purification of inorganic substances; be able to: make up the material balance of the synthesis process of the substance, determine the practical yield of the product; possess: chemical experiment skills, basic synthetic and analytical methods for obtaining and researching chemicals and reactions.
6	**Chemical technology**	5	Analytical chemistry	Final State Attestation	**Aim.** To give an idea of the basic provisions and theory of chemical production technology and their practical application to industrial facilities. **Content.** The main components of production chemical and technological processes (raw materials, energy, catalysis, equipment; hydromechanical, thermal and mass-exchange processes of the chemical industry). Production of sulfuric, nitric and phosphoric acids, ammonia, urea, ethylene, paraffin and unsaturated hydrocarbons, oxygen-containing organic compounds. Technology of production of salts and fertilizers. **Expected results**: To know: the basic principles of the organization of chemical production, its structure; methods for evaluating the effectiveness of the chemical-technological process and the entire production as a whole; general patterns of chemical transformations in industrial production conditions; structure, organization and technological design of the main chemical industries of modern chemical enterprises of East Kazakhstan Region and the Republic of Kazakhstan. be able to: demonstrate knowledge about the laws of chemical transformations in industrial production conditions, as well as about the structure, organization and technological design of the main chemical industries; calculate the main characteristics of the chemical process, choose a rational scheme for the production of a given product; evaluate the technological efficiency of production; generalize and process experimental information; possess: methods for analyzing the efficiency of chemical production; skills for calculating and determining the technological indicators of the process.
6	**Organization of pupils' research activities in chemistry**	5	Analytical chemistry	Final State Attestation	**Aim.** To form ideas about the theoretical foundations of the organization of research activities of students in chemistry, about the principles of organizing research activities of students in the educational process of the school, the formation of skills for developing methodological support for research activities of students in the educational process of the school. **Content.** Scientific and methodological foundations and specifics of the organization of research and project activities of students in chemistry. The specifics of project management within framework of tutor support. Organization and con-

					duct of chemical experiments and observations in laboratory conditions. Application of modern techniques in organization of laboratory experiments. Conducting experimental field research. Safety precautions when working with chemicals. **Expected results:** To know: the specifics of the organization of research and project activities of students in chemistry; the specifics of project management within the framework of tutor support; organization and conduct of chemical experiments and observations in laboratory conditions; methods of experimental field research; application of modern techniques in the organization of laboratory experiments; safety when working with chemicals; be able to: apply the necessary methods of scientific research when developing scientific papers; use special methods when performing scientific research; to develop methodological recommendations for the organization of research activities based on the results of the study of scientific literature; to have the skills of: choosing the topic of scientific work; design of research and educational research; organization and conduct of activities aimed at the development of research activities of students.
7	**Environmental and green chemistry**	4	Biochemistry	Final State Attestation	**Aim.** To form an idea of the qualitative and quantitative composition of anthropogenic pollution of the biosphere as a result of human industrial and agricultural activities and mechanisms of chemical transformations of substances in the environment, as well as the possibilities, role and place of "green chemistry" in modern natural science. **Content**. Environmental pollution; global biochemical cycles of elements; changes in chemical composition of atmosphere; anthropogenic impacts on nature. Problems of environmental ethics and chemical production. Twelve principles of "green chemistry" by Anastas and Warner. Directions of "green chemistry" development. Legislation of RK environmental protection. The international obligations of RK to eliminate production, export and import, to reduce of certain pollutants. **Expected results:** To know: the current state and trends in the development of ecological chemistry; patterns of interaction of living organisms and their aggregates with the environment; ecological significance of soil chemical properties; the effect on living organisms of the movement and chemical composition of air masses; types of bioindicator plants used in environmental diagnostics; principles of "green chemistry" and its latest developments; be able to: conduct screening analysis of habitat quality; reasonably choose a method and methodology for the analysis of environmental objects and biological objects; to carry out a screening bioindication survey of the ecological state of biogeocenoses; to process the results of analytical measurements; to apply the principles of ecological and "green chemistry" when performing chemical experiments; to possess: the laws of the action of environmental factors to predict optimal ecological niches of plants; methods of sampling and conservation of biological material and environmental objects; methods of registering analytical parameters during bioindication and chemical research.
7	**Coordination chemistry**	4	General and inorganic chemistry	Final State Attestation	**Aim.** In-depth study of the chemistry of coordination compounds; study of the structure and properties of coordination compounds. **Content.** Fundamentals of coordination theory; chemical bonding in complexes; coordination centers; ligands; isomerism of coordination compounds; formation of complexes: thermodynamic aspect; research methods in coordination chemistry; fundamentals of synthesis and reactivity of coordination compounds; applied aspects of coordination chemistry. The concept of biocoordination chemistry. Biocomplexes and bioclusters. Biocomplexes with anions of inorganic acids, amino acids, proteins, porphyrins. **Expected results**: Know: general ideas about coordination chemistry, including coordination chemistry of rare earth elements and actinides, as well as general patterns in changing the chemical properties of the corresponding CS; be able to: isolate the main thing; make suggestions when setting up or rationalizing the corresponding experiment; use computational methods to solve various chemical tasks of an educational and scientific laboratory nature; possess: terminology and the technique of conducting the simplest estimates and calculations, for example, using circular thermochemical cycles or the theory of the ligand field; possess basic chemical laws, theories, patterns and chemical transformations for explanation and use in real chemical processes encountered in the educational process; possess methods

					of safe use of chemical materials taking into account their physical and chemical properties
8	**Modern chemistry and chemical safety**	4	Applied chemistry	Final State Attestation	**Aim.** To promote the training of specialists on the basis of traditional and new branches of chemistry, and ways of using chemistry in solving problems in the field of assessing and reducing man-made and environmental risks in modern society, as well as ways of using chemistry in solving problems of the concept of sustainable development. **Content.** Chemical safety in post-industrial society. Relationship between chemistry and sustainable development. Risk of man-made and environmental crises. Chemical hazard is a special category of technogenic hazard. Methods of assessment of technogenic risk. Ensuring safety of the operation of chemical facilities to increase protection of population and environment. Environmental protection techniques in chemical production. Fundamentals of chemical production safety management. **Expected results:** To know: about the relationship between chemistry and sustainable development, as well as the theoretical foundations of traditional and new sections of chemistry and how to use them in solving specific chemical problems, chemical safety of production; methods for assessing technogenic risk; ensuring the safety of operation of chemical facilities to increase the protection of the population and the environment; environmental protection techniques in chemical production; be able to: perform actions (classification of substances, drawing up process diagrams, systematization of data, etc.) taking into account the basic concepts and general patterns formulated within the framework of basic chemical disciplines; possess: skills of using the theoretical foundations of basic chemical disciplines in solving specific chemical and materials science problems
8	**Nanotechnology in chemistry**	4	Chemical synthesis	Final State Attestation	**Aim.** To form a system of knowledge about the basics of nanochemistry, synthesis and analysis of nanomaterials, application of nanotechnology in organic chemistry, biology, medicine and other fields. **Content.** Basic concepts of nanochemistry and nanotechnology. History of nanotechnology development. Nanostructured elements of a substance: atoms, molecules, fullerenes, nanotubes, clusters. Quantum dots are artificial molecules. Nanostructured polymers. Nanotechnology tools: nanocrystals, nanotubes, nanorods and their derivatives. Materials of electronics for nanotechnology. Future of nanotechnology: problems and prospects. Classification and methods of obtaining nanoparticles. Nanoobjects as basis of new drugs and their targeted delivery systems. **Expected results**: To know: definition and classification of nanoparticles, concepts of nanomaterials, their special physical and chemical properties; basic methods of synthesis and analysis of nanomaterials; existing and promising applications of nanotechnology and nanomaterials; harmful effects of nanomaterials on ecology, human health and safety, as well as ways to prevent them; to be able to: analyze and evaluate various methods of synthesis to propose methods for the analysis of nanomaterials depending on their nature; to propose possible applications of various nanomaterials; demonstrate knowledge about the laws of chemical transformations in industrial production conditions, as well as about the structure, organization and technological design of the main chemical industries; possess: skills of searching for sources of information about new achievements in nanochemistry and nanotechnology.

LIST
of components for your choice for the educational program
6B01509 "Chemistry-Biology"
Duration of studies: 2 years. Form of study: full - time (SH)

№	Name of the discipline	Code of discipline	Amount of credits	Semester
	2. Basic disciplines			
1	**Component of choice 1**		3	1
	Cytology and histology	CH2222		
	Immunology	Imm2222		
2	**Component of choice 2**		4	1
	General and molecular genetics	GMG2223		
	Genetic foundations of plant breeding	GFPB2223		
3	**Component of choice 3**		5	1
	Microbiology and virology	MV2224		
	Soil microbiology	SM2224		
4	**Component of choice 4**		5	2
	Cell biotechnology	CB2225		
	Introduction to biotechnology	IB2225		
5	**Component of choice 5**		5	2
	Human and animal anatomy and physiology	HAAP3226		
	Physiology of higher nervous activity	PHNA3226		
6	**Component of choice 6**		5	2
	Plant taxonomy	PT3227		
	Flora of Kazakhstan	FK3227		
7	**Component of choice 7**		5	3
	Physical and colloidal chemistry	PCC3228		
	Polymer chemistry	PC3228		
8	**Component of choice 8**		5	3
	Plant physiology	PP4229		
	Physiology of steppe plants	PSP4229		
	3. Profiling disciplines			
1	**Component of choice 1**		5	3
	Room and garden floriculture	RGF3305		
	Decorative gardening with the basics of landscape design	DGBLD3305		
2	**Component of choice 2**		4	4
	Modern methods of teaching biology	MMTB3306		
	Methods of organization of extracurricular work in biology	MOEWB3306		
3	**Component of choice 3**		5	4
	Innovative technologies for teaching chemistry	ITTC4307		
	Methods of organizing extracurricular work in chemistry	MOEWC4307		
4	**Component of choice 4**		5	4
	Methodology for calculating tasks in chemistry	MCTC4308		
	Methodology of conducting a school chemical experiment	MCSCE4308		
5	**Component of choice 5**		5	3
	Applied chemistry	AC4309		
	Chemical synthesis	CS4309		
6	**Component of choice 6**		5	4
	Chemical technology	CT4310		
	Organization of pupils' research activities in chemistry	OPRAC4310		
7	**Component of choice 7**		4	4
	Environmental and green chemistry	EGC4311		
	Coordination chemistry	CC4311		
8	**Component of choice 8**		4	4
	Modern chemistry and chemical safety	MCCS4312		
	Nanotechnology in chemistry	NC4312		