

ONTUSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry	46-11 ...
Curriculum for the discipline "Biochemistry"	32 of 1p.

Syllabus
Curriculum for the discipline "Biochemistry"
Educational program - 6B10115 "Medicine"

1. General information about the discipline:			
1.1	Course Code: Bio 2204	1.6	Academic year: 2025-2026
1.2	Name of the discipline: "Biochemistry"	1.7	Course: 2
1.3	Prerequisites: chemistry, molecular biology and medical genetics	1.8	Semester: 3
1.4	Postrequisites: "General pathology", "Digestive and endocrine system in pathology", "Genitourinary system in pathology".	1.9	Number of credits (ECTS): 4
1.5	Cycle: BD	1.10	Component: VK

2. Contents of the course:
Developing knowledge about the functional organization of enzymes, the role of membranes in metabolism, mechanisms of substance transport, vitamins and their biological role, anaerobic energy pathways, catabolism, carbohydrate, lipid, and protein metabolism, and the concept of nitrogen balance as an indicator of protein metabolism. Principles of analysis for the diagnosis and treatment of diseases.

3.	Summative assessment form:		
3.1	Testing ☐	3.5	Coursework
3.2	Writing	3.6	Essay
3.3	Oral	3.7	Project
3.4	Certification of practical skills ☐	3.8	Other (specify)

4. Objectives of the discipline:
developing in students a holistic understanding of the molecular mechanisms and regulation of basic metabolic processes, the characteristics of their occurrence in human organs and tissues, and the use of knowledge of biochemical indicators for diagnosis and monitoring of treatment effectiveness.

5. Final learning outcomes (FLO of the discipline):	
LO 1	Demonstrates knowledge of the structure, functions, and properties of representatives of the main classes of bioorganic compounds: carbohydrates, lipids, simple and complex proteins, vitamins, etc. Understands the molecular mechanisms of metabolic processes and their regulation and the possible consequences of their disruption. Knows the basic biochemical constants of biological fluids in the human body under normal and pathological conditions.
LO 2	Conducts biochemical studies to determine intermediates of carbohydrate, lipid, and nitrogen metabolism in human biological fluids; determines the activity of specific enzymes in blood serum.
LO 3	Interprets the results of basic biochemical studies; uses metabolic maps and specialized reference material to predict the characteristics of biochemical process disorders and their regulation due to deficiencies of biologically active substances (vitamins, enzymes, hormones).

ONTUSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry	46-11 ...
Curriculum for the discipline "Biochemistry"	32 of 2p.

LO 4	Demonstrates: own knowledge and skills in conducting biochemical research; ability to conduct literary search and analysis of scientific articles in independent study of the discipline; ability to work in a team.		
5.1.	LO discipline	Learning outcomes of the EP, which are associated with the discipline's LO	
	LO 1 LO 2 LO 3 LO 4	LO1.	Apply fundamental knowledge in biomedical, clinical, epidemiological and social-behavioral sciences in practice.
		LO 11	Analyzes the effectiveness of diagnostics and treatment results using the principles of personalized medicine.

6.	Detailed information about the discipline					
6.1	The location of the department is Al-Farabi-1 square, building No. 1, 4th floor, rooms 400, 404, 406, 408, 411, 413 biology_biochemistry@mail.ru , ext.: (ATS) 40-82-06. ext. 227					
6.2	Quantity hours	Lectures	Practical. les.	Lab.	SIWP	SIW
		8	32	-	12	56/12

7. Information about teachers:					
No.	Full name	Degrees and position	Email address	Scientific direction	Achievements
1.	Kenzhebekov P.K.	PhD, professor	kenzhebekov.p@gmail.com	"Study of the chemical composition of volatile aroma-forming compounds in some meat products"	42 scientific publications, 1 textbook
2.	Asilbekova G.K.	Master of Biology, senior teacher	shahats@mail.ru	Microelementoses	16 scientific publications, 1 textbook
3.	Kanzhigitova M.Zh.	Master of Biology, senior teacher	Molya_1503@mail.ru		15 scientific publications
4.	Zhienbaeva A.	Master of Biology, senior teacher	alia.zhienbaeva@mail.ru		10 scientific publications
5.	Abdirova T.O.	teacher	tyul_84@mail.ru		3 scientific publications

8. Thematic plan

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ		 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry		46-11 ...
Curriculum for the discipline "Biochemistry"		32 of 3p.

No.	Topic	Summary	LO discipline	Number of hours	Forms/methods/technologies of teaching	Forms/methods of assessment
1.	Lecture: The structure of enzymes and their biological functions.	Structural and functional organization of enzymes. Specificity of enzyme action. Mechanism of enzyme action. Fundamentals of enzymatic reaction kinetics. Regulation of enzyme activity. Enzymopathies. Use of enzymes in medicine.	LO1	1	Introductory, overview	feedback questions
	Practical lesson: Structure and properties of enzymes. Coenzymes. Mechanisms of enzyme action.	Enzymes. Similarities and differences between enzymes and non-enzyme catalysts. Activation energy. Structural and functional organization of enzymes. Apoenzyme, cofactor. Multienzyme complexes. Methods for determining enzyme activity and units. Mechanisms of enzyme action. Enzyme specificity. Fisher and Koshland hypotheses. Kinetics of enzymatic reactions. Nomenclature and classification of enzymes. Laboratory work: Determination of aminotransferase activity.	LO1 LO2 LO4	3	seminar, situational tasks, testing	Checklist
	SIWP: Isoenzyme s. Enzymopathies.	Isoenzymes. Enzymopathies. Regulation of enzyme activity. Enzyme inhibition.	LO1 LO2 LO4	1/5	essay, analysis of a scientific article, presentation	Checklist
2.	Lecture: Energy exchange.	Anaerobic pathway of energy production. Specific and general catabolic pathways. Oxidative decarboxylation of pyruvate. The Krebs cycle. The relationship between tissue respiration and oxidative phosphorylation. Uncouplers of BO and OF. Inhibitors of tissue respiration and oxidative phosphorylation.	LO1	1	overview	feedback questions

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ		 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry		46-11 ...
Curriculum for the discipline "Biochemistry"		32 of 4p.

	Practical lesson: Practical lesson: Tissue respiration. Electron transport chain (ETC). Oxidative phosphorylation.	The process of biological oxidation and its significance. The structure and properties of enzymes of the mitochondrial electron transport chain (ETC). Oxidative phosphorylation. Coupling of respiration with phosphorylation. Mitchell's theory. Nonphosphorylative oxidation and its significance. Inhibitors of respiratory dehydrogenases, phosphorylation, and uncouplers of respiration from phosphorylation.	LO1 LO2 LO4	3	seminar, situational tasks, testing	Checklist
	SIWP: Hereditary enzymopathies. The role of enzymes in medicine. Metabolism and energy.	Hereditary enzymopathies. The role of enzymes in medicine. Stages of energy metabolism in the body. Catabolism of essential nutrients (proteins, fats, and carbohydrates). Macroergic compounds (the role of ATP).	LO1 LO2 LO4	1/6	essay, analysis of a scientific article, presentation	Checklist
3	Lecture: Carbohydrate metabolism	Carbohydrate metabolism. Digestion, absorption, and transport of carbohydrates. Breakdown and synthesis of carbohydrates.	LO1	1	overview	feedback questions
	Practical lesson: The main carbohydrates in the human body and their biological functions. Carbohydrate metabolism. Laboratory training:	Carbohydrates, classification, and biological role. The main stages of carbohydrate metabolism in the body. Digestion and absorption of carbohydrates in the gastrointestinal tract. Glucostatic function of the liver. Anaerobic and anaerobic glycolysis, biological significance. Glycogen, biological role. Glycogenogenesis. Glycogenoses and aglycogenoses. Gluconeogenesis, biological significance. The Cori cycle, significance.	LO1 LO2 LO3	3	Seminar, case studies, testing laboratory work.	Checklist

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry	46-11 ...
Curriculum for the discipline "Biochemistry"	32 of 5p.

		The pentose phosphate cycle, its significance. Carbohydrate metabolism pathologies (hyperglycemia, hypoglycemia). Laboratory work: "Determination of glucose concentration in blood serum."				
	SIWP: The main carbohydrates of human tissues and their biological significance.	The main carbohydrates of human tissues and their biological significance. Carbohydrates are the structural and functional components of cells. Regulation of carbohydrate metabolism in the body. Factors contributing to carbohydrate metabolism disorders. Changes in monosaccharide and disaccharide metabolism in hereditary pathologies (galactosemia, fructosemia, lactosemia). Regulation and disorders of carbohydrate metabolism.	LO1 LO2 LO4	1/6	essay, analysis of a scientific article, situational problems	Checklist
4.	Lecture: Lipid metabolism.	Lipid digestion. Absorption of lipid digestion products. Formation and metabolism of transport lipoproteins. Intracellular lipolysis. Oxidation of saturated, unsaturated, and odd-chain fatty acids. Ketone body metabolism. Fatty acid biosynthesis. Lipid metabolism pathology.	LO1	1	overview	feedback questions
	Practical lesson: Lipid metabolism. Breakdown and biosynthesis of fatty acids. Laboratory training.	Classification, chemical structure, and biological functions of lipids. Cholesterol and its derivatives. Stages of lipid metabolism in the body. The mechanism of lipid digestion in the digestive tract. Enzymes involved in this process. Metabolism of chylomicrons, VLDL, LDL, and HDL. Intracellular	LO1 LO2 LO3	3	Seminar, case studies, testing, laboratory work	Checklist

		lipolysis. Glycerol oxidation. Oxidation of even-carbon fatty acids. Energy balance. Oxidation of unsaturated and odd-carbon fatty acids. Biosynthesis of fatty acids. Biosynthesis of triglycerides. Biosynthesis of phosphoglycerides and phosphatidic acid. Biosynthesis of ketone bodies. Biosynthesis of cholesterol, elimination from the body. Laboratory work: "Determination of the concentration of total cholesterol in blood serum."				
	SIWP: Steroid exchange. Pathology of lipid metabolism.	Biochemical basis of lipid metabolism disorders. Elimination of cholesterol and bile acids from the body. Lipid metabolism pathology. Hypercholesterolemia. Biochemistry of atherosclerosis. Gallstone disease.	LO1 LO2 LO4	1/6	essay, analysis of a scientific article, situational problems	Checklist
5.	Lecture: Metabolism of proteins and amino acids. Chromoprotein metabolism.	Biological value of proteins. Nitrogen balance. Digestion of proteins in the digestive tract. Absorption of amino acids. Transamination of amino acids. Deamination of amino acids. Decarboxylation of amino acids. The role of biogenic amines and their transformations. Heme biosynthesis and regulation of its biosynthesis. Porphyria. Iron metabolism. Hemoglobin catabolism. Bilirubin metabolism. Jaundice.	LO1	1	overview	feedback questions
	Practical lesson: Metabolism of proteins and amino	Protein nutrition. Biological value of proteins. Nitrogen balance. Digestion of proteins in the gastrointestinal tract. Absorption and transformation	LO1 LO2 LO3	3	seminar, situational tasks, testing, laboratory work	Checklist

	acids.Laboratory practical training.	of amino acids. Protein putrefaction in the intestine. Clinical significance of determining indican and hippuric acid in urine. General pathways of amino acid catabolism: transamination, deamination, and decarboxylation. Biosynthesis and degradation of biogenic amines. Pathways of ammonia formation and detoxification in the body. The relationship between protein, carbohydrate, and lipid metabolism. Completion of the laboratory assignment: "Determining the concentration of urea in blood serum."				
	SIWP: Main sources of amino acids. Decarboxylation of amino acids. Midterm exam No. 1.	The main sources of amino acids in tissues and their utilization. Amino acid decarboxylation. Biogenic amines: histamine, serotonin, γ -aminobutyric acid, catecholamine formation, and biological functions. Oxidation of biogenic amines and monoamine oxidase inhibitors (MAOIs). Regulation and disorders of nitrogen metabolism: kwashiorkor, marasmus, gout, etc. Midterm exam No. 1. "Enzymes", "Bioenergetics", "Metabolism of proteins, lipids and carbohydrates".	LO1 LO2 LO4	2/5	reproduction of biochemical reactions, presentation, glossary Control questions, test assignments, situational tasks.	Checklist Evaluation of answers to control questions, test assignments and solutions to situational problems
6.	Lecture: Biochemistry of hormones.	Biochemistry of hormones. The role of hormones in body function and metabolism regulation. Classification of hormones. Hormonal signaling through membrane receptors. Signaling via intracellular receptors. Structure,	LO1	1	overview	feedback questions

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ		 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry		46-11 ...
Curriculum for the discipline "Biochemistry"		32 of 8p.

		biosynthesis, and biological functions of hormones.				
	Practical lesson: Hormonal regulation of metabolism and body functions.	Neuroendocrine regulation of metabolism. Classification of hormones by site of synthesis, chemical structure, and biological functions. Interaction of hormones with receptors and mechanisms of hormonal signaling in the cell. Mechanisms of hormone action: * membrane * membrane-intracellular (indirect) * cytosolic (direct). Hypothalamus hormones: thyrotropin-releasing hormone, corticotropin-releasing hormone, gonadotropin-releasing hormone, somatotropin-releasing hormone, somatostatin. Pituitary hormones: prolactin, TSH, LH and FSH, ACTH. Hypothalamic-pituitary system dysfunction. Pancreatic and gastrointestinal hormones.	LO1 LO2 LO4	3	seminar, situational tasks, testing	Checklist
	SIWP: Pathology of thyroid and adrenal hormones.	Thyroid disease. Hypo and hyperthyroidism. Mineralocorticoids. Glucocorticoids.	LO1 LO2 LO4	1/6	essay, analysis of a scientific article, problem solving	Checklist
7	Lecture: Biochemistry of the liver and kidneys.	Biochemistry of the liver and kidneys. The detoxifying function of the liver. Biological functions of the kidneys. Water-salt metabolism.	LO1	1	overview	feedback questions
	Practical lesson: Biochemistry of the liver and kidneys. Water-salt metabolism.	Liver biochemistry. Chemical composition, structure, and biological functions of the liver. The biological role of the liver in protein, carbohydrate, and lipid metabolism. Detoxifying function of the liver. Metabolism of natural, foreign, and medicinal compounds in the liver.	LO1 LO2 LO4	3	seminar, situational tasks, testing	Checklist

		Mechanisms of detoxification of natural, foreign, and medicinal substances in the liver. Biochemical methods for diagnosing liver dysfunction. Electrolyte composition of body fluids. Biological functions of the kidneys. The role of the kidneys in regulating the electrolyte balance of fluid systems and water-salt metabolism. Disorders of mineral metabolism. The role of the kidneys in regulating pH and acid-base balance. Mechanisms of acidosis and alkalosis.				
	SIWP: Mechanisms of detoxification in the liver. Ethanol metabolism in the liver. Mineral metabolism disorders.	Mechanisms of detoxification in the liver. Chemical liver carcinogenesis. Ethanol metabolism in the liver. Mineral metabolism disorders. Phosphorus-calcium metabolism.	LO1 LO2 LO4	1/6	presentation, analysis of scientific articles on the topic, glossary	Checklist
8.	Lecture: Blood biochemistry.	Blood biochemistry. Structure and metabolism of erythrocytes. Glucose metabolism in erythrocytes. Disorders of erythrocyte metabolism. The blood coagulation system. The anticoagulation system. The role of platelets in hemostasis. Fibrinolysis. Plasma proteins and enzymes.	LO1	1	overview	feedback questions
	Practical lesson: Blood biochemistry. Laboratory practical.	Chemical composition of blood plasma, biological functions. Blood plasma enzymes. Diagnostic value of indicator enzymes. Blood plasma proteins. Normo-, hypo-, hyper-, para-, and dysproteinemia. Individual blood plasma proteins, acute phase proteins, the complement	LO1 LO2 LO3	3	Seminar, case studies, testing, laboratory work	Checklist

		system. Non-protein nitrogenous substances in the blood. Azotemia. Diagnostic value of determining biochemical parameters of the blood. The transport role of blood in the transfer of oxygen and carbon dioxide, as well as its buffering properties. Features of erythrocyte metabolism. Laboratory work: "Quantitative determination of total protein in blood serum."				
	SIWP: Blood coagulation, hemostasis mechanisms.	The process of hemostasis. Blood coagulation factors. Extrinsic and intrinsic mechanisms of blood coagulation. The process of fibrinolysis. The anticoagulant system of the blood.	LO1 LO2 LO4	1/6	presentation, reproduction of blood coagulation and anticoagulant system diagrams, glossary	Checklist
9.	Practical lesson: Biochemistry of muscle connective tissue. Biochemistry of the intercellular matrix.	Chemical composition of muscle tissue, biological functions. Types of muscle tissue (striated, cardiac, smooth), features of composition. Muscle proteins. Sarcoplasmic and myofibrillar proteins. Structure of myosin filaments. Structure of actin filaments. Biochemical mechanism of contraction and relaxation of muscle tissue. Dystrophy and denervation of muscle tissue. Features of the structure and function of connective tissue. Organic and inorganic composition of connective tissue. Biochemistry of the intercellular matrix. Collagen, elastin. Composition, synthesis, structures. Glycosaminoglycans and proteoglycans of connective tissue. Changes in connective tissue during aging and	LO1 LO2 LO4	4	seminar, situational tasks, testing	Checklist

		collagenoses. Factors influencing connective tissue metabolism.				
	SIWP: Metabolism in connective tissue. Chemical composition of striated skeletal muscles.	Metabolism in connective, bone, and dental tissues. Collagen biosynthesis. Collagenoses. Chemical composition of striated skeletal muscle. Sarcoplasmic proteins: myoglobin, structure, and functions. Important myofibrillar proteins: actin, myosin, actomyosin, tropomyosin, and troponin.	LO1 LO2 LO4	1/5	essay, analysis of a scientific article, situational problems	Checklist
10.	Practical lesson Biochemistry of bone and dental tissue. Biochemistry of nervous tissue and cerebrospinal fluid.	Organic and inorganic composition of bone and dental tissue. Mineralization and demineralization processes of bone and dental tissue. Factors influencing bone and dental tissue metabolism. Regulation of bone and dental tissue metabolism. Chemical composition of nervous tissue, biological functions. Nerve fiber structure. Mechanisms of nerve impulse generation and conduction. Inhibitors of action potential development. Chemical composition of cerebrospinal fluid, biological functions. Synaptic transmission of nerve impulses. Nerve tissue peptides. Compounds influencing synaptic transmission of nerve impulses. Vision. Brain metabolism.	LO1 LO2 LO4	4	seminar, situational tasks	Checklist
	SIWP: Metabolism in connective, bone and dental tissues. Midterm exam No. 2.	Proteins and other organic substances of bone and dental tissue. The role of phosphates and calcium in connective tissue metabolism. Boundary Test No.2. "Biochemistry of Hormones," "Biochemistry of the Liver and Kidneys,"	LO1 LO2 LO4	1/5	Control questions, test assignments, situational tasks.	Evaluation of answers to control questions, test assignments and solutions to situational problems

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry	46-11 ...
Curriculum for the discipline "Biochemistry"	32 of 12p.

		"Biochemistry of Blood," "Biochemistry of Muscle, Connective, and Nerve Tissue."				
--	--	--	--	--	--	--

Preparation and conducting of midterm assessment: 12 hours

9. Teaching methods and forms of control		
9.1	Lectures	Introductory, overview.
9.2	Practical classes	Completion of practical work, oral questioning (extended conversation), work in small groups, situational tasks, testing, quantitative determination of biochemical parameters and preparation of a laboratory work protocol.
9.3	SIW/SIWP	Presentation, glossary on the topic, reproduction of biochemical reaction processes, essay on the topic, analysis of scientific articles.
9.4	Midterm exam	Midterm assessment is conducted in the traditional format: oral, written, and in the form of testing, as well as solving situational problems.

10. Evaluation criteria

10.1 Criteria for assessing the learning outcomes of the discipline

No · LO	Name of learning outcomes	Unsatisfactory	Satisfactorily	Fine	Great
LO 1	Demonstrates knowledge of the structure, functions, and properties of representatives of the main classes of bioorganic compounds: carbohydrates, lipids, simple and complex proteins, vitamins, etc. Understands the molecular mechanisms of metabolic processes and their regulation and the possible consequences of their disruption. Knows the basic biochemical constants of biological fluids in the human body under normal and	1. Does not have knowledge of the structure, functions, and properties of representatives of the main classes of bioorganic compounds: carbohydrates, lipids, simple and complex proteins, vitamins, etc. 2. Does not understand the molecular mechanisms of the course and regulation of metabolic processes and the possible consequences of their disruption. 3. Does not know	1. Possesses knowledge of the structure, functions, and properties of representatives of the main classes of bioorganic compounds: carbohydrates, lipids, simple and complex proteins, vitamins, etc. 2. Understood the molecular mechanisms of the course and regulation of metabolic processes and the possible consequences of their disruption. 3. Knows the basic biochemical	1. Applies knowledge about the structure of the main classes of bioorganic compounds when describing biochemical processes occurring in the body. 2. Writes down biochemical reactions accurately and clearly, indicating the enzymes that catalyze these processes, while demonstrating a complete understanding of the molecular mechanisms of	1. Demonstrates excellent knowledge of the structure of the main classes of bioorganic compounds when describing biochemical processes occurring in the body. Analyzes this topic and connects it to previous learning. 2. Consistently and without any difficulty writes down the reactions

	pathological conditions.	the basic biochemical constants of biological fluids of the human body in normal and pathological conditions.	constants of biological fluids of the human body in normal and pathological conditions.	metabolism and regulation in the body. 3. Applies knowledge of basic biochemical constants to discuss the state of the body in normal and pathological conditions.	of biochemical processes, indicating the enzymes that catalyze these processes, while demonstrating a complete understanding of the molecular mechanisms of the course and regulation of metabolism in the body. 3. Demonstrates excellent knowledge of the basic biochemical constants of the body's biofluids to assess the patient's condition.
LO 2	Conducts biochemical studies to determine intermediates of carbohydrate, lipid, and nitrogen metabolism in human biological fluids; determines the activity of	1. Does not conduct biochemical studies to determine intermediates of carbohydrate, lipid and nitrogen metabolism in human biological fluids in accordance with the description of the laboratory work. 2. Does not	1. Conducts biochemical studies to determine intermediates of carbohydrate, lipid and nitrogen metabolism in human biological fluids in accordance with the description of the laboratory work, but does not show activity and requires	1. Independently completes all practical and laboratory work, draws appropriate conclusions and takes an active part in the discussion of the results of the work and	1. Freely navigates the selection of necessary reagents, equipment, and laboratory glassware for laboratory work, performs at a high level,

specific enzymes in blood serum.	determine activity of specific enzymes in blood serum. 3. Does not understand the diagnostic value of determining enzyme activity.	the assistance of the teacher. 2. Determines the activity of specific enzymes in blood serum based on descriptions, but makes mistakes and requires the help of a teacher. 3. Understood the diagnostic value of determining enzyme activity.	submits completed reports. 2. Correctly and consistently determines enzyme activity in blood serum without outside assistance and makes correct conclusions. 3. Possesses knowledge of the diagnostic value of determining enzyme activity, while demonstrating a good level of knowledge of the educational material.	draws appropriate conclusions, actively participates in the discussion of work results, and submits completed reports. 2. Independently and consistently determines the activity of enzymes in blood serum without outside help and makes correct conclusions based on educational material. 3. Competently uses theoretical knowledge about the diagnostic value of determining enzyme activity, draws appropriate conclusions, while demonstrating original thinking.
----------------------------------	---	---	--	---

LO 3	Interprets the results of basic biochemical studies; uses metabolic maps and specialized reference material to predict the characteristics of biochemical process disorders and their regulation due to deficiencies of biologically active substances (vitamins, enzymes, hormones).	1. Unable to interpret the results of basic biochemical tests. 2. Does not understand the metabolic maps of the body's structural and functional components. 3. Cannot use reference material when predicting the characteristics of disruption of biochemical processes and their regulation due to a deficiency of biologically active substances (vitamins, enzymes, hormones).	1. Interprets the results of basic biochemical studies, allows for minor inaccuracies when discussing situational problems, and has difficulty drawing conclusions. 2. Difficulty describing metabolic processes presented on metabolic maps of the structural and functional components of the body. 3. Poor understanding of reference material when predicting the characteristics of disruption of biochemical processes and their regulation.	1. Applies theoretical knowledge to interpret basic biochemical studies. Draws correct conclusions based on the interpretation of data presented in situational problems. 2. Competently and clearly analyzes in sequence the metabolic patterns of the structural and functional components of the body, presented on the maps. 3. Effectively uses reference material when predicting the characteristics of disruption of biochemical processes and their regulation.	1. Demonstrates excellent knowledge of reference biochemical parameters when interpreting proposed biofluid analysis data. Demonstrates original thinking when analyzing situational problems, based on a deep understanding of theoretical material. 2. Demonstrates excellent knowledge of the required educational material in describing the metabolic schemes of the structural and functional components of the body, presented on the maps. 3. Effectively uses reference material when
------	---	---	---	---	---

					predicting the characteristics of disruption of biochemical processes and their regulation, while demonstrating critical thinking.
LO 4	Demonstrates: own knowledge and skills in conducting biochemical research; ability to conduct literary search and analysis of scientific articles in independent study of the discipline; ability to work in a team	1. Does not have the skills to independently conduct biochemical research. 2. Unable to find the necessary literary material and is unable to analyze scientific articles. 3. Does not demonstrate the ability to work in a team.	1. Allows inaccuracies when conducting biochemical studies and does not fully complete them. 2. Conducts a search for the necessary literary material, analyzes scientific articles, but expresses his thoughts without logic and arguments. 3. Knows how to work in a team, but does not show initiative.	1. When conducting biochemical research, demonstrates good knowledge of theoretical material, displays research skills and a desire for independent self-education. 2. Collects the necessary literary material to study a specific range of problems, analyzes scientific articles, while demonstrating critical thinking. 3. Able to work actively in a team, clearly express one's own thoughts and advise others, able to advise on a	1. Demonstrates: excellent skills in independently conducting biochemical research; analyzes research results, demonstrating excellent knowledge of the necessary theoretical material; the ability to predict the state of the body based on the data obtained; and a desire for independent self-education. 2. Searches for necessary information in reference materials and

range of possible applications of biochemical research.

scientific literature, and compares this data. Analyzes scientific articles, demonstrating critical thinking and is able to clearly express their own beliefs.

3. Works creatively in a team, presents his/her own beliefs in a well-reasoned manner, effectively exchanges information, and is able to advise others on the range of possible applications of biochemical research.

10.2 Methods and criteria for evaluation

CHECKLIST for PRACTICAL LESSON

N o.	Evaluation criteria	Level			
		Great	Fine	Satisfactori ly	Unsatisf actory
Practical classes:					
1	Oral response to the questions of this task	30	21	15	0

ONTUSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ		 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry		46-11 ...
Curriculum for the discipline "Biochemistry"		32 of 18p.

2	Written response to the questions of this assignment/preparation of the laboratory work protocol	30	21	15	0
3	Completing test assignments	12	8	6	0
4	Solving situational problems	28	20	14	0
	General:	100	70	50	

1. Oral response to the questions of this task

Approximately 3 questions of maximum 10 points:

No.	Questions	Level			
		Great	Fine	Satisfactorily	Unsatisfactory
1	1 question on the topic	10	7	5	0
2	2 questions on the topic	10	7	5	0
3	3 questions on the topic	10	7	5	0
	Total:	30	21	15	0

No.	Evaluation criteria	Points
1	Awarded if the student made no errors or inaccuracies during their answer. They are familiar with the theories, concepts, and approaches of the discipline being studied and critically evaluate them, and utilize the scientific advances of other disciplines.	27-30
2	It is awarded if the student did not make any serious errors in their answer, made minor inaccuracies or major errors that were corrected by the student themselves, and was able to systematize the program material with the help of the teacher.	21-26
3	This is given if the student made inaccuracies and minor mistakes during the answer, limited himself to the educational literature specified by the teacher, and experienced great difficulty in systematizing the material.	25-35
4	This is given if the student made fundamental errors during their answer, failed to cover the main literature on the topic of the lesson, is unable to use the scientific terminology of the subject, and answers with gross stylistic and logical errors.	0-24

2. Written response to the questions in this assignment

Approximately 3 questions of maximum 10 points:

No.	Questions	Level			
		Great	Fine	Satisfactorily	Unsatisfactory
1	1 question on the topic	10	7	5	0
2	2 questions on the topic	10	7	5	0
3	3 questions on the topic	10	7	5	0
	Total:	30	21	15	0

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry	46-11 ...
Curriculum for the discipline "Biochemistry"	32 of 19p.

No.	Evaluation criteria	Points
1	The student demonstrated original thinking, demonstrated a deep knowledge of the material, and drew on scientific advances from other disciplines in his answer. He used scientific terminology.	27-30
2	The student demonstrated knowledge of the material and made minor inaccuracies, which were corrected by the student. He used scientific terminology.	21-26
3	The student made inaccuracies and minor mistakes during his answer, used scientific terminology, experienced great difficulty in systematizing the material, and needed the teacher's help.	15-20
4	The student did not answer the teacher's questions, made fundamental mistakes and inaccuracies, and did not use scientific terminology in his answers.	0-14

Conducting laboratory work

No.	Evaluation criteria	Points
1	Completed practical and laboratory work on time and without any errors and submitted reports on them, took an active part in the discussion of the results of the work, made well-founded conclusions, and demonstrated original thinking.	27-30
2	Completed practical and laboratory work on time and submitted reports on them without any fundamental comments, took an active part in the discussion of the work results	21-26
3	Completed practical and lab assignments on time and submitted reports. Was inactive during work and required assistance from the instructor.	15-20
4	Failure to submit practical reports on time and making fundamental errors during their completion. Not completing all the practical work required by the program. Failure to participate in the discussion of the work results.	0-14

3. Completing test tasks

No.	Evaluation criteria	Points
1	90-100% correct answers	10-12
2	70-89% correct answers	8-9
3	50-69% correct answers	6-7
4	Less than 50% correct answers	0-2

4. Solving situational problems

No.	Evaluation criteria	Points
1	Demonstrates original thinking when solving a situational problem. Fully utilizes theoretical knowledge necessary for solving the problem. Demonstrates excellent knowledge of reference biochemical parameters when interpreting proposed biofluid analysis data. Demonstrates the ability to draw logical conclusions based on a situational problem, while demonstrating a thorough understanding of the required course material.	25-28

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry	46-11 ...
Curriculum for the discipline "Biochemistry"	32 of 20p.

2	Possesses the necessary knowledge to solve a given situational problem. Allows for minor inaccuracies when discussing a given case. Capable of drawing correct conclusions based on the proposed situational problem.	19-24
3	Allows minor inaccuracies when discussing a given problem, has difficulty interpreting the analyses proposed in the situational problem, and draws conclusions with difficulty.	14-18
4	Makes fundamental mistakes in discussing situational problems. Passive, unable to draw appropriate conclusions.	0-13

Situational tasks-maximum 28 points (each task maximum 14 points):

No	Questions	Level			
		Great	Fine	Satisfactorily	Unsatisfactory
1	1 situational task on the topic	14	10	7	0
2	2 situational tasks on the topic	14	10	7	0
	Total:	28	20	14	0

CHECKLIST for SIWP/SIW

N o.	Evaluation criteria	Level			
		Great	Fine	Satisfactori ly	Unsatisf actory
Independent workstudents					
1	Making a presentation	40	30	15	0
2	Completing essays or analyzing scientific articles	20	15	10	0
3	Completing the glossary	10	8	7	0
4	Solving situational problems/writing biochemical reactions or formulas	30	20	17	0
	General:	100	73	46	0

1. Presentation of the topic:

No.	Evaluation criteria	Points
1	The presentation was completed independently, within the assigned timeframe, and contained at least 25 slides. At least 7 literary sources were used. The slides were informative and concise. During the presentation, the author demonstrated a thorough knowledge of the topic and was accurate in answering questions during the discussion.	31-40
2	The presentation was completed independently, within the assigned timeframe, and contained at least 23 slides. At least six literary sources were used. The slides were informative and concise. During the presentation, the author demonstrated a good knowledge of the topic. The author made minor errors in answering questions, which he or she corrected.	4:30 PM
3	The presentation was completed independently, within the specified deadline, with at least 20 slides. At least 5 literary sources were used. The slides lack substance. During the defense, the author made fundamental errors in answering questions.	10-15

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry	46-11 ...
Curriculum for the discipline "Biochemistry"	32 of 21p.

4	The presentation was not submitted by the deadline; it had at least 20 slides. Fewer than 5 references were used. The slides lacked substance. During the defense, the author made serious errors in answering questions. He was unsure of his own material.	0-9
---	--	-----

2. Analysis of scientific articles:

No.	Evaluation criteria	Points
1	The work was completed neatly and submitted on time. It was independently written on at least three pages of printed text. The author's thoughts on the problem were clearly and convincingly presented. Authors' references were provided throughout the text. During the defense, the author narrated the text rather than read it. He confidently and accurately answered all questions. Articles used for the work were no more than five years old.	16-20
2	The work was completed neatly and submitted on time. It was independently written on at least three pages of typed text. The author's thoughts on the problem were clearly expressed, but without arguments. Authors were referenced throughout the text. During the defense, the author narrated the text rather than read it. When answering questions, the author made minor errors. Articles used for the work were no more than five years old.	10-15
3	The work was completed neatly and submitted on time. It was independently written on at least two pages of typed text. The author's thoughts on the problem were presented in a scattered manner, lacking arguments. Authors were not referenced throughout the text. During the defense, the author read the text. Hesitantly answers questions and makes fundamental errors. The work was based on articles more than five years old.	6-9
4	The work is written in less than two printed pages. The ideas are presented scatteredly, without supporting arguments. The text contains no citations to the authors. During the defense, the author reads the text. When answering questions, he makes serious errors and is unsure of the material. The work uses articles more than five years old.	0-5

3. Preparation of written creative work (essay)

No.	Evaluation criteria	Points
1	The content of the paper is fully consistent with the topic; the theme is explored in depth and with argumentation. The presentation of ideas is well-structured, logical, and consistent. The essay's problem is clearly articulated. There are no factual errors. The conclusion contains inferences that logically follow from the content of the main body.	16-20
2	The topic is explored fairly fully and convincingly, with only minor deviations. The thesis is clearly formulated and consistent with the essay's topic. The main body of the essay is logical and coherent, but not fully substantiated, and contains a few factual inaccuracies.	11-15
3	The answer to the topic is correct, but one-sided or incomplete. There are deviations from the topic or individual errors in the presentation of factual material. The material is presented fairly logically, but there are some irregularities in the flow of thought. The conclusions do not fully correspond to the content of the main body.	5-10

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry	46-11 ...
Curriculum for the discipline "Biochemistry"	32 of 22p.

4	The topic is not fully explored, indicating a superficial knowledge. It is characterized by a haphazard arrangement of material and a lack of connection between sections. It is distinguished by the presence of serious speech errors.	0-4
---	--	-----

4. Solving situational problems

No	Evaluation criteria	Points
1	Demonstrates original thinking when solving a situational problem. Fully utilizes theoretical knowledge necessary for solving the problem. Demonstrates excellent knowledge of reference biochemical parameters when interpreting proposed biofluid analysis data. Demonstrates the ability to draw logical conclusions based on a situational problem, while demonstrating a thorough understanding of the required course material.	9-30 PM
2	Possesses the necessary knowledge to solve a given situational problem. Allows for minor inaccuracies when discussing a given case. Capable of drawing correct conclusions based on the proposed situational problem.	18-20
3	Allows minor inaccuracies when discussing a given problem, has difficulty interpreting the analyses proposed in the situational problem, and draws conclusions with difficulty.	10-17
4	Makes fundamental mistakes in discussing situational problems. Passive, unable to draw appropriate conclusions.	0-9

5. Preparing a glossary

No	Evaluation criteria	Points
1	Awarded if the student has compiled a glossary independently; it contains at least 20 terms. The terms are relevant to the topic being defended; the wording is correct, consistent with the biological meaning, and complete. The terms are arranged alphabetically, and a full definition is provided.	9-10
2	Awarded if the student has compiled a glossary independently; it contains at least 20 terms. The terms are relevant to the topic being defended; the term is correctly formulated and corresponds to its biological meaning. There is no alphabetical order. There are some inaccuracies.	7-8
3	This is given if the student has compiled the glossary independently; its size is at least 20 terms. The wording of the term corresponds to the biological meaning, but is not complete. There is no alphabetical order;	5-6
4	This is given if the student has compiled a glossary independently; its size is at least 10 terms. The terms are not relevant to the topic; serious biological errors are allowed. There is no alphabetical order;	0-4

CHECKLIST for interim certification

No.	Evaluation criteria	Level			
		Great	Fine	Satisfactorily	Unsatisfactory
Midterm exam					
1	Written response to questions	30	20	15	0
2	Completing test assignments	30	20	15	0
3	Solving situational problems	40	30	20	0
	General:	100	70	50	0

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry	46-11 ...
Curriculum for the discipline "Biochemistry"	32 of 23p.

1. Written response to questions

Approximately 3 questions of maximum 10 points:

No.	Questions	Level			
		Great	Fine	Satisfactorily	Unsatisfactory
1	1 question on the topic	10	6	5	0
2	2 questions on the topic	10	6	5	0
3	3 questions on the topic	10	8	5	0
	Total:	30	20	15	0

No.	Evaluation criteria	Points
1	The student demonstrated original thinking, demonstrated a deep knowledge of the material, and drew on scientific advances from other disciplines in his answer. He used scientific terminology.	27-30
2	The student demonstrated knowledge of the material and made minor inaccuracies, which were corrected by the student. He used scientific terminology.	21-26
3	The student made inaccuracies and minor mistakes during his answer, used scientific terminology, experienced great difficulty in systematizing the material, and needed the teacher's help.	15-20
4	The student did not answer the teacher's questions, made fundamental mistakes and inaccuracies, and did not use scientific terminology in his answers.	0-14

2. Completing test tasks

No.	Evaluation criteria	Points
1	90-100% correct answers	9-30 PM
2	70-89% correct answers	16-20
3	50-69% correct answers	11-15
4	Less than 50% correct answers	0-10

3. Solving situational problems

Situational tasks-maximum 40 points

No.	Questions	Level			
		Great	Fine	Satisfactorily	Unsatisfactory
1	situational task	40	30	15	0
	Total:	40	30	15	0
No.	Evaluation criteria	Points			
1	Demonstrates original thinking when solving a situational problem. Fully utilizes theoretical knowledge necessary for solving the problem. Demonstrates excellent knowledge of reference biochemical parameters when interpreting proposed biofluid analysis data. Demonstrates the ability to draw logical conclusions based on a situational problem, while demonstrating a thorough understanding of the required course material.	30-40			

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry	46-11 ...
Curriculum for the discipline "Biochemistry"	32 of 24p.

2	Possesses the necessary knowledge to solve a given situational problem. Allows for minor inaccuracies when discussing a given case. Capable of drawing correct conclusions based on the proposed situational problem.	21-29
3	Allows minor inaccuracies when discussing a given problem, has difficulty interpreting the analyses proposed in the situational problem, and draws conclusions with difficulty.	10-20
4	Makes fundamental mistakes in discussing situational problems. Passive, unable to draw appropriate conclusions.	0-9

Multi-point system of knowledge assessment			
Grading in a letter system	Digital equivalent of points	Percentage content	Assessment according to the traditional system
A	4.0	95-100	Great
A -	3.67	90-94	
B +	3.33	85-89	
B	3.0	80-84	Fine
B -	2.67	75-79	
C +	2.33	70-74	
C	2.0	65-69	Satisfactorily
C -	1.67	60-64	
D +	1.33	55-59	
D -	1.0	50-54	Unsatisfactory
FX	0.5	25-49	
F	0	0-24	

№.	Educational discipline		
1.	while on the department's premises	Name	comply with the disciplinary requirements specified upon
2.	Electronic library of the South Kazakhstan Medical Academy	Link	- https://e-lib.skma.edu.kz/genres
3.	mandatory attendance of lectures, laboratory classes according to the schedule;	Responsible	Republican Interuniversity
4.	don't be late for classes	Electronic library (EBSI) apps;	http://rmebrk.kz/
5.	During classes, wear special clothing (BBSI caps);	Digital library	A provides leave certificate issued by the dean's office based on
6.	do not miss classes; Digital library "Epigraph"	Electronic library "Epigraph"	- http://www.elib.kz/
7.	missed classes should be compensated by attending work-offs;	Epigraph - a portal for	https://mbook.kz/ru/index
8.	actively participate in multimedia textbooks;	multimedia textbooks;	
9.	comply with the Academic Regulations and	EBS IPR SMART regulations and	https://www.iprbookshop.ru/auth
10.	complete homework and SIW assignments in a timely and accurate manner according to the SIW schedule;	Information and legal system	https://zan.kz/ru
11.	In case of failure to complete assignments and missing a lecture, the final grade is reduced;	complete assignments and	https://research.ebsco.com/
12.	be patient, open and friendly towards fellow students and teachers;	EBSCO Medical Collection	
13.	take good care of the department's property;	EBSCO	
14.	In connection with the absence of lectures for an unjustified reason, 1 point is deducted from the overall admission rating for each absence;	Scopus	https://www.scopus.com/
15.	In connection with the absence of classes under the SIWPS for an unjustified reason, 2 points are deducted from the overall admission rating for each absence;	1. Biochemistry [Electronic resource]: textbook for universities / ed. E. S. Severina. - 5th ed., rev. and additional - Electron. text data. (66.3 MB). - M.: GEOTAR - Media, 2013. - 768 p. - CD-ROM	
16.		2. Biochemistry [Electronic resource]: textbook / edited by E. S. Severin. - 5th ed. - Electronic text data. (66.4 MB). - M.: Publishing group "GEOTAR-Media", 2011. - 768 p. electronic optical disc (CD-ROM)	
17.		3. Tapbergenov S.O. Medical and clinical biochemistry / Tapbergenov S.O. 2020.-512 p. https://www.elib.kz/ru/search/read_book/429/	

ONTÜSTIK-QAZAQSTAN MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
Department of Chemical Disciplines, Biology and Biochemistry	46-11 ...
Curriculum for the discipline "Biochemistry"	32 of 25p.

15. If a student receives an unsatisfactory grade (0-49 points) during the midterm assessment, he/she will not be allowed to take the final assessment.
16. If a student receives an unsatisfactory grade in the practical skills assessment, he/she will not be allowed to take the final assessment.
17. If a student is absent from a lecture, practical lesson, or SIW (independent work of the student) lesson according to the schedule without a valid reason, an absence mark ("0") is entered in the AIS Platonus electronic educational journal.

13. Academic policy based on the moral and ethical values of the academy

Understanding the importance of the principles and culture of academic integrity, which express students' honesty in practical and laboratory work, as well as in SIW classes, exams, and expressing their position in interactions with faculty and administration.

Course grading policy: The student's final grade upon completion of the course is made up of the sum of the admission rating assessment (ARA) and the final control assessment (FCA) and is assigned according to a point-rating letter system.

$$ME = ARA + FCA$$

Admission Rating Assessment (ARA) equals 60 points or 60% and includes: assessment of current control (ACC) and assessment of midterm exam (ME).

Evaluation of current control (ECC) consists of the average grade for practical classes + the average grade for independent work

Assessment of midterm exam (AME) includes the average rating of 2 Midterm exam.

Admission Rating Score (60 points) calculated using the formula:

$$ME_{avg} \times 0.2 + AME_{avg} \times 0.4$$

Final control (FC) It is conducted in the form of testing and the student can receive 40 points or 40% of the overall grade.

During testing, the trainer is offered 50 questions.

The final assessment is calculated as follows: if the student answered 45 questions out of 50 correctly, this will be 90%.

$$90 \times 0.4 = 36 \text{ points.}$$

Final assessment is calculated if the student has positive grades both for the admission rating (AR) = 30 points or 30% or more, and for the final control (FC) = 20% or more.

Final score (100 points) = $ME_{avg} \times 0.2 + ACC_{avg} \times 0.4 + FC \times 0.4$ a student who received an unsatisfactory grade for one of the types of control (ME1, ME2, CCavg) is not allowed to take the exam.

Penalty points are subtracted from the average score of the current control.

14. Approval and revision			
Date of approval	Protocol No.	Full name of the manager	Signature
Date of agreement with the library and information center	Protocol No. 25.06.25.	Head of the BIC Darbicheva R.I.	
Date of approval at the department	Protocol No. 26.06.25.	Head of the Department of Chemical Disciplines, Biology and Biochemistry, Acting Professor K.N. Daurenbekov	
Date of approval for AK EP	Protocol No. 27.06.25.	Chairman of the JSC "Medicine" Auezhankyzy D.	
Date of review at the department	Protocol No. _____	Head of the Department of Chemical Disciplines, Biology and Biochemistry, Acting Professor K.N. Daurenbekov	
Date of revision at AK EP	Protocol No. _____	Chairman of the JSC "Medicine" Auezhankyzy D.	

ONTÜSTIK-QAZAQSTAN
**MEDISINA
AKADEMIASY**
«Оңтүстік Қазақстан медицина академиясы» АҚ



SOUTH KAZAKHSTAN
**MEDICAL
ACADEMY**
АО «Южно-Казахстанская медицинская академия»

Department of Chemical Disciplines, Biology and Biochemistry

46-11 ...

Curriculum for the discipline "Biochemistry"

32 of 27p.

ONTÜSTIK-QAZAQSTAN
**MEDISINA
AKADEMIASY**
«Оңтүстік Қазақстан медицина академиясы» АҚ



SOUTH KAZAKHSTAN
**MEDICAL
ACADEMY**
АО «Южно-Казахстанская медицинская академия»

Department of Chemical Disciplines, Biology and Biochemistry

46-11.02

Curriculum for the discipline "Biochemistry"

32 of 28p.