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Казахский гуманитарно-юридический инновационный университет
Kazakh Humanitarian Juridical Innovative University

Ақпараттық- технологиялар және экономика факультеті
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Department of Information and Technology and Economics

Қолданбалы биология кафедрасы
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Economy and Management Department

5В012500 – ХИМИЯ-БИОЛОГИЯ
ЭЛЕКТИВТІ ПӘНДЕР КАТАЛОГЫ
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5В012500 – ХИМИЯ-БИОЛОГИЯ
КАТАЛОГ ЭЛЕКТИВНЫХ ДИСЦИПЛИН
год поступления - 2018

5V012500 - CHEMISTRY- BIOLOGY
THE CATALOGUE OF ELECTIVE SUBJECTS
Year of entrance - 2018

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Elective course №	The name of subject	Number of credits		Pre requisites	Post requisites	Short description of the content, the aims of education, expected results
		RK	ECTS			
GENERAL EDUCATIONAL DISCIPLINES						
Elective courses (EC)						
1	Self-Knowledge	2	3	school is Self-knowledg e course "	Psychology	The purpose of the study. The study of actual problems of the psychology of self-knowledge and self-development, reveals the concepts, structure, mechanisms, barriers of self-knowledge and self-development, their role and importance in human life. Special attention is paid to the issues of psychological and pedagogical support and maintenance of self-knowledge and self-development at different age stages, as well as in the sphere of professional activity of a social worker. Summary. Self-knowledge is the knowledge of oneself, it is a toolkit for discovering inexhaustible personal and creative potential, identifying those areas of life where this potential can be fully exploited. The assertion of the value of self-knowledge can be traced in many religious, philosophical, psychological and pedagogical concepts. For example, in the religions of the Ancient East, an integral harmonious system of self-knowledge has been developed, which serves as a means of comprehending the true essence of man, achieving unity with the Universe. Expected learning outcomes: on the basis of self-knowledge, knowledge about oneself is born. This knowledge is grouped into constructs according to the principle of proximity, for example, intellectual properties, character traits, emotional qualities, abilities, and behavioral characteristics. Competences: educative
1	Culturology	2	3	school History course	Fundamentals of anti-corruption culture	The purpose of the study. The main purpose of the discipline is to represent cultural science as an integral expression of humanitarian knowledge. The teaching of the course “cultural studies” should take into account that this is an independent and specific area of human culture, a “living system” included in the modern socio-cultural context. Summary. «Culturology” is associated with the cycle of social and humanitarian disciplines: history, political science, philosophy, sociology. Culturology carries out the functions of the knowability of the world. Expected results of the study: as a result of studying the discipline, students should know: the structure and composition of modern culturological knowledge; cultural studies and philosophy of culture; sociology of culture, cultural anthropology; cultural studies and cultural history; be able to: distinguish the basic concepts of cultural science: the dynamics of culture, the language and symbols of culture, cultural codes, intercultural communications, cultural values and norms, cultural traditions, cultural picture of the world, social cultural institutions Competences: educative.
2	Political science	2	3	The modern history of Kazakhstan	-	The purpose of the study. The political science course gives the student a minimum of knowledge about political realities, norms of political behavior, political values necessary for a citizen, teaches him to operate with a modern internationally recognized categorical-conceptual apparatus, develops the ability to critically analyze and predict the political situation, develops interest and respect for national traditions, promotes

						cooperation between nations. Summary. Political science is a branch of knowledge about politics in all its manifestations and interrelations with other areas of public life. Political science studies the relations of various social, ethnic, religious and other groups about power, political institutions and, above all, the state and parties, political consciousness and culture, subjects of politics: personality, elites, leaders, nation, state, etc., domestic and interstate political processes. Expected results of the study: as a result of studying the discipline, students should know: the subject and objectives of the course; the main content of the course "political science"; master the fundamental knowledge of political theory; range of achievements of historical thought in the study of ancient culture; be able to: work independently with literature of a general humanitarian nature, be able to find key ideological problems and their solutions; logical, systematic and critical thinking; use the baggage of philosophical erudition to formulate and prove their own judgments on various issues of everyday life. Competences: educative.
2	Sociology	2	3	Psychology	-	The purpose of the study. To form students' ideas about society, the systems that make it up, the laws of its functioning and development, social institutions, relationships and communities. Summary. Sociology (from the Latin. Societas - society Greek. Λόγος - science) - is the science of society, the systems that make it, the laws of its functioning and development, social institutions, relationships and communities. Sociology studies society, revealing the internal mechanisms of its structure and the development of its structures. Expected results of the study: as a result of studying this course, the student should know: the laws of the development and functioning of society; features of the analysis of the modern system of social inequality, social mobility and stratification; own: practical skills of self-analysis of the current state of society; to use in cognitive and professional activities basic knowledge in the field of humanities and economics; be able to: correlate the knowledge of the foundations of sociology with professional activities; own: practical skills of applying the knowledge gained in the analysis of real social situations. Competences: educative.
2	Fundamentals of anti-corruption culture	2	3	Culturology	-	The purpose of the study. The study of the course and familiarization of students with the formation of a system of knowledge on combating corruption and the development on this basis of citizenship in relation to this phenomenon. Summary. Fundamentals of anti-corruption culture is a complete interdisciplinary system of knowledge for all specialties and areas of training bachelors Expected results of the study: as a result of studying the discipline, students should know: the essence of corruption and the causes of its origin, a measure of moral and legal and legal responsibility for co-corruption offenses; be able to: own the skills of acquiring new knowledge about anti-corruption culture is a holistic interdisciplinary system of knowledge. Competences: educative
3	Religious	3	5	school History course	-	The purpose of the study. Study the course and familiarize students with topical issues of religious studies. Summary. Religious studies study the laws of origin, development and functioning of religion, its structure and various components, its diverse phenomena, how they appeared in the history of society, the interrelation and

						interaction of religion and other areas of culture. Religious studies are a science whose subject is religion. Expected results of the study: as a result of studying this course, the student should know: the current state of religious studies in Kazakhstan and abroad; identify current theoretical problems of religious studies; highlight the current problems of the institutionalization of religious studies; be able to: show the main problems of religious studies. Competences: educative.
Basic disciplines						
Elective courses (EC)-						
1	Introduction to the teaching profession	2	3	-	Pedagogy	The purpose of the study. Formation of professional and pedagogical orientation of students for future educational activities. Summary. Philosophy of education. Education as a system of professional activity and the result of the formation of a competent specialist. The essence and purpose of philosophy in preparing the future teacher. Personality, its problems in modern socio-economic conditions. The teacher and his role in modern society. Expected results of the study: students should know: about the subject and object of activity of the future teacher, about the social purpose of the teacher in modern society, about the essence of the main pedagogical phenomena (personality, teacher, upbringing and education); be able to: diagnose the whole educational process of the school; creatively use pedagogical knowledge when observing the course-educational activities of a teacher, the educational work of the class teacher; assist the work of the school; communicate with schoolchildren, be able to speak in front of a student audience; deeply aware of the social meaning and content of their future specialty; consciously and actively involved in independent educational research, social activities. Competences: educative, research, methodical.
1	Fundamentals of pedagogical education	2	3	-	Pedagogy	The purpose of the study. Formation of professional competence of the bachelor of pedagogical education on the basis of awareness of the essential characteristics of the educational process and understanding pedagogical experience. Summary. General principles of pedagogy. Modern ethics of attitude to childhood. Basics of pedagogical communication. The basics of classroom activity. The content of education. Priority parenting strategies. Diagnostics of education of the individual and team. Forms of the organization of the educational process. Methods of education. Modern technology education. Expected results of the study: the student should know: modern scientific understanding of the essence of the educational process and modern educational technologies; to master the value-semantic bases of pedagogical activity and fill the subject knowledge with personal meaning; to form the skills and abilities to carry out the educational process and to ensure readiness to perform various types of their own professional activities; develop professionally important personal qualities and pedagogical abilities (autonomy, responsibility, interpersonal skills, initiative, creative qualities, ability to successfully socialize in society, professional mobility, etc.); possess skills of professional reflection - a tool, understanding the dynamics of professional and personal development in the process of educational and cognitive activity in the development of the discipline. Competences: educative, research, methodical, social and communicative.

2	Cytology and histology	3	5	school biology course	Anatomy and morphology of plants	The purpose of the study. To form students' ideas about the methods of studying cells and tissues of plants and animals, cell organelles and their structure, classification, structure and function of tissues. Summary. Introduction Basics of cytology. Methods for the study of cytology. Microscopy Ways to study cells and tissues. Cell research methods. Chemical structure of cells. The general structure of prokaryotic and eukaryotic cells. Cytoplasm. Plasma membrane. Organoids of cytoplasm. Membrane (one- and two-membrane) and non-membrane organoids. Their structural features, properties and functions. The structure of the cell nucleus. Protein biosynthesis. Separation of cells. The structure of the nucleus. The science of histology. Epithelium tissue. Histology. Fabrics Internal middle tissues (connective tissue). Muscle. Tissues of the nervous system. Histological technique. Preparation of fixed preparations of cells and tissues. Basics of histogenesis. Epithelium tissue. Internal (connective) tissue. Muscle. Tissues of the nervous system. Expected results of the study: as a result of the course, the student should be able to: consider cytological and histological preparations in practical classes using microscopes, as well as students should work independently with microscopes, drawings of morphology, cell physiology and tissue systems; as a result of studying the discipline, the student must master: the method of preparation of cytological, histological preparations; material about cell types and main types of tissue with viewing of drugs on a microscope and the implementation of drawings and diagrams in albums; to put into practice the received theoretical knowledge; as a result of studying the course, the student should know the following types of laboratory research: the basic principles of cell theory; cell and tissue research methods; structure and function of cells and cell organelles; differentiation and mechanisms of cellular distribution; method of studying the structure, classification of tissues in the body. Competencies: methodical, research, educative.
2	Cell and tissue biology	3	5	school biology course	Botany	The purpose of the study. To equip the future specialist with modern ideas about the most promising areas of cell and tissue biology development in the world, to show its relationship with achievements in the field of cell and tissue biotechnology, molecular biology, cellular and molecular biophysics, biochemistry, molecular genetics, microbiology, molecular immunology and bioinformatics. Summary. Introduction Theoretical foundations of cell and tissue biology. Objects of cell and tissue biology. Cell structure. Features of the structure of plant, animal, fungal and prokaryotic cells. Plant cells, their cultures. The use of plant cell cultures. Biology of cultured plant cells. Protoplast as an object of biological design. Animal cells, their cultures. Use of animal cell culture. Somatic hybridization. Cell biology of microbiological systems. Cell and tissue biology in medicine. Cellular, tissue and genetic engineering. Expected results of the study: the student should know: the theoretical foundations of cell and tissue biology, objects of cell and tissue biology, structural features of plant, animal, fungal and prokaryotic cells, plant and animal cells, their cultures, the use of plant and animal cell cultures, the biology of cultivated plant cells, cell, tissue and genetic engineering; should be able to: critically analyze experiments, conduct a bibliographic search for literary sources, arrange literary data; must possess: the skills of using microscopes, preparation of

						cellular and histological preparations. Competencies: methodical, research, educative.
3	General chemistry	2	3	school chemistry course	Inorganic chemistry	The purpose of the study. Formation of the basic chemical worldview based on the study of the theoretical foundations of general chemistry and the acquisition of skills in the chemical laboratory, namely: the formation of ideas about the basic concepts, laws of general chemistry; the formation of knowledge about the mechanisms and general patterns of chemical processes; the formation of practical skills in the application of acquired knowledge in professional activities. Summary. Atomic Molecular Teaching. Basic laws of chemistry. Fundamentals of chemical thermodynamics. Basics of chemical kinetics. The doctrine of chemical equilibrium. Solutions (physical and chemical theory of dissolution, electrolytic dissociation, hydrolysis). Elements of electrochemistry. Redox reduction reactions. The main classes of inorganic compounds. Expected results of the study: the student should know: the fundamentals of chemical thermodynamics, the kinetic bases for describing chemical reactions, methods and mechanisms for their acceleration, the theory of chemical equilibrium and methods for its displacement, the foundations of the theory of solutions, elements of electrochemistry; be able to: use the knowledge and skills in the theory and practice of general chemistry to master the theoretical foundations and methods of research in the field of inorganic materials, based on thermodynamic and kinetic concepts, predict the possibilities of chemical processes, suggest optimal conditions for reversible reactions; predict the possibility of exchange reactions in electrolyte solutions; justify the processes during electrolysis; compare the thermodynamic, redox activity of substances; own: professionally profiled knowledge and practical skills in the field of general chemistry. Competencies: methodical, research, educative.
3	Chemistry of elements of the periodic table	2	3	school chemistry course	Inorganic synthesis	The purpose of the study. To give students an idea of the current state and ways of development and the current state of the periodic law and the periodic system of chemical elements, to consider the most interesting and important problems related to the law of periodicity and systematics of chemical elements, including controversial and not completely solved until now. Summary. Periodic law and the classical system of chemical elements. Stages of development of the doctrine of periodicity. Forms of the image of the periodic law. The evolution of the forms of the image of the periodic law. Periodic system of elements in the light of ideas about the structure of atoms. The frequency of changes in the properties of elements. Changing the properties of elements in the main directions of the system. Periodic system and the theory of chemical bonding. Chemical bonding in crystals, solids, complex compounds. Problems and solutions to the doctrine of periodicity at the present stage. The problem of the lower boundary at the chemical and physical stage of evolution. Anti-elements. The upper limit of the periodic system of elements. The problem of transuranium elements. Modern systems of elements. International long-period 18-group form of the periodic system of elements. Methodical aspects of using various forms of the periodic system of elements in the educational process. Expected results of the study: the student must know: the theoretical foundations of inorganic chemistry; know the methods of production and chemical properties of basic simple substances and compounds of elements; know the

						physical meaning of the periodic law and the periodic system of traditional and international; be able to explain modern theories of periodicity; be able to creatively analyze the theoretical concepts and the actual material of inorganic chemistry; to characterize in historical development the formulations of the periodic law and the form of the periodic system of chemical elements; be able to use reference and scientific and technical literature. Competences: methodical, research.
4	Human anatomy	2	3	Cytology and histology	The human and animal physiology	The purpose of the study. The study of the whole organism, its individual parts, structure, age-related sex differences, the topographic relationship between organs, parts of the body. Summary. Introduction Skeleton. Peripheral skeleton. Research methods in anatomy. Axial skeleton. Skull. Skeleton of limbs Syndesmology. Myology. The digestive, respiratory, urogenital systems. Morphological and functional characteristics of the cardiovascular system. Nervous system. Central and peripheral nervous system. Touch system. Analyzers. Endocrine system. Skin and its derivatives. Expected results of the study: the student should know: the place of anatomy in biology and medicine, the main stages of its development as a science; main directions in modern anatomy and the nature of anatomical research methods; general principles of the structure of the human body and their manifestations in the organization of body systems; regularities of the structure of organs of various types and their principal organ-specific features; anatomy, topography and functions of organs, systems and apparatus of the body, taking into account the basic constitutional features; the most significant in practical terms, features of the age anatomy; be able to: determine by visual signs the constitutional type of a person (meso-, brachi- or dolichomorphic); to demonstrate and correctly name the movements carried out in the main joints of the human body; correctly outline the contours of the organs on the skin surface taking into account their skeletopy; own: the skills of morphological assessment of the human body in anthropological studies Competences: educative, methodical, research.
4	Morphology of internal organs	2	3	Cell and tissue biology	Physiology of higher nervous activity	The purpose of the study. Form an understanding of the morphology of the internal organs of a person and their systems. Summary. The morphology of the internal organs (splanchnology): the respiratory, digestive, sexual, urinary and reproductive systems, the endocrine system, the vascular system (angiology), and the nervous system. Expected results of the study: the student should know: morphological features of the structure of the internal organs of a person, their topography; patterns of formation of internal organs and systems in the process of ontogenesis as a reflection of phylogenetic development; features of the morphological structure of man; be able to: establish the relationship of the anatomical structure, morphology and functions of organs; make judgments about the main directions of development of the internal organs and systems of the human body; possess the skills of morphological assessment of the human body in anthropological studies. Competences: educative, methodical, research.
5	Inorganic chemistry	3	5	General chemistry	Analytical chemistry	The purpose of the study. Studying the properties of chemical elements and their compounds on the basis of the periodic law D.I. Mendeleev, modern ideas about the structure of matter, using the concepts of chemical thermodynamics, chemical kinetics and electrochemistry, as

						well as methods of obtaining and practical use of the most important elements and their compounds. Summary. Introduction The structure of the atom. Periodic law D.I. Mendeleev. Periodic system of chemical elements. Chemical bond Fundamentals of chemical thermodynamics. Solutions. Oxidation and reduction processes. Electrochemical reactions. Chemical kinetics. Basics of geochemistry. Nomenclature of simple substances and inorganic compounds. Hydrogen. Oxygen. Noble gases. Halogen free Chalcogens. Nitrogen. Phosphorus. Carbon. Silicon. Boron. Fundamentals of solid state chemistry. Polarization of atoms and ions. Atomic nucleus. Basic concepts of radiochemistry. Complex compounds. Alkali metals. Beryllium, magnesium, calcium, strontium, barium. Aluminum, gallium, indium, thallium. Germanium, tin, lead. Arsenic, antimony, bismuth. Titanium, zirconium, hafnium. Vanadium, niobium, tantalum. Chromium, molybdenum, tungsten. Manganese, technetium, rhenium. Iron, cobalt, nickel, platinum metals. Copper, silver, gold. Zinc, cadmium, mercury. Elements of the subgroup scandium. Lanthanides. Actinium and actinides. Principles of obtaining simple substances. Methods of separation, purification and analysis of substances Expected results of the study: students who have completed the study of this discipline should: know: the theoretical foundations of inorganic chemistry; patterns of changes in the properties of simple substances and compounds within groups and rows of the periodic system; methods and methods for the synthesis of inorganic substances; the essence of modern physical and physicochemical research methods used in inorganic chemistry, as well as the main tasks that are solved by these methods; wn: methods and methods for the synthesis of inorganic substances; skills of describing the properties of substances on the basis of the laws arising from the periodic law and the Periodic system of the elements; be able to: conduct experiments on the synthesis and study of inorganic compounds; interpret the results of a chemical experiment; solve design tasks for this discipline; be able to: use in knowledge and professional activities basic knowledge in the field of inorganic chemistry; in the conditions of the development of science and technology to the critical reassessment of accumulated experience and creative analysis of their capabilities; use their skills to solve professional and social problems. Competences: educative, methodical, research.
5	Inorganic synthesis	3	5	Chemistry of elements of the periodic table	Physico-chemical methods of analysis	The purpose of the study. To form ideas about the basics and features of both widely used and specific methods for the synthesis of inorganic substances; methods of cleaning compounds and obtaining substances of high purity. Summary. Introduction Getting simple substances. Synthesis of binary compounds. Getting salts when carrying out reactions in solutions. Examples of the synthesis of compounds of other classes. Methods for obtaining pure substances. Methods for obtaining substances of high purity. Methods for the synthesis of anhydrous inorganic compounds. Synthesis of solids by chemical assembly. The main methods of separation, concentration and purification of inorganic substances. Expected results of the study: the student must know: the fundamental sections of chemistry necessary to perform synthetic work; the main provisions of the theory of the subject, the basic physical and chemical properties of inorganic compounds; be able to: analyze literary and experimental data; select specific methods of synthesis, based on the task, the morphology of the sample, specific methods of cleaning the target product from impurities;

						own: methods of synthesis of the main classes of inorganic compounds; skills to choose a rational scheme of synthesis and identification of compounds, depending on the nature of substances and their quantitative content; specific skills of conducting chemical experiments in special conditions. Competences: educative, methodical, research.
6	Anatomy and morphology of plants	3	5	Cytology and histology	Systematics of plants	The purpose of the study. Formation of students' ideas about the structure of the plant body, its associated functions and their evolutionary change. Summary. Introduction The similarities and differences of plants and their cells with other living organisms. The position of plants in various systems of the organic world. The structure of the plant cell. The main provisions of the cell theory. Eukarnochnaya cell. The structure of the plant cell. The simplest plant organisms. Algae organization systems. VEGETABLE FABRICS. Educational tissue. Meristem. Assimilation, storage, air-carrying, integumentary, secondary-covering, excretory (secretory), mechanical, conductive tissue. VEGETATIVE ORGANS OF PLANTS. The concept of organ in plant morphology. Root, shoot, bud, stem, leaf and their anatomy, morpho-functional features and classification. Generative organs of plants. Vegetative, asexual and sexual reproduction of plants. Types of sexual reproduction of plants. Alternation of generations. Flower and its structure. Androecium, gynecium and their features of anatomical and morphological characteristics. Formulas and diagrams of a flower. Arrangement of flowers on the plant. Flowering and pollination of plants. Seed. Fetus. Structure, classification of seeds and fruits. Expected results of the study: the student must have basic botanical terms underlying the anatomy and morphology of plants; know the structure of cells, tissues and organs of plants; have an idea about the formation of the structure of plant organisms in ontogeny and phylogenesis; to be able to use a microscope, to prepare preparations for microscopy, to recognize the elements of the structure of plant organisms and to correctly register the results of observations. Competences: educative, methodical, research.
6	Botany	3	5	Cell and tissue biology	Flora of the world	The purpose of the study. To form among students an integrated system of knowledge about the structure, diversity, classification of higher plants, and plant communities, taking into account modern scientific achievements. Summary. Introduction Plant morphology. Features of the cell structure of higher plants. Fabrics The emergence of leaf-stem organization of higher plants. Anatomical and morphological structure of vegetative organs. Plant reproduction and life cycle features. Flower as a special reproductive organ of angiosperms. Systematics of higher plants. General questions of taxonomy. A systematic review of higher plants. Higher spore plants. Seed plants. Geobotany. The influence of the most important environmental factors on morphogenesis, plant distribution and the formation of plant communities. Expected results of the study: the student should know: basic concepts (terms), structural features of plant organisms at the macro- and microscopic levels; features of plant reproduction; features of plant development during ontogenesis and in the process of evolution; characteristic features, classification of various taxa of modern and fossil higher plants; be able to: navigate in the diversity of the plant world, diagnose various taxonomic groups of plants; to use knowledge and practical skills in pedagogical, scientific, industrial and environmental activities, in the study of other biological disciplines; own: the main methods of anatomy,

						morphology, systematics, geobotany for the study of plants at the level of tissues, organs, organisms, plant communities; identification skills of various taxonomic groups of higher plants; the main methods and techniques for describing plant communities. Competences: educative, methodical, research.
7	General and molecular genetics	3	5	Human anatomy	Biochemistry	The purpose of the study. To give students an idea of genetics, its problems, current state and the latest achievements, as well as to develop students' genetic thinking. Summary. The subject and tasks of general and molecular genetics, the history of its development. The material basis of heredity and variability. Structure and types of nucleic acids. The implementation of hereditary information. Types of reproduction of organisms. Mono-, di- and polybreeding. Patterns of inheritance of characters. Basics of genetic analysis. Chromosomal theory of heredity. Types and causes of variability of organisms. Gene structure Basic molecular cellular mechanisms. The current state of the problems of genetics. Possibilities of managing heredity and variability of organisms. Expected results of the study: After studying this course, the student should know: the subject and tasks of general and molecular genetics, the history of its development; material bases of heredity and variability, structure and types of nucleic acids, realization of hereditary information, types of reproduction of organisms, patterns of inheritance of characters, bases of genetic analysis, chromosomal theory of heredity, types and causes of variability of organisms, fine structure of the gene, basic molecular cellular mechanisms, current state of problems genetics, possibilities of managing heredity and variability of organisms; be able to: conduct a bibliographic search of literary sources; solve genetic problems on mono-, di- and polyhybrid crossing; competently conduct experiments to study heredity and variability; be able to apply knowledge of genetics in practical activities; learn to use the studied techniques and methods of genetics for the needs of biotechnology; have skills: building a second strand of DNA in accordance with the nucleotide composition of the first strand of DNA; constructing mRNA in accordance with the nucleotide composition of one of the DNA strands; determining the amino acid composition of proteins in accordance with the nucleotide composition of DNA or mRNA; the construction of the Pennet lattice for solving genetic problems of character inheritance; using the hybridological method of studying patterns of inheritance of characters; assessing the contribution of genetic and external factors to the development of pathology with a hereditary predisposition; determine the frequency of pathological genes and genotypes in the human population; compilation of pedigrees, their presentation in graphical form and analysis of the type of inheritance of a pathological trait; making a prediction of the development of a hereditary disease in a carrier of a pathological gene or a prediction of the birth of a child with a hereditary pathology. Competences: educative, methodical, research.
7	Genetics with fundamentals of selection	3	5	Morphology of internal organs	Chemistry the basics of soil science	The purpose of the study. To study the material basis of heredity, variability, patterns of inheritance of characters, the relationship of the influence of genotype and environmental factors on the development of the organism, the basis of modern methods of genetics, genetic engineering, selection. Summary. Introduction The material basis of heredity. Cell cycle Mitosis. Meiosis. Patterns of inheritance traits and principles of heredity. Variability. Classification of

						variability. Modification variability. Mutational variability. The influence of physical environmental factors on the mutation process. Genetic basis of ontogenesis. Genetics of plant development. Genetics of populations. Nonchromosomal (cytoplasmic) inheritance. Mutational variability. The influence of physical environmental factors on the mutation process. The influence of chemical agents of the environment on the mutation process. Determination and differentiation. Expected results of the study: the student should know: the material basis of heredity, variability and mechanisms for their implementation; patterns of inheritance of characters; the influence of genotype and environmental factors on the development of the organism; be able to: apply the basic laws of heredity and patterns of inheritance of characters to the analysis of the inheritance of normal and pathological characters; analyze material from various sources of information; calculate the frequency of occurrence of alleles in populations of different plant and animal species; own: skills of work with literature, including periodical scientific literature; methods of genetic, cytogenetic and population analyzes of the phenomena of heredity and variability; skills of describing the karyotypes of plants and animals. Competences: educative, methodical, research.
8	Analytical chemistry	3	5	Inorganic chemistry	Organic chemistry of aliphatic compounds	The purpose of the study. Obtaining basic education by students in all aspects of modern analytical chemistry, developing on the basis of the fundamental laws of physics and chemistry basic methods and techniques for establishing the qualitative and quantitative composition of various objects and ensuring the control of technological processes. Summary. Assessment of the reliability of analytical data. The law of action of the masses. Redox Reactions. Complexing in analytics. Qualitative analysis. Cations. Anions. Salt analysis. Quantitative analysis. Gravimetric analysis. Titrimetric analysis. Analysis of organic compounds. Physico-chemical and optical methods of quantitative analysis. Photometric methods of analysis. Chromatographic method of analysis. Refractometric analysis method. Electrochemical methods of analysis. Potentiometric analysis method. Expected results of the study: as a result of mastering the discipline, the student should be able to: describe the mechanism of chemical reactions of quantitative and qualitative analysis; justify the choice of methods of analysis, reagents and chemical equipment for a specific task; prepare solutions of a given concentration; conduct quantitative and qualitative analysis in compliance with safety regulations; analyze mixtures of cations and anions; monitor and evaluate the course of chemical processes; calculate the results of the analysis and evaluate the reliability of the results; must know: the aggregate state of matter; analytical classification of ions; instrumentation and analysis techniques; the importance of chemical analysis, methods of qualitative and quantitative analysis of chemical compounds; the frequency of the properties of elements; methods of expressing the concentration of substances; theoretical foundations of analysis methods; theoretical foundations of chemical and physicochemical processes; analysis technique; types of errors in the analysis; device of the main laboratory equipment and rules of its operation. Competences: educative, methodical, research.

8	Physico-chemical methods of analysis	3	5	Inorganic synthesis	Structure of matter	The purpose of the study. Students get knowledge about the methods of chemical and physico-chemical analysis, their theoretical foundations, as well as their acquisition of skills and abilities to draw theoretical conclusions based on the observed phenomena. Summary. The laws of thermodynamics. Hess law. Methods for calculating the thermal effects of chemical reactions. Heat capacity. The dependence of heat capacity on temperature. Kirchhoff's law. The second law of thermodynamics. Entropy. Gibbs energy and Helmholtz energy. Thermodynamic potentials as a criterion for the direction of the processes and as a measure of system performance. The isotherm equation of a chemical reaction. The law of the masses. Chemical equilibrium Phase equilibrium. Gibbs Phase Rule. Phase equilibrium in one-component systems. Solutions. Solid solutions. Classification of solutions. The vapor pressure of the components above the solution. Electrochemistry. Electrolytes. Theories of electrolyte solutions. The concept of the rate of chemical reaction. Kinetics of simple reactions. The dependence of the reaction rate on temperature. Electrolysis. Chemical kinetics and catalysis. Disperse systems. The concept of dispersed and calloid systems. The concept of dispersed and calloid systems. Surface tension. The influence of various factors on the magnitude of the surface tension. Thermodynamics of surface phenomena. Adsorption. Quantitative ways of expressing adsorption. Adsorption theory. Expected results of the study: students should know: the development of theoretical foundations and the acquisition of skills of physico-chemical analysis of research; teach students; the essence of the laws and chemical processes underlying the method of analysis, methods of definitions; be able to: understand the processes of physico-chemical analyzes; use the methods of physico-chemical analysis for the analysis and examination of various objects; to use physico-chemical methods for different types of analysis in a complex way; draw up analysis schemes, choose an analysis method. own: the basic techniques of the chemistry of the definition and analysis of objects; theoretical foundations of physico-chemical chemistry; have an idea of the possibilities and limitations of the use of a particular method of analysis, the solution of certain practical problems. Competences: educative, methodical, research.
9	Systematics of plants / Flora of the world	3	5	Anatomy and morphology of plants/Botany	Plant physiology/Phytochemistry	The purpose of the study. Formation of students' theoretical and practical knowledge of modern systematics of plants, instilling in students the skills and abilities of independent work with plant objects, the development of interest in conducting research in the field of floristics and systematics. Summary. The subject, tasks, methods and importance of modern taxonomy of plants. Systematics: history, classification, nomenclature. General characteristics of lower and higher plants. Prokaryotes. Department of blue-green algae. Algae divisions: green, char, euglenic, pyrophytic, yellow-green, diatom. Department Mushrooms. Classes: Chytridiomycetes, Oomycetes, Zygomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes. Department Lichens. Higher plants. Departments: Mossy, Riniophytes, Aquatic, Horsetail, Fern. Division Gymnosperms. Division Angiospermous plants. Class bipartite. Monocot class. General characteristics, the most important directions of evolution. Expected results of the study: as a result of studying the systematics of the plant, the student should know: the diversity of the plant world and the basic laws of its formation, structure, spatial distribution, structure, evolution,

						systematic groups of plants; the duality of the tasks of taxonomy: promoting orientation in the diversity of plants and the disclosure of natural relationships between groups of plants; correlation of concepts: systematics, evolution, phylogenesis, systematics and floristics; taxonomic categories used in modern systematics; lower and higher plants as the main educators of modern vegetation cover; characteristics of specific plants, which embody the features of the group as a combination of species and higher systematic categories; the volume of systematic groups, the geographical distribution of plants, the place and role of plants in ecological systems; the practical importance of the properties of plants of different groups; be able to: distribute plants into groups, have a clear idea of the place in the system of certain plants; to use in practice the economically important properties of representatives of various groups of plants; master skills: identifying plants belonging to groups that are difficult to systematically; microscopy, preparation, sketching, work with the herbarium; to distribute plants in groups, to have a clear idea of the place in the system of certain plants; to use in practice the economically important properties of representatives of various groups of plants. Competences: educative, methodical, research.
9	Flora of the world	3	5	Botany	Plant physiology	The purpose of the study. Formation of a complex of knowledge about the features of the flora of the world, the Republic of Kazakhstan and the East Kazakhstan region, the ways and patterns of their formation, systematic, ecological and structural diversity of plants, as well as characterization of their role in biocenoses, economic importance and protection. Summary. Introduction to the subject. Basic concepts and terms. History of the study of flora. Features of the distribution of climate, soil and flora of the world, Kazakhstan and East Kazakhstan. Features of local vegetation cover in the East Kazakhstan region. Introduction of tree and shrub flora. Cultural flora and weeds. Floristic research methods. A systematic analysis of the flora of the world, Kazakhstan and East Kazakhstan. Biomorphic analysis of flora. Phytocenotic analysis of flora. Ecological groups of plants. Analysis of endemism, relictism. Objects of flora, protected and listed in the Red Book. Expected results of the study: the student should know: the terminology of the discipline, features of the flora of the world, RK and EKR, modern approaches to the analysis of floras, the principles of geobotanical and floristic zoning, the main systematic and ecological groups of plants, especially the protection of the flora of the world, RK and the region in the reserve, national park, game reserves; be able to: apply knowledge in floristic studies, make notes of floras and their analysis, recognize rare and protected plant species of the Republic of Kazakhstan, in collections, in drawings, in nature; own: the methodology of floristic studies, techniques for describing plant communities, methods for determining the species range, knowledge and skills for the professional treatment of botanical objects. Competences: educative, methodical, research.
10	Microbiology and Virology	3	5	Anatomy and morphology of plants	Invertebrate Zoology	The purpose of the study. 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. Summary. Introduction to microbiology and virology. The

						morphology and structure of microorganisms. Systematics, morphology and structure of prokaryotic cells. The morphology and structure of the eukaryotic cell. Microbiological laboratory, its tasks. Microscope device Immersion system. Paints and coloring solutions. Preparation of bacterial preparations. Simple and complex staining methods. Morphology of mold fungi. Coloring by the method of Gram, Tsil Nielsen. Methods for the detection of spores and capsules. Determination of the mobility of bacteria. The morphology and structure of rickettsia, mycoplasma, chlamydia, algae and protozoa. The influence of external factors on microorganisms. The physiology of microorganisms. Metabolism. Food microorganisms. Reproduction and differentiation of microorganisms. Growth and cultivation of microorganisms. Preparation of nutrient media. Cultural properties of microorganisms. Microorganisms and the environment. The role of microorganisms in the circulation of substances in nature. The variability of microorganisms. Genetics of microorganisms. Selection of microorganisms. The basic properties and structure of viruses. The main properties of viruses. Bacteriophages. Chemical composition and architecture of viruses. Reproduction of viruses. Cultivation of viruses. Practical use of microorganisms. Rules for obtaining and processing of pathological material. Expected results of the study: the student must know: the basic properties of microorganisms; their classification, role in nature and human life; the realm of viruses, their use in the production of antiviral vaccines; biological features of microorganisms causing food spoilage; be able to: use the literature in the field of microbiology and virology; possess: methods that allow to identify non-permanent elements of microorganisms; isolating pure cultures of microorganisms and studying their biochemical properties using microbiological research methods used to assess environmental objects. Competences: educative, methodical, research.
10	Soil Microbiology	3	5	Botany	Invertebrate Fauna	The purpose of the study. Formation of knowledge and skills in general, soil and agricultural microbiology, understanding the role of soil microorganisms in agroecological processes. Summary. Objects, history, tasks, directions and prospects for the development of microbiology. Morphology and systematics of microorganisms. The ratio of microorganisms to environmental factors. Methods and types of nutrition of microorganisms. The spread of microorganisms in various substrates: soil, manure, grain, etc. Metabolism of microorganisms. The conversion of carbon compounds by microorganisms. The participation of microorganisms in the nitrogen cycle in nature. Biological fixation of atmospheric molecular nitrogen. Microorganism transformations of sulfur, phosphorus, iron and other compounds. Microbial complexes of soil. Principles and concepts of soil microbiology. Agroecological role of soil microorganisms. Associations of microorganisms with the root system of living plants. The role of soil microorganisms in the formation and destruction of humus. Ecological, biochemical and microbiological concepts of humus formation. The value of soil microflora in land reclamation. The biological activity of different types of soil, methods for determining the composition of soil microorganisms. Expected results of the study: the student should 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 suggest ways to regulate it, use bioindication, bio-tests. Must have the following competencies: - owns 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; able to use regulatory legal documents in their activities; strives for self-development, improvement of his qualifications and skills; able to put into practice basic general professional knowledge of the theory and methods of field research in the field of soil science, land reclamation, physics, chemistry, geography, biology, ecology, soil erosion, agrochemistry and agrophysics, soil landscape design, soil radiology, protection and rational use of soil; applies in practice knowledge of the theoretical foundations of management in the use and protection of soil cover; knows how to use normative documents determining the cost of field, laboratory, computational and interpretational works in the field of soil science, melioration, physics, chemistry, geography, biology, ecology, soil erosion, agrochemistry and agrophysics, soil landscape design, soil radiology, protection and rational soil use. Competences: educative, methodical, research.
11	Invertebrate Zoology	3	5	Microbiology and Virology	Vertebrate Zoology	The purpose of the study. Obtaining basic knowledge of anatomy, morphology, physiology, embryology, systematics and ecology of invertebrate animals of the world and regional fauna. Summary. Introduction to zoology. The definition, methods and objectives of zoology, the main stages of its development. The basic laws of animal evolution. The kingdom of the simplest. Protozoology. Type Sarcomastigophors. Subtype Flagellates. Type of ciliates. Spore-forming protozoa. The kingdom of Prometazoa. The organization of the plate and sponges. The origin of multicellular. Hypotheses of the origin of multicellular. Type Flatworms. Leading features of the organization, representatives of free-living and parasitic flatworms. Role in the evolution of the kingdom Animalia. Type Nemertiny. Type Golovobobotnye Primary and coelomic animals. Type Ringed Worms. Leading features of the organization, the metamerism of the body. Characteristics of individual classes. Type Arthropods. Leading features of the organization, exoskeleton, body segmentation. Arthropods classification. Subtype Trilobitomorfy. Subtype Helicer. Subtype Moth. Type Onyhophore. Peculiarity of organization, features of similarity with polychaetes and arthropods, ecology. Type Molluscs. The leading features of the organization, the mantle, the shell, the divisions of the body. Biology. Commercial value. Classification of mollusks. Subtype Bokonervnye, Heaton class: originality of organization, ecology. Subtype Shell. A general idea of other types of primary coelomic animals and their position in the system of the animal kingdom. Secondary coelomic animals. Common features and differences. Type Echinoderms. Type Poluhordovye. Expected results of the study: as a result of mastering the discipline, the student should know: the fundamentals of systematics, morphology, physiology of invertebrates; be able to: demonstrate the basic understanding of invertebrate zoology, put them into practice, critically analyze the information obtained and present the results of research. own: the skills of research work, teaching invertebrate zoology and discussion. Competences: educative, methodical, research.

11	Invertebrate Fauna	3	5	Soil Microbiology	Vertebrate Fauna	The purpose of the study. To form a complex of knowledge about the composition, distribution and formation of the fauna of invertebrates in the world, the Republic of Kazakhstan, as well as the East Kazakhstan region; on the distribution of animals in various ecological environments and geographic zones; about the role of animals in ecosystems and practical significance for humans. Summary. The subject, purpose, objectives, history of the study and formation of the fauna. The fauna of invertebrate animals of the world: various continents, oceans, seas, rivers, lakes. Fauna of the Republic of Kazakhstan. Fauna of East Kazakhstan. The distribution of animals in various environmental environments and geographic zones. The role of animals in ecosystems and practical significance for humans. Invertebrates listed in the Red Book. Expected results of the study: the student should know: the fundamentals of animal taxonomy in the volume of classes and basic units; the diversity of invertebrate animals of the Republic of Kazakhstan and the East Kazakhstan region (rare and endangered species of animals); information about the role of animals in nature and human activities; be able to: use the methods of observation, description, identification and classification of biological objects; apply modern methods of working with biological objects in the field and laboratory conditions; distinguish representatives of different classes and families; to characterize the structure and environmental features of the main groups of animals; identify and recognize in nature the main groups and species of animals on the traces of vital activity, appearance, voices; create educational collections; arrange and store collection material; work with animals in nature and the laboratory; conduct tours and perform in public; own: modern methods of processing, analysis and synthesis of field and laboratory biological information; skills in identifying animals to the family, genus and species; skills of independent work, self-organization and organization of tasks. Competences: educative, methodical, research.
12	Organic chemistry of aliphatic compounds	2	3	Analytical chemistry	Organic chemistry of cyclic compounds	The purpose of the study. Formation of ideas about the basic laws of the structure, properties and mutual transformations of various classes of aliphatic compounds. Summary. Introduction Electronic theory of chemical bonding. Theory of directed valences. Theory of electronic bias. Isomerism Classification of organic reactions. Classification of organic compounds. Alkanes (saturated hydrocarbons). Alkenes (ethylene hydrocarbons, olefins). Alkynes (acetylenic hydrocarbons). Alkadienes (diene hydrocarbons). Halogenated alkanes. Alkanols (monohydric alcohols). Two-, trihydric alcohols. Ethers. Thiospirits. Thioesters and other sulfur compounds. Nitro compounds of aliphatic series. Amines aliphatic series. Aldehydes and ketones. Monocarboxylic acids. Carboxylic acid derivatives. Connections with two or more functions. Dicarboxylic acids. Hydroxy carboxylic acids and optical isomerism. Aldehyde and keto acids. Tautomerism. Amino acids. Expected results of the study: the student should know: the subject of organic chemistry, the theory of the chemical structure of AMButlerov, the characteristics of the covalent bond; inductive, mesomeric effects, structural isomerism, stereoisomerism, geometric isomerism, optical isomerism, conformational isomerism; addition, cleavage, substitution, rearrangement, homolytic and heterolytic reactions; homologous series of methane, ethylene, acetylene, oxygen-containing compounds, nitrogen-containing compounds, their nomenclature, laboratory and industrial methods for their preparation, physical and chemical properties;

						be able to: depict structurally isomers of the main classes of aliphatic compounds; give names for different types of nomenclature - rational, historical and international, and determine the structure of a substance by name; be able to describe the reaction taking into account the mechanism and determine the reaction products, analyzing the conditions of its implementation. Competences: educative, methodical, research.
12	Structure of matter	2	3	Physico-chemical methods of analysis	Chemistry of high-molecular compounds	The purpose of the study. To form an understanding of the modern concepts of the structure of chemical compounds and the possibilities of their use for understanding and predicting the physical properties of substances and their reactivity under various conditions. Summary. Historical aspect. Fundamentals of the modern theory of chemical structure. The phenomenon of isomerism. Basic concepts, terms, definitions. Structural isomerism. Spatial structure of compounds. Electronic structure of compounds. Geometry of molecules. The relationship of the spatial structure and geometry of the molecules with the electronic structure. Spatial and electronic structure of "non-classical" structures and intermediates. Intermolecular interactions. Energy characteristics of substances and their constituent chemical particles. Optical properties of molecules. Oscillatory spectra, connection with the structure. Electronic spectra, connection with structure. Electrical properties of matter and the structure of its molecules. Magnetic properties of matter and the structure of chemical particles. Structure and reactivity of chemical compounds. Expected results of the study: the student should know: the basic principles of the structure of chemical particles, the most important characteristics of the chemical, electronic and spatial structure of stable compounds and intermediates in chemical reactions of various types, the nature of intermolecular interactions; be able to: identify the basic principles of the structure of chemical particles, the relationship between different aspects of the chemical, electronic and spatial structure of compounds; to be guided in the features of the chemical behavior of various types and classes of chemical compounds, due to their structure; own: skills of analysis and determination of the nature of the structure on the basis of a set of data on the physical and chemical properties of a substance obtained by experimental and theoretical methods. Competences: educative, methodical, research.
13	Organic chemistry of cyclic compounds	3	5	Organic chemistry of aliphatic compounds	Physical and colloidal chemistry	The purpose of the study. Formation of ideas about the basic laws of the structure, properties and mutual transformations of various classes of cyclic compounds. Summary. Alicyclic compounds. Aromatic hydrocarbons. Phenols and aromatic alcohols. Aromatic aldehydes and ketones. Aromatic carboxylic acids and their derivatives. Nitrogenous organic matter. Heterocyclic compounds. Structure, isomerism, nomenclature, physical and chemical properties of all studied cyclic compounds. Expected results of the study: As a result of studying the course, the student should know: the basic concepts and laws of organic chemistry; types of organic reactions and the mechanisms of their occurrence, factors influencing the reactions; methods of cleaning organic matter. be able to: plan the synthesis of complex organic structures; to carry out the synthesis of organic substances and their indentation; put into practice various methods of purification of organic substances. Competences: educative, methodical, research.

13	Chemistry of high-molecular compounds	3	5	Structure of matter	Polymer Chemistry	The purpose of the study. To form students' competences related to the ability to master the skills of a chemical experiment, the main methods of obtaining and research of high-molecular compounds, their physicochemical properties; skills to work on modern teaching and scientific equipment when conducting chemical experiments; methods of recording and processing the results of chemical experiments; methods of selection of material for theoretical and laboratory work for the subsequent application of the acquired knowledge and skills to perform professional tasks. Summary. Introduction Classification methods for the synthesis of polymers. Chain polymerization. Methods for carrying out polymerization reactions. Step polymerization. Methods for carrying out polycondensation reactions. Copolymerization and copolycondensation. Expected results of the study: the student should know: the types of chemical reactions and their main features; recent achievements and development prospects in the field of chemistry, their relationship with other fields of knowledge; the basic rules and techniques of self-organization and self-education; be able to: perform calculations using chemical formulas and equations; conduct a chemical experiment in accordance with the rules for the safe handling of equipment and chemicals; develop an individual trajectory of self-education; own: skills to work with laboratory equipment; skills for determining the physicochemical constants of the compound obtained; methods of processing the obtained experimental results; rules and methods of self-education. Competences: educative, methodical, research.
14	Vertebrate Zoology/	3	5	Invertebrate Zoology	Evolutionary teaching	The purpose of the study. Acquaintance of students with the anatomical and morphological structure, vital activity, ecological and morphological adaptations and diversity of the type of chord animals and key directions of their evolution. Summary. Zoology of vertebrates as a science. Place of zoology in the system of sciences. History of zoology. General characteristics of the type of chord. Organization of uncranial (for example, lancelet). Larval-chord or tunicate. General characteristics of the vertebrate subtype. Vertebrates without germinal membranes. Class Cartilaginous fishes. Class Bony fish. Class Amphibians. General characteristic of the class Reptiles. A systematic review of modern reptiles. General characteristics of the class Birds. A systematic review of birds. General characteristics of the class of mammals. A systematic review of modern mammals. Expected results of the study: as a result of studying the discipline, the student should know: the main features of the organization of chordates, the volume and type system, the morphological and ecological characteristics of representatives of each class, the class system; know about the origin and evolution of the type, subtypes and classes of chordates; about the role of animals in the ecosystem and the biosphere as a whole; know the structure and characteristics of the local vertebrate fauna and the ecology of mass and rare animal species; Latin names of taxons of chordates; be able to: apply theoretical knowledge in professional and practical activities, conduct tours; own: methods of laboratory zoological research on morphology. Competences: educative, methodical, research.
14	Vertebrate Fauna	3	5	Invertebrate Fauna	Anthropogenesis	The purpose of the study. To form a complex of knowledge about the composition, distribution and formation of the fauna of vertebrate animals of the world, the Republic of Kazakhstan, as well as the East Kazakhstan region; on the distribution of animals in various ecological environments

						and geographic zones; about the role of animals in ecosystems and practical significance for humans. Summary. The subject, purpose, objectives, history of the study and formation of the fauna. Fauna of the vertebrates of the world: various continents, oceans, seas, rivers, lakes. Fauna of the Republic of Kazakhstan. Fauna of East Kazakhstan. The distribution of animals in various environmental environments and geographic zones. The role of animals in ecosystems and practical significance for humans. Vertebrates listed in the Red Book. Expected results of the study: the student should know: the fundamentals of animal taxonomy in the volume of classes and main groups (for the most important groups - families and individual representatives); the diversity of vertebrate animals of the Republic of Kazakhstan and the East Kazakhstan region (rare and endangered species of animals); information about the role of animals in nature and human activities; be able to: use the methods of observation, description, identification and classification of biological objects; apply modern methods of working with biological objects in the field and laboratory conditions; to distinguish representatives of different classes and families, to characterize the structure and ecological features of the main groups of animals; work with animals in nature and the laboratory; conduct tours, speak in public; own: modern methods of processing, analysis and synthesis of field and laboratory biological information; skills in identifying animals to the family, genus and species; skills of independent work, self-organization and organization of tasks. Competences: educative, methodical, research.
15	Biochemistry	3	5	General and molecular genetics	Applied chemistry	The purpose of the study. Formation of students' holistic system of knowledge about the chemical composition of living organisms, physico-chemical and biological properties of natural compounds, the main metabolic pathways, mechanisms of regulation and mutual metabolism of metabolic processes. Summary. Introduction to biochemistry. The purpose and main tasks of biochemistry. The place of biochemistry among biological disciplines and other sciences. Squirrels. Amino acids. - as structural components of proteins. Principles of classification of amino acids. Biochemical functions of amino acids. The structure of proteins. The levels of organization of protein molecules. Enzymes Classification, nomenclature, structure and properties of enzymes. Carbohydrates: classification, nomenclature, structure and properties. The functional role of carbohydrates in mammalian cells, plants, microorganisms. Lipids. General properties, classification and nomenclature of lipids. The functional importance of lipids in the cell. Nucleic acids and their structural components. Nucleosides and nucleotides, their structure and properties. The biological role of nucleotides in the body. DNA and RNA. Properties and specificity of nucleic acids. DNA structure. DNA functions. RNA. Types of RNA. Characteristics of the main types. Vitamins. The biological importance of vitamins for the body. Classification, structure, and properties of vitamins. Hormones, their properties and biological role. Classification of hormones. Metabolism of nucleic acids, proteins and amino acids, carbohydrates, lipids. Energy biochemical processes. Expected results of the study: the student should know: the basic principles of the structural organization of the most important biological macromolecules - proteins, nucleic acids, carbohydrates, lipids; the functional role of proteins,

						nucleic acids, carbohydrates, lipids, hormones in the vital processes; specific properties and kinetic characteristics of enzymes, as well as the role of enzymes for biotechnology; properties and the role of DNA and RNA in the reproduction and transfer of genetic information; the main ways and mechanisms of regulation of metabolism; theoretical and practical significance of biochemistry, the relationship with other natural sciences; the latest achievements in the field of biochemistry and the prospects for their use in various fields of biotechnology, national economy, medicine, pharmacy; about the relationship of biological function and molecular structure of compounds; about the connection of molecules of nature with biotechnological production; be able to: use this knowledge to master other biological disciplines, as well as to solve practical issues of biotechnology; carry out qualitative and quantitative analysis of biological material; work with biochemical equipment; apply theoretical knowledge in solving technological problems; gain experimental research skills; to be guided in the source information on biological chemistry; own: modern laboratory biochemical methods for studying biological molecules to solve practical problems of biotechnology. Competences: educative, methodical, research.
15	Chemistry the basics of soil science	3	5	Genetics with fundamentals of selection	Introduction to chemical technology	The purpose of the study. Formation of ideas, theoretical knowledge and practical skills on the scientific basis and methods of agronomic chemistry. Summary. Plant nutrition and ways of its regulation. Composition and absorption capacity of the soil. Agrochemical properties of soil Chemical soil reclamation. Classification of fertilizers and methods of their introduction. Nitrogen fertilizers The role of nitrogen in plant life. Content and conversion of nitrogen in the soil. Basic nitrogen fertilizers, their properties and use. Phosphate fertilizers. The role of phosphorus, potassium in plant life. Content and availability of phosphorus and potassium in the soil. Phosphate fertilizers. Potash fertilizers. Complex fertilizers. Composition, properties and applications of complex and combined fertilizers. Microfertilizers. The value of trace elements for plants and their content in the soil. Organic fertilizer. Diversified effect of organic fertilizers on plants and soil. Manure, its properties, storage and use. System of application of fertilizers. Agronomic and economic efficiency of fertilizer application. Expected results of the study: the student should know: the chemical composition of plants and their nutritional characteristics; agrochemical properties of various soil types; chemical composition and properties of fertilizers; conditions for the effective use of fertilizers for obtaining planned crop yields; modern methods of determining the needs of crops for fertilizers; methods of chemical analysis of soil and plants; methods of mathematical-static processing of experimental data; be able to: conduct a selection of soil and plant samples for analysis; carry out chemical analysis of soil, plants and fertilizers; determine the need for fertilizers, the most effective terms and methods, technology of application and termination of fertilizers; conduct soil and plant diagnostics. Competences: educative, methodical, research.
16	Plant physiology	3	5	Systematics of plants	Modern methods of teaching biology	The purpose of the study. Formation of knowledge about the general patterns and specific mechanisms underlying the physiological processes occurring in plant organisms and the rationale of practical techniques aimed at increasing plant productivity. Summary. The subject and tasks of plant physiology, the history of its development. Features of the structure of the

						plant cell and its differences from the animal cell. The type of a plant cell and its use in plant biotechnology. Carbon nutrition of plants: leaf pigments, energy and chemistry of photosynthesis, composition, localization and functions of photosystem I and II, use of solar energy for energy production in biotechnology, water exchange of plants: the main mechanisms of water entry into the cell and further into the plant, movement of water through the plant ; evaporation of water by the plant, the basis of plant resistance to drought. Mineral nutrition: the supply and movement of nutrients in the plant, the main macro-and micronutrients, nutrient mixtures for the cultivation of plants, the physiological basis of fertilizer application. Breath of plants: its importance in the life of plants, the influence of various factors on the intensity of respiration; components of the respiratory chain; mechanism of oxidative phosphorylation. Plant growth and development: phytohormones, principles of regulation of growth and development. Expected results of the study: the student must know: the subject and tasks of plant physiology, the history of its development; structural features of the plant cell and its differences from the animal cell; totipotency of the plant cell and its use in plant biotechnology; carbon nutrition of plants: leaf pigments, energy and chemistry of photosynthesis, composition, localization and functions of photosystem I and II, use of solar energy for energy production in biotechnology; water metabolism of plants: the main mechanisms of water entry into the cell and further into the plant, the movement of water through the plant; water evaporation by plants, the basics of plant resistance to drought; mineral nutrition: the supply and movement of nutrients in the plant, the main macro-and micronutrients, nutrient mixtures for the cultivation of plants, the physiological basis of fertilizer use; plant respiration: its significance in plant life, the influence of various factors on respiration intensity; components of the respiratory chain; the mechanism of oxidative phosphorylation; plant growth and development: phytohormones, principles of regulation of growth and development processes; physiological bases of plant protection and resistance, the use of biotechnology methods to increase plant resistance and productivity; be able to: conduct a bibliographic search of literary sources; prepare nutrient solutions for aquatic plant cultures; to clearly carry out the plan of experiments with plant objects; work with live plants, choosing the best plant varieties for the experiment, sow them correctly, take care of the crops; compare and find differences between control and experimental plants; conduct phenological observations; to make experiments on the removal of physiological parameters of plants; draw the obtained results using graphic images; make a comparative analysis of the results; summarize and draw conclusions based on the results obtained; have skills: conducting experiments on the study of basic physiological processes; determination of osmotic pressure, intensity of transpiration, photosynthesis, respiration; excretion of chlorophyll and determination of its quantity and physicochemical properties; determine the effect of various mineral elements on the growth and development of plants, individual indicators of growth, plant resistance. Competences: educative, methodical, research.
16	Phytochemistry	3	5	Flora of the world	Theory and technology of teaching biology	The purpose of the study. To form students' knowledge, skills and practical skills on phytochemistry, based on theoretical information on individual groups of biologically active substances, including their definition, classification, physicochemical properties, methods of production,

						purification and separation, methods of identification, qualitative and quantitative definitions, using rational and modern research methods. Summary. General phytochemistry. The purpose and objectives of the discipline, the basic concepts, the essence of the methods of phytochemistry and phytochemical analysis, qualitative analysis, methods of quantitative determination of biologically active substances. Special phytochemistry. Methods for the quantitative and qualitative determination of biologically active substances in the corresponding medicinal plant materials containing vitamins, polysaccharides, essential oils, fatty oils, alkaloids, cardiac glycosides, saponins, simple phenols, tannins, anthracene derivatives, flavonoids, coumarins. Expected results of the study: the student should know: the basic concepts of pharmacognosy, methods of phytochemical analysis, the tasks of pharmacognosy at the present stage and its importance for the practical activities of a pharmacist; the main directions of scientific research in the field of phytochemistry of medicinal plants; the main groups of biologically active substances of natural origin and their most important physicochemical properties; the biosynthesis pathways of the main groups of biologically active substances; methods for the isolation and purification of basic biologically active substances from medicinal plant materials; main methods for the qualitative and quantitative determination of biologically active substances in medicinal plant materials; biological standardization of medicinal plant materials; quality indicators of raw materials and methods for their determination; safety regulations when working with medicinal plants and medicinal raw materials. To acquire such skills as: to isolate and carry out the purification of active biologically active substances from medicinal plant materials; conduct high-quality and microchemical reactions to biologically active substances to confirm their presence in medicinal plants and raw materials (polysaccharides, essential oils, vitamins, cardiac glycosides, saponins, anthracene derivatives, coumarins, flavonoids, tannins, alkaloids, etc.); to analyze according to the methods of quantitative determination, medicinal plant raw materials for the content of essential oils, cardiac glycosides, saponins, alkaloids, anthracene derivatives. tannins, flavonoids, coumarins, vitamins, etc .; carry out the determination of moisture, ash, extractive substances; to carry out statistical processing and registration of the results of pharmacognostic and phytochemical analyzes. Competences: educative, methodical, research.
17	Physical and colloidal chemistry	3	5	Organic chemistry of cyclic compounds	Chemical technology	The purpose of the study. Acquisition of theoretical knowledge of physical and colloid chemistry for further more in-depth study of the disciplines of the main cycle, necessary for the successful implementation of the professional activity of a bachelor. Summary. The laws of thermodynamics, thermodynamic potentials. Chemical equilibrium Phase balance, solutions. Thermodynamics of chemical equilibrium. The law of the masses. Chemical equilibrium and its signs. Electrochemistry. Chemical kinetics and catalysis. Disperse systems, thermodynamics of surface phenomena. Adsorption. Adsorption from gases on a solid adsorbent, adsorption on a solid surface of their solutions, adsorption of electrolytes, exchange adsorption. Adsorption theory. Electrical properties of dispersed systems, stability and coagulation. Solutions Navy and their properties, gels and jellies. Electrical properties of IUD solutions. Molecular-kinetic properties of solutions of high molecular compounds. Expected results of the study: the student should know: the

						main laws governing the chemical processes and the characteristics of the equilibrium state; the beginnings of thermodynamics and the basic equations of chemical thermodynamics; methods of thermodynamic description of chemical and phase equilibria in multicomponent systems; thermodynamics of electrolyte solutions and electrochemical systems; equations of formal kinetics and kinetics of complex, reactions; about the fundamental concepts and laws of colloid chemistry as a science about surface phenomena and disperse systems; basic concepts and relations of thermodynamics of surface phenomena, surface tension and surface energy, adsorption, adhesion, cohesion, wetting, spreading, capillary condensation; mechanisms of formation of the surface layer; about the structural-mechanical properties and rheological methods for the study of dispersed systems; about the features of the optical properties of dispersed systems, scattering, light absorption, coloration of sols; about stability and coagulation in dispersed systems; be able to: perform basic chemical operations; determine the thermodynamic characteristics of chemical reactions and equilibrium concentrations of substances; determine the direction of the process in the given initial conditions; to establish the boundaries of the stability regions of the phases in one-component and binary systems; determine the composition of coexisting phases in binary heterogeneous systems; compose kinetic equations in differential and integral form for simple reactions; carry out calculations using the basic thermodynamic relations of surface phenomena and calculations of the main characteristics of dispersed systems; calculate the energy parameters of adsorption; predict the influence of various factors on surface tension and surface energy; obtain and purify colloidal solutions; determine the sign of the charge of colloidal particles; predict the effect of dispersion on the reactivity, equilibrium constant and phase transition temperature; summarize and process experimental information in the form of laboratory reports; own: the skills to calculate the thermal effects of chemical reactions at a given temperature under conditions of constant pressure or volume; skills for calculating the equilibrium constants of chemical reactions at a given temperature; chemical equilibrium calculation methods; methods for measuring surface tension, contact angle, magnitude of adsorption and specific surface, viscosity; skills in the selection of appropriate methods, measuring instruments and laboratory equipment in certain studies. Competences: educative, methodical, research.
17	Physical and colloidal chemistry/Polymer Chemistry	3	5	Organic chemistry of cyclic compounds / Chemistry of high-molecular compounds	Chemical technology / Nanotechnology in chemistry	The purpose of the study. The study of the foundations of chemistry and physics of polymers and their role in human life. Summary. Chemistry of polymers. Basics of synthesis of polymers and their derivatives. Reactions to obtain polymers and their derivatives. Polymer physics. The main provisions of the physics of polymers. Polymer properties. Isolation and determination of polymers. The role of polymers in human life. Polymer production. Expected results of the study: the student should know: modern ideas about the structure and properties of high-molecular compounds used in the production of powders, solid rocket fuels and polymer composites; theoretical foundations of the synthesis of high-molecular compounds and their chemical transformations; main physico-chemical processes occurring during the manufacture of polymer composite materials; standard methods for determining the properties of powders, solid rocket fuels, polymeric materials;

						be able to: synthesize polymeric materials in the laboratory; conduct research on the properties of polymeric materials, powders, solid rocket fuels using standard methods; own: the experience of choosing the methodology for conducting complex tests of polymers, polymer composite materials and products based on them. Competences: educative, methodical, research.
18	Environmental chemistry	2	3	Evolutionary teaching	writing a thesis	The purpose of the study. Form an understanding of the qualitative and quantitative composition of anthropogenic pollution of the biosphere as a result of industrial and agricultural activities of man and the mechanisms of chemical transformations of substances in the environment. Summary. The subject and basic concepts of environmental chemistry. Environmental pollution. The concept of ecosystems. Global biogeochemical cycles of elements. Global biogeochemical cycles of elements. Global cycles of elements. Changes in the chemical composition of the atmosphere and climate of the earth. Principles for assessing the toxicity of substances. Anthropogenic effects on nature. Anthropogenic effects on the atmosphere, hydrosphere, vegetation and animals. Classification of anthropogenic impacts. Expected results of the study: the student should know: the current state and trends in the development of environmental chemistry; patterns of interaction of plant organisms and their aggregates with the habitat, as well as factors affecting these processes; the qualitative and quantitative characteristics of light, as an environmental factor affecting plants; the ecological value of the chemical properties of the soil; the effect on plants of movement and chemical composition of air masses; plant response to adverse environmental factors; plant types of bioindicators used in environmental diagnostics; be able to: conduct a screening analysis of the quality of the habitat; it is reasonable to choose a method and a methodology for analyzing environmental objects and biological objects in accordance with the objectives of the study; to carry out screening bioindication examination of the ecological state of biogeocenoses; conduct metrological processing of analytical measurements; own: laws of action of environmental factors to predict the optimal ecological plant niches; methods of sampling and conservation of biological material and environmental objects to determine the quality of the habitat; methods of registration of analytical parameters when conducting bioindicative and chemical studies. Competences: educative, methodical, research.
18	Coordination chemistry	2	3	Anthropogenesis	writing a thesis	The purpose of the study. In-depth study of the chemistry of coordination compounds; study of the features of the structure and properties of coordination compounds in organoelemental chemistry. Summary. 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. Basics of the synthesis of coordination compounds. Reactivity of coordination compounds. Applied aspects of coordination chemistry. Expected results of the study: the student should 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; give suggestions when setting up or rationalizing the relevant experiment;

						own: terminology and techniques for conducting the simplest estimates and calculations, for example, using circular thermochemical cycles or ligand field theory. Competences: educative, methodical, research.
MAIN DISCIPLINES						
Elective courses (EC)						
1	Hydrobiology of plants and animals	3	5	Vertebrate Zoology	Green chemistry	The purpose of the study. Equip students with knowledge about aquatic habitats - hydrobionts, their populations and communities. Summary. Hydrobiology as a science. Reservoirs and their population. Life forms of hydrobionts. Food of hydrobionts. Water-salt exchange of hydrobionts. Breath of hydrobionts. Growth, development and energy of hydrobionts. Structure and functional features of hydrobiont populations. Reproduction and dynamics of hydrobiont populations. Hydrobiocenosis. Biological productivity of aquatic ecosystems and ways to increase it. Ecological aspects of the problem of clean water and protection of aquatic ecosystems. Expected results of the study: the student should know about: the subject and tasks of hydrobiology; ecological processes of vital activity of organisms in the hydrosphere (nutrition, metabolism, respiration, growth and development); species composition of aquatic organisms in reservoirs; life forms of hydrobionts; aquatic ecosystems as units of the biosphere; hydroecosystems and ecological bases of their rational development; structure, functional features, dynamics of hydrobiont populations. be able to: use the obtained theoretical material in the field; own: methods of ecological analysis of hydrobionts. Competences: educative, methodical, research.
1	Biology of reproduction and development	3	5	Vertebrate Fauna	Genetic engineering	The purpose of the study. Acquisition of knowledge about the patterns and mechanisms of individual development of organisms, familiarization with the complex of traditional (descriptive, comparative, historical) and modern methods of research of various stages of ontogenesis. Summary. The subject, objectives, history of the development of BRR. Methods for obtaining and research of embryonic material. Periodization of ontogenesis, modification of periods of ontogenesis. Conditions of reproduction of organisms. Life cycles Gametogenesis. Classification of ova. Fertilization and parthenogenesis. Patterns of crushing, the formation of blastul. Gastrulation in lancelet. Common features of the development of amniot. Early bird development. Early development of mammals Determination, embryonic regulation and induction processes in early development. Cytodifferentiation, histogenesis, organogenesis. Development of endoderm, mesoderm, ectoderm derivatives. Growth. Physiological and reparative regeneration. Aging. Biological age. Metamorphosis. Phylogenesis. Expected results of the study: the student should know: the main stages of development of the R & D, the value of R & R in the system of biological sciences and its applied value; content of the concepts: progenesis, fertilization, parthenogenesis, morphogenesis, growth, development, metamorphosis, regeneration, aging; peculiarities of ontogenesis of invertebrate animals with direct development, incomplete transformation and metamorphosis; characteristics of the ontogeny of vertebrates (anamnias and amniotes); content of the concepts: "organogenesis", "histogenesis"; morphogenetic and embryological mechanisms of evolutionary changes, modifications of the periods of ontogenesis, which have ecological and evolutionary significance; be able to: distinguish by description, morphological features in the figures, micrographs and micro-preparations of

						gametes, the stages of development of various organisms; using models and tables to determine the stage of organogenesis; cultivate, prepare and describe bird embryo preparations; own: microscopy skills. Competences: educative, methodical, research.
2	The human and animal physiology	3	5	Human anatomy	Applied biology	The purpose of the study. To equip the future specialist with knowledge of the laws of life processes occurring in humans and animals; to give students an idea of the life processes of the animal organism and its constituent parts (cells and subcellular structures, tissues, organs, organ systems) in their unity and relationship with the environment. Summary. Introduction The subject, content and tasks of animal physiology. Research methods in physiology. General physiology. Physiology of excitable tissues. Physiology of the muscles. Mechanisms of regulation of body functions. Private physiology of the central nervous system. The structure and function of the spinal cord. Brain. Sensory systems. Nervous regulation of vegetative functions. The internal environment of the body. The system of internal organs and their regulation. Heat production and heat transfer. Lactation. Expected results of the study: the student should know about: the subject and tasks of human and animal physiology, the history of its development; features of the structure of the animal cell and its differences from the plant cell; theoretical and methodological foundations of physiology; physiology of excitable tissues; human analyzers physiology; private physiology of the central nervous system; mechanisms and patterns of activity of the vegetative functions of the body; be able to: conduct a bibliographic search of literary sources; carry out somatometry (anthropometry); identify short-term verbal-logical memory; determine mental performance; to determine the main physiometric indicators; evaluate the physical development of a person; apply the received theoretical knowledge and practical skills in practical and research activities. Competences: educative, methodical, research.
2	Physiology of higher nervous activity	3	5	Morphology of internal organs	Introduction to biotechnology	The purpose of the study. The study of the basic principles of the higher nervous activity of animals and humans, the physiological mechanisms of command, the structure of a behavioral act. Summary. Historical background of the emergence of the theory of higher nervous activity. Brain structures, which are the material substratum of logical activity (high nervous activity). The concept of higher nervous activity. The concept of conditioned and unconditioned reflexes. The mechanism of formation of conditioned reflexes. Approximate reflex. Types of inhibition of conditioned reflexes. The formation of conditional reflex switching (stage). Training. Classification forms of education. Features of GNI in various animals. The structure of the behavioral act (by PK Anotinu). Behavior in a probabilistic environment. Neural mechanisms of behavior. Needs, their classification. The concept of motivation. Motivation as a state, as a dominant. Neurochemical motivational. Emotions and their functions. Neurochemistry of emotions. Neurophysiological mechanisms of memory. Types of memory. Functional asymmetry of the brain. The second signal system. Age and sex differences. Speech and thinking. Brain and consciousness. Consciousness, subconscious, superconscious. Sleep, theory of sleep, phase and stage of sleep. The role of sleep in the processes of memory and learning. Sleep and logical activity. Typology of higher nervous activity. Pavlov's theory on the typology of GNI, taking into account the role of the first and second signaling systems. Methods for studying the characteristics of GNI in

						humans and animals. Expected results of the study: To possess a sufficient arsenal of the subject, to understand the mechanisms of the brain, the mechanisms of psychological processes. Competences: educative, methodical, research.
3	Methods of solution of tasks on chemistry	3	5	Methods of teaching chemistry	Modern methods of teaching chemistry	The purpose of the study. Develop students' creative abilities and teach them to use the basic laws and concepts of inorganic chemistry when solving experimental, computational and other problems of increased complexity, to teach students how to solve problems in several alternative ways, and to choose the most elegant solutions. Formation of students' knowledge and skills in teaching students how to solve chemical problems. Summary. The system of chemical problems, their place in the teaching of chemistry. The practical importance of the ability to solve problems. Classification of tasks in chemistry. Signs of classification. Analysis of the chemical problem. Formation of concepts about the two sides of the chemical problem. Ways to solve chemical problems. The main ways to solve chemical problems. Additional ways to solve chemical problems. Methods of solving problems of high complexity. The use of physics and mathematics in solving problems in chemistry. Methods of solving problems in chemical formulas and equations. Methods for solving problems on a mixture of substances (solid, liquid gases). Methods for solving problems on solutions, solubility, equilibrium in electrolyte solutions. Methods of solving problems in thermochemistry, chemical thermodynamics. Methods of solving problems on the topic of oxidation - reduction reactions and electrochemistry. The solution of qualitative and quantitative experimental problems to determine the composition of substances and mixtures. Formation of the ability to compose texts of chemical tasks of increased complexity. Combined tasks, tests. The use of ICT in the analysis and solution of problems in chemistry. Expected results of the study: the student should have the following knowledge, skills and abilities: possess methodical techniques for solving problems of varying degrees of complexity in the main sections of chemistry; possess methodic techniques for solving olympiad problems; be able to solve complex creative problems of a theoretical and applied nature; be able to solve problems with the help of a computer and a personal computer; own computer programs for solving problems; master the technique of using multimedia tools to teach students how to solve chemical problems; be able to make up the conditions and formulate solutions to tasks and exercises of increased complexity. Competences: methodical, educational.
3	Technique of carrying out of school chemical experiment	3	5	Methods of teaching chemistry	Theory and technology of teaching chemistry	The purpose of the study. Form a holistic view of the preparatory stages and methods of conducting a school chemical experiment. Summary. Chemistry Cabinet and its equipment. Chemical experiment in the system of organizational forms of education. Methods of chemical experiment. Technique and methods of chemical experiment in the study of the main sections of chemistry. Methods of conducting the main demonstration experiments and laboratory work in the study of the main sections of chemistry. Expected results of the study: the student should know: the construction scheme and methods of conducting a chemical experiment in school; techniques and methods of chemical experiment in the study of the main sections of chemistry; be able to: organize and conduct basic demonstration experiments and laboratory work own: methodical methods of conducting a school chemical

						experiment. Competences: methodical, educational, social and communicative.
4	Evolutionary teaching	2	3	Vertebrate Zoology	Environmental chemistry	The purpose of the study. To form an idea about the general laws and driving forces of the evolutionary process. Summary. The emergence and development of evolutionary theory (pre-Darwin period). The evolutionary concept of J.B. Lamarck. The philosophical foundations of Lamarck's views. Scientific and socio-historical background of the evolutionary theory. The evolutionary teachings of Charles Darwin. Evidence of the evolution of natural species. Modern problems of evolutionary theory. The main stages of chemical and biological evolution. The driving forces of evolution: the struggle for existence, hereditary variability, population waves, isolation. Microevolutionary process. Population differentiation of the species as a result of the interaction of directed factors. View and speciation. Structure, concepts and criteria of the species. Ways speciation. Ways of macroevolution: divergence, convergence, parallelism. Net evolution and ways of its implementation. The focus of the evolutionary process. Forms of directed evolution. Methods of phylogenetic transformations of organs. Biological progress, criteria and methods for its implementation. General laws of macroevolution: progressive orientation, irreversibility, progressive specialization Expected results of the study: the student should know: the subject, goals and objectives of the course; the emergence, development and contemporary problems of evolutionary theory; the evolutionary concepts of J.-B. Lamarck, C. Darwina; processes of speciation; ways of macroevolution (divergence, convergence, parallelism); phylogenetic transformation of organs; be able to: determine the qualitative functional changes in organs; identify quantitative functional changes in organs; identify and describe the origin of a person; identify the driving forces of anthropogenesis. possess skills: the application of acquired knowledge in theoretical and practical activities. Competences: educative, methodical, research.
4	Anthropogenesis	2	3	Vertebrate Fauna	Coordination chemistry	The purpose of the study. On the basis of modern ideas about the evolution of the organic world, to form a holistic vision of the picture of the world and the place of mankind in it, taking into account the unique combination of the biological and social component of human nature. Summary. Introduction to the subject. A brief historical overview of the process of formation of the modern structure of knowledge about the historical course of anthropogenesis. The range of current concepts of anthropogenesis and analysis of their argumentation. Options for consistent synthesis. Analysis of the paleoecological situation accompanying anthropogenesis. Probable ancestors of man and the system of kinship within the order of primates. Analysis of the current situation of human development. Expected results of the study: the student must know: the theoretical and methodological principles of the modern stage of development of the complex of biological sciences about man in their inseparable unity by the social sciences. be able to: apply the knowledge gained in the field of research and professional activities; own: the terminological apparatus of the discipline; methods of collecting and analyzing ethnological materials. Competences: educative, methodical, research.
5	Modern methods of teaching	3	5	Plant physiology	writing a thesis and passing the state exam	The purpose of the study. Acquaintance with the theoretical and methodological aspects of the technological approach in education; training in methods of modeling the educational

	biology					process of biology through the use of modern learning technologies; the formation of the motivational orientation of students to innovation in the organization of the educational process in biology. Summary. Introduction Technology and learning theory. The concept of educational technology. Diversity and possible classifications of educational technologies. The sense-search activity of a specialist in the design of technology training. Modern traditional learning. Technology of problem-based learning in biology class. The technology of modular education in biology class. Information and communication technologies in biology class. Technology design training in biology class. Interactive learning technologies in biology class. Technology case studies in biology class. Technology development of critical thinking in biology class. Test technology in biology class. Expected results of the study: the stolent should know: methods and technologies of multicultural, differentiated and developmental education in the course of biology; be able to: use a variety of forms, techniques, methods and means of teaching biology within the framework of federal state educational standards of basic general education and secondary general education; possess: forms and methods of teaching biology, including those that go beyond the scope of studies: design activities, laboratory experiments, field practice, office processing, etc. Competencies: educational, methodical, research, social and communicative.
5	Theory and technology of teaching biology	3	5	Phytoche mistry	writing a thesis and passing the state exam	The purpose of the study. To form ideas about the theory and technology of teaching biology. Summary. Technology of teaching biology as a pedagogical science. Methodological basis of the technology of teaching biological disciplines. Communication theory and technology of teaching biological disciplines with other sciences. Technology formation of natural science concepts. Expected results of the study: the student must know: the content of SES of general secondary education, school programs in biology, - the content of textbooks in biology; be able to: own a variety of forms, methods and teaching methods, in practice to apply their knowledge, to produce didactic material for biology lessons; independently work with a book (textbook, determinant); schematically depict the object being studied and supply it with the corresponding signatures; conduct phenological observations in nature; have skills: setting a laboratory experiment, the methodology for carrying out practical work in nature, etc. The student must be competent in all major issues of didactics and methods of teaching biology, understand the place of this science among all other pedagogical sciences and its social significance in modern society. Competencies: educational, methodical, research.
6	Applied biology	2	3	The human and animal physiology	writing a thesis	The purpose of the study. To form ideas about the main theoretical and practical achievements in various branches of production based on the achievements of modern biological science. Summary. The purpose, objectives, object and subject of study. The essence of applied biology. Directions of applied biology. Applied aspects of biology in medicine, agriculture, power industry, biotechnology, metallurgy, etc. Soil science, agriculture, agrochemistry. Agriculture. The classification of crop rotations. Scientific basis of plant nutrition. Field crops, vegetable growing. Grain and leguminous crops. Vegetable growing open and closed ground. Biological basis of livestock and fruit growing. Agrotechnics main fruit and berry crops. Applied molecular biology. Applied value of genetic research and genetic engineering for biotechnology.

						Expected results of the study: the student should know: natural features of the region, the specifics of their study, place in the content of general biological education, biological features of agricultural crops and domestic animals, agricultural techniques of cultivation of agricultural crops and promising varieties of cultivated plants, about breeding, feeding, cultivation of agricultural animals, the role of the latest biological research in modern scientific knowledge of nature; be able to: conduct naturalistic, research and environmental-environmental work with children in school and out-of-school educational institutions, create a class-laboratory, a base for field practices, methodically competently organize the work of students in these conditions, use scientific and educational literature for independent preparation and in-depth study of the discipline, work with living objects in the laboratory and natural conditions. own: the main methods of biological sciences, (including field research). Competencies: educational, methodical, research, social and communicative.
6	Introduction to biotechnology	2	3	Physiology of higher nervous activity	writing a thesis	The purpose of the study. 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. Summary. Introduction to the discipline. Biological objects. Introduction to biotechnology. Biological objects and products of biotechnological processes. Cultivation and growth of cells. Cultivation of biological objects. Cellular and genetic engineering. Technological bioenergy and biotechnological processes of mineral processing. Biotechnology of microorganisms and plants. Biotechnology in industrial microbiology. Engineering Enzymology. Agricultural biotechnology. Biotechnology in animal husbandry and environmental protection. Prospects for the development of biotechnology. Expected results of the study: the student should know about: the scientific basis of biotechnology; the main directions of production of useful substances; fundamentals of engineering enzymology; methods and possibilities of gene and cell engineering; fundamentals of technological bioenergy and biological processing of raw materials; the use of biotechnology as an alternative in agriculture; fundamentals of environmental biotechnology. be able to: navigate in modern areas and methods of biotechnology; use knowledge of biotechnology in the study of special disciplines; apply acquired knowledge in the rational use of natural resources and environmental protection; use the data when writing essays. Competences: methodical, research.
7	Green chemistry /Genetic engineering	3	5	Hydrobiology of plants and animals/Biology of reproduction and development	writing a thesis	The purpose of the study. To form an idea of the possibilities, role and place of "green chemistry" in modern natural science; state the principles of "green chemistry" and how to interpret them; teach the application of principles in everyday scientific (chemical) practice for the rational and safe work with chemicals; to give the basics of the joint (integrated) use of the principles of "green chemistry" at various scales. Summary. Introduction Modern chemical industry. The limitations of hydrocarbons and sources. The role and tasks of "green" chemistry against the background of production and consumption of chemicals. The interaction of "green" chemistry and ecology. The emergence of a new scientific direction "green" chemistry. Causes and place of origin of "green" chemistry. Principles of "green" chemistry.

						Renewable Chemicals. Carbon dioxide as a potential source for the chemical industry. The special role of carbon dioxide in terms of carbon cycle, global warming and chemical resource. New chemical technologies and energy sources. New processing technology of popular plastic. Production, use and processing of ionic liquids. Biotechnology and microbiological industry. Biodiesel. Green chemistry in action. Atomic efficiency. Recent developments in chemical synthesis through the eyes of green chemistry. Expected results of the study: as a result of mastering the discipline, the student should know: the principles of "green chemistry" and understand the need for their observance; be able to: apply the principles of "green chemistry" when performing chemical experiments and developing new synthetic techniques; own: the culture of handling substances and materials, both in the scale of the chemical laboratory and the social sphere; In the course of studying the course, the student forms educational, methodological, and research competencies.
7	Green chemistry /Genetic engineering	3	5	Hydrobiology of plants and animals/Biology of reproduction and development	writing a thesis	Purpose of study. To acquaint students with the basic provisions and principles of genetic engineering, with methods and methodological techniques, types of introduction of alien fragments into animal cells, plants and bacteria; show the possibilities of genetic engineering in creating microorganisms with new properties for solving various problems. Summary. The purpose and objectives of genetic engineering. Structure and properties of the DNA molecule. Enzymes used in genetic engineering. Vector systems. Plasmids. Phages. Cosmids. Methods for gene isolation in genetic engineering. Enzyme method. Restriction - modification. Molecules in vector transformations in genetic engineering. The design of recombinant DNA molecules. Transformation of recombinant DNA molecules into cells. Screening. Adaptation and the work of alien genes in microorganisms. Increased genes in the eukaryotic cell. Species introduction of genes in mammals. Determination of DNA nucleotide structure. Genetic engineering in the structure of chromosomes and genome. Cell Engineering. Getting a hybrid. Genetic engineering of the plant. Transgenic animals. Cloning. The use of genetic engineering methods in obtaining biologically active substances. Expected results of the study: the student should know: the purpose and objectives of genetic engineering. Methods of genetic engineering. The history of genetic engineering; structure and properties of the DNA molecule; patterns in the structure of DNA; reparation; DNA replication (reduplication); enzymes, their characteristics used in the construction of recombinant DNA; restriction endonucleases. Classification of restricts and their nomenclature; be able to: apply this knowledge to develop strategies to solve specific biological problems. Competences: educational, methodical, research.
8	Applied chemistry	2	3	Biochemistry	writing a thesis	The purpose of the study. To form the basic concepts of chemical production, familiarity with the theoretical foundations of chemical technology, the main components of chemical-technological processes, as well as consideration on this basis of some production technologies of some of the most important chemical products (acids, ammonia, urea, ethylene, polymeric materials). Summary. The subject and tasks of applied chemistry. Modern requirements for chemical production. Chemistry and energy. Raw material Water in the chemical industry. Thermal processing of solid fuels. Oil refining. Oil products. Processing of natural combustible gases. Production of hydrogen, nitrogen and oxygen. Production of acids. General

						information about metallurgy. Technology of the main organic synthesis. Processing of aromatic hydrocarbons. High molecular weight compounds (Navy). General concepts of the chemistry of the Navy. Scopes of high-molecular compounds. Expected results of the study: the student should know: the main technological processes of production of the most important chemical products in industrial and laboratory conditions, the main instruments and devices of chemical technology, safety requirements, industrial hygiene and environmental standards for the production of chemical products; be able to: solve typical tasks in applied chemistry, determine technologically and economically optimal conditions for carrying out technological processes; to make structural formulas of polymers; to design the main routes for the synthesis of polymers; possess: skills of synthesis, isolation and purification of chemicals in the laboratory, working with modern equipment for modeling technological processes with the main methods of obtaining polymers, skills of determining the physical and mechanical properties and identification of polymers and composite materials; possess knowledge of applied chemistry. Competences: educational, methodical, research.
8	Introduction to chemical technology	2	3	Chemistry the basics of soil science	writing a thesis	The purpose of the study. To form an understanding of the general laws of chemical-technological processes in relation to the main types of reactors and chemical-technological systems, the laws of homogeneous and heterogeneous, catalytic and non-catalytic processes. Summary. The subject and objectives of the discipline. Basic concepts, definitions and terms. Technology, classification. Priority directions of development of modern chemical technology. Theoretical foundations of chemical technology. Chemical production and chemical process. General laws of chemical processes. The main types of chemical processes. Chemical reactors and their classification. Chemical technology systems (CTS). Raw material subsystem XTS. Energy subsystem XTC. The most important industrial chemical production. Expected results of the study: the student should know: the prospects for the technical development of the enterprise; technical requirements for raw materials, materials, finished products; main technical and design features of chemical production; methods of rational use of raw materials, energy and other types of resources; methods of intensification of chemical technological special terminology; be able to: analyze mathematical chemical technology; evaluate the composition and properties of intermediate products with the aim of developing new technological processes that will ensure their fullest use; analyze and justify the optimal parameters of technological processes; own: the skills of compiling heat and material balances of chemical devices and installations; methods of kinetic analysis and modeling of chemical reactors. In the process of studying this discipline a student masters the following competencies: educational, methodical, research.
9	Modern methods of teaching chemistry	3	5	Methods of solution of tasks on chemistry	writing a thesis and passing the state exam	The purpose of the study. To acquaint with the theoretical and methodological aspects of the technological approach in education; to teach methods of modeling the educational process of chemistry through the use of modern learning technologies; to create a motivational orientation of students towards innovation in the organization of the educational process in chemistry. Summary. Introduction Technology and learning theory.

						The concept of educational technology. Diversity and possible classifications of educational technologies. The sense-search activity of a specialist in the design of technology training. Modern traditional learning. Technology of problem-based learning in chemistry lessons. The technology of modular education in chemistry classes. Information and communication technologies in chemistry classes. Technology design training in chemistry classes. Interactive learning technologies in chemistry classes. Technology case studies in chemistry classes. Technology development of critical thinking in the classroom chemistry. Test technology in chemistry classes. Expected results of the study: the student should know: methods and technologies of multicultural, differentiated and developmental education in the course of chemistry; be able to: use a variety of forms, techniques, methods and means of teaching chemistry within the framework of the federal state educational standards of basic general education and secondary general education; possess: forms and methods of teaching chemistry, including those that go beyond the scope of studies: design activities, laboratory experiments, industrial chemical research, etc. Competencies: educational, methodical, research, social and communicative.
9	Theory and technology of teaching chemistry	3	5	Technique of carrying out of school chemical experiment	writing a thesis and passing the state exam	The purpose of the study. On the basis of modern achievements of psychological and pedagogical science and practice, a specific branch of knowledge (chemistry), as well as effective technologies and practices of school education in the subject area of chemistry, students should develop professional competencies necessary to successfully complete the educational, developmental and educational tasks included in professional duties of the school teacher. Summary. Theory and technology of teaching chemistry as a subject and its scientific foundations. Place of chemistry as a school subject in the system of secondary education. The content of the course of chemistry. The concept of "learning standard". The process of learning chemistry and its characteristics. Scientific and educational activities that provide the learning process. Chemistry teaching technologies. Organizational forms of teaching chemistry, their brief description. Technologies for monitoring learning outcomes and diagnosing knowledge and skills. Extracurricular technology training. Technology training in the original chemical concepts, concepts, chemical terminology. Technologies of organizing and conducting a chemical experiment. Expected results of the study: the student should know: the requirements of the state standard of general education in the subject area of chemistry for all levels of education in school; goals, objectives and content in general education chemistry; content, structure and methodological apparatus of curricula and school textbooks in chemistry; methods and techniques of teaching chemistry; basic organizational forms of education in chemistry; be able to: plan teaching activities; analyze, from theoretical positions, methods of teaching chemistry, school programs and textbooks in chemistry, other teaching aids; optimally choose the method of teaching chemistry; prepare a lesson outline, organize and conduct various forms of teaching chemistry; conduct a demonstration experiment. Competencies: educational, methodical, research, social and communicative.

10	Chemical technology	3	5	Physical and colloidal chemistry	writing a thesis	The purpose of the study. To give an idea of the main provisions and the theory of chemical production technology and their practical application to industrial facilities. Summary. Chemical technology as a science. The role and importance of chemical technology in modern conditions of social development. Directions in the development of chemical technology. The main products of the chemical industry, the dynamics and scale of their production. Physical and chemical laws of technological processes. Chemical technology systems. The structure of chemical-technological systems. Examples of technological solutions in the chemical industry. Raw materials in the chemical industry, requirements for raw materials, classification of raw materials. Prospects for general chemical technology. Current trends in the development of the theory and practice of chemical technology. New chemical-technological processes. Promising sources of raw materials and energy for the chemical industry. Expected results of the study: the student should know: the basic principles of the organization of chemical production, its hierarchical structure; methods for evaluating the effectiveness of the chemical process and the entire production as a whole; general laws of chemical transformations in industrial production; structure, organization and technological design of the main chemical production facilities of modern enterprises of chemical profile of the East Kazakhstan Region. be able to: 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; summarize and process experimental information. own: methods of analyzing the performance of chemical plants; skills of calculation and determination of technological indicators of the process. Competences: educative, research, methodical.
10	Nanotechnology in chemistry	3	5	Polymer Chemistry	writing a thesis	The purpose of the study. To form a system of knowledge about the fundamentals of nanochemistry, the synthesis and analysis of nanomaterials, the application of nanotechnology in organic chemistry, biology, medicine and other fields. Summary. Basic concepts of nanotechnology. Nanochemistry and objects of its study. The main types of nano-objects and nanosystems based on them. Methods for the preparation and stabilization of nanoparticles, methods for studying the size and shape of nanoparticles. Methods for the synthesis of nanostructured materials. Place nanomaterials in science and technology. Nanosecurity problems. Expected results of the study: the student should know: - the definition and classification of nanoparticles, the concept of nanomaterials, their special physical and chemical properties; main methods of synthesis and analysis of nanomaterials; existing and future applications of nanotechnology and nanomaterials; harmful effects of nanomaterials on the environment, human health and safety, as well as ways to prevent them. be able to: analyze and evaluate various methods for the synthesis of certain nanomaterials; offer methods for analyzing nanomaterials depending on their nature; suggest possible applications for various nanomaterials. own: the skills to find sources of information about new achievements of nanochemistry and nanotechnology. Competences: educative, research, methodical.

THE LIST OF DISCIPLINES
elective courses for the educational program
specialty – 5B012500 "Chemistry-Biology"

Form of study: full-time
Duration of training: 4 years.

The name of discipline	Discipline code	Credits		Semester
		RK	ECTS	
General educational disciplines				
Component of choice 1		2	3	1
Self-Knowledge	SK 1106	1+1+0		
Culturology	Cul 1106			
Component of choice 2		2	3	4
Political science	PS 2107	1+1+0		
Sociology	Soc 2107			
Fundamentals of anti-corruption culture	FAC 2107			
Component of choice 3 (Established by the university)		3	5	4
Religious	Rel 2108	2+1+0		
Basic disciplines				
Component of choice 1		2	3	1
Introduction to the teaching profession	ITP 1210	1+1+0		
Fundamentals of pedagogical education	FPE 1210			
Component of choice 2		3	5	1
Cytology and histology	CH 1211	2+0+1		
Cell and tissue biology	CTB 1211			
Component of choice 3		2	3	1
General chemistry	GC 1212	1+0+1		
Chemistry of elements of the periodic table	CEPT 1212			
Component of choice 4		2	3	2
Human anatomy	HA 1213	1+1+0		
Morphology of internal organs	MIO 1213			
Component of choice 5		3	5	2
Inorganic chemistry	IC 1214	2+0+1		
Inorganic synthesis	IS 1214			
Component of choice 6		3	5	2
Anatomy and morphology of plants	AMP 1215	2+0+1		
Botany	Bot 1215			
Component of choice 7		3	5	3
General and molecular genetics	GMG 2216	2+0+1		
Genetics with fundamentals of selection	GWFS 2216			
Component of choice 8		3	5	3
Analytical chemistry	AC 2217	1+1+1		
Physico-chemical methods of analysis	PMA 2217			
Component of choice 9		3	5	3
Systematics of plants	SP 2218	2+0+1		
Flora of the world	FW 2218			
Component of choice 10		3	5	3
Microbiology and Virology	MV 2219	2+0+1		
Soil Microbiology	SM 2219			
Component of choice 11		3	5	4
Invertebrate Zoology	IZ 2220	2+0+1		
Invertebrate Fauna	IF 2220			
Component of choice 12		2	3	4

Organic chemistry of aliphatic compounds	OCAC 2221	1+0+1		
Structure of matter	SM 2221			
Component of choice 13		3	5	5
Organic chemistry of cyclic compounds	OCCC 3222	2+0+1		
Chemistry of high-molecular compounds	CHC 3222			
Component of choice 14		3	5	5
Vertebrate Zoology	VZ 3223	2+0+1		
Vertebrate Fauna	VF 3223			
Component of choice 15		3	5	5
Biochemistry	Bio 3224	2+0+1		
Chemistry the basics of soil science	CBSS 3224			
Component of choice 16		3	5	6
Plant physiology	PP 3225	2+0+1		
Phytochemistry	Phyt 3225			
Component of choice 17		3	5	6
Physical and colloidal chemistry	PCC 3226	2+0+1		
Polymer Chemistry	PC 3226			
Component of choice 18		2	3	7
Environmental chemistry	EC 4227	1+1+0		
Coordination chemistry	CC 4227			
Profiling disciplines				
Component of choice 1		3	5	6
Hydrobiology of plants and animals	HPA 3303	2+1+0		
Biology of reproduction and development	BRD 3303			
Component of choice 2		3	5	6
The human and animal physiology	HAP 3304	2+0+1		
Physiology of higher nervous activity	PHNA 3304			
Component of choice 3		3	5	6
Methods of solution of tasks on chemistry	MSTC 3305	2+1+0		
Technique of carrying out of school chemical experiment	TCSCE 3305			
Component of choice 4		2	3	6
Evolutionary teaching	ET 3306	1+1+0		
Anthropogenesis	Ant 3306			
Component of choice 5		3	5	7
Modern methods of teaching biology	MMTB 4307	2+1+0		
Theory and technology of teaching biology	TTTB 4307			
Component of choice 6		2	3	7
Applied biology	AB 4308	1+1+0		
Introduction to biotechnology	IB 4308			
Component of choice 7		3	5	7
Green chemistry	GC 4309	2+1+0		
Genetic engineering	GE 4309			
Component of choice 8		2	3	7
Applied chemistry	AC 4310/	1+1+0		
Introduction to chemical technology	ICT 4310			
Component of choice 9		3	5	7
Modern methods of teaching chemistry	MMTC 4311	2+1+0		
Theory and technology of teaching chemistry	TTTC 4311			
Component of choice 10		3	5	7
Chemical technology	CT 4312	2+1+0		
Nanotechnology in chemistry	NC 4312			