

Ministry of Health of the Republic of Belarus
Educational institution
"Gomel State Medical University"

Department of Biological Chemistry

Authors:

O.S. Logvinovich, Head of the Department, PhD (Biol. Sci.), Associate Professor

A.N. Koval, Associate Professor (position and title), PhD (Biol. Sci.)

A.V. Litvinchuk, Associate Professor (position and title), PhD (Biol. Sci.)

M.V. Gromyko, Senior Lecturer

METHODOLOGICAL RECOMMENDATIONS

for a practical lesson in the academic discipline "Biological Chemistry"
for 2nd year **students** of the Faculty of Foreign Students
majoring in 1-79 01 04 "Medical Care"

Topic: Control class No. 5 on partitions: "Regulation of metabolism. Biochemistry of hormones", "Biochemistry of organs and tissues".

Duration 4 hours

Approved at the meeting of the Department of Biological Chemistry
(Protocol No. 10 dated 29.08.2025)

Gomel, 2025

1. LEARNING AND EDUCATIONAL GOALS, MOTIVATION FOR MASTERING THE THEME, REQUIREMENTS FOR THE INITIAL LEVEL OF KNOWLEDGE: the control of educational activities allows to evaluate received knowledge, skills and abilities, get the necessary help in time and achieve learning goals, which creates favorable conditions for the development of cognitive abilities and the activation of independent work at the classes.

Purpose of the class: to revise and systematize covered material.

Class objectives:

The student must know:

1. the main questions of the passed partition « Biochemistry of organs and tissues ».

The student must be able to:

1. to systematize covered material.

2. CONTROL QUESTIONS FROM RELATED DISCIPLINES (no).

3. CONTROL QUESTIONS ON THE TOPIC OF THE CLASS.

3.1 Hormones: definition, properties, nomenclature, classification. Principles of organization and functioning of the neuroendocrine system (examples).

3.2 The mechanism of hormone action (catecholamines, peptide, steroid, thyroid). Characterization of receptors (1-TMS, 7-TMS, intracellular).

3.3 TSH: chemical nature, mechanism of action, regulation of secretion. T₃ and T₄: chemical nature, biosynthesis, regulation of secretion, mechanism of action, role in metabolism, main clinical manifestations of hypo- and hyperproduction of these hormones.

3.4 STH: chemical nature, mechanism of action, regulation of secretion, role in metabolism, main clinical manifestations of hypo- and hyperproduction of the hormone.

3.5 Insulin: chemical nature, stages of synthesis, regulation of secretion, mechanism of action, role in metabolism. The main clinical manifestations of hypo- and hyperproduction of insulin. Type 1 diabetes (insulin-deficient) and type 2 diabetes (insulin resistant). Similarities and differences.

3.6 Glucagon: chemical nature, regulation of secretion, mechanism of action, role in metabolism, main clinical features. Manifestations of hypo- and hyperproduction.

3.7 ACTH: chemical nature, mechanism of action, regulation of secretion, main clinical manifestations of hypo- and hyperproduction. Glucocorticoids: structure, regulation of secretion, mechanism of action, role in metabolism, main clinical manifestations of hypo- and hyperproduction.

3.8 Mineralocorticoids: chemical nature, regulation of secretion, mechanism of action, role in metabolism, main clinical manifestations of hypo- and hyperproduction.

3.9 Catecholamines: chemical nature, regulation of secretion, metabolism in tissues, mechanism of action, role in metabolism, main clinical manifestations of hypo- and hyperproduction.

3.10 Gonadotropins (FSH and LH): chemical nature, regulation of secretion, mechanism of action, role in metabolism, main clinical manifestations of hypo- and hyperproduction. Estrogens: chemical nature, mechanism of action, regulation of secretion, main clinical manifestations of hypo- and hyperproduction.

- 3.11 Gonadotropins (FSH and LH): chemical nature, regulation of secretion, mechanism of action, role in metabolism, main clinical manifestations of hypo- and hyperproduction. Androgens: chemical nature, regulation of secretion, mechanism of action, role in metabolism, main clinical manifestations of hypo- and hyperproduction.
- 3.12 The adaptive role of hormones. The concept of stress. Hormonal regulation of energy metabolism in stress.
- 3.13 Blood, its functions. Blood plasma - qualitative and quantitative composition. The main physical and chemical constants of blood in normal and pathological conditions.
- 3.14 Blood plasma proteins: general characteristics, classification, separation methods, characteristics of individual representatives of each class. Changes in the protein spectrum of blood in pathology, types of proteinemia.
- 3.15 Residual (non-protein) nitrogen: composition, origin, diagnostic value of individual components. Types of azotemia and their causes.
- 3.16 Principles of organization and mechanisms of ABB regulation (physico-chemical and physiological). Types, causes and mechanism of development of acidosis and alkalosis. Mechanisms for correcting of ABB impairments.
- 3.17 Erythrocytes. General characteristics, structure, features of metabolism. Antioxidant defence of red blood cells. Glutathione, its structure, functions.
- 3.18 Hb, its structure, properties. Derivatives of Hb, types of Hb. Comparative characteristics of Hb and myoglobin. Transport of gases. The role of 2,3-BPG. Metabolic impairments during hypoxia. Abnormal Hb. Thalassemia, hemoglobinopathies.
- 3.19 Biosynthesis of heme. Reactions, enzymes, localization, regulation and biological role. Porphyria.
- 3.20 Hb catabolism in RES cells. Bilirubin metabolism in liver and transformation in gastrointestinal tract. Causes and laboratory diagnosis of jaundice: haemolytic, parenchymal, and obstructive.
- 3.21 Leukocyte metabolism features. Biochemical principles of phagocytosis. Respiratory burst. Features of platelets metabolism, role in hemostasis.
- 3.22 Excretory renal function. Mechanism and stages of urine formation. The mechanism of tubular active transport for glucose, amino acids, etc. Impairments of filtration, reabsorption, and secretion, their laboratory diagnostics. Clearance in normal and pathological conditions, its clinical and diagnostic value.
- 3.23 Composition and properties of urine. Organic and inorganic components of urine in normal and pathological conditions. Impairments of filtration, reabsorption, secretion processes and their laboratory diagnostics. Pathological components of urine (blood, protein, glucose, bilirubin): causes of their appearance and diagnostic value.
- 3.24 Homeostatic renal functions. The role of kidneys in regulation of blood pressure, electrolyte balance, ABB (mechanisms of acido- and ammoniogenesis), blood glucose levels (features of GNG in kidneys), the level of biologically active substances, erythropoiesis, etc.
- 3.25 Metabolic heterogeneity of renal tissue. Features of metabolism in kidneys of carbohydrates, lipids, proteins.
- 3.26 Causes of development and main metabolic disorders in acute renal failure (ARF) and chronic renal failure (CRF). Kidney stones, their composition, causes and mechanism of occurrence.

- 3.27 Functions of the liver. Features of hepatocyte metabolism in the pericentral and periarterial zones. The role of liver in interorgan metabolism (Cori cycle, Felig cycle, creatine synthesis).
- 3.28 The role of liver in carbohydrate metabolism. Clinical and diagnostic value of blood glucose level analysis. Galactose and fructose tolerance test.
- 3.29 The role of liver in lipid metabolism. Causes and mechanism of fatty liver development. Clinical and diagnostic value of determining of blood cholesterol, TAG, ketone bodies, atherogenic coefficient, etc.
- 3.30 The role of liver in nitrogen metabolism: metabolism of proteins and amino acids, creatine, nucleic acids, etc. Clinical and diagnostic value of determining concentration of total protein and its fractions in blood, urea, creatinine, etc.
- 3.31 Biochemical liver tests. Clinical and diagnostic value of total and direct bilirubin, ALT, AST, LDH4,5, ALP, GGTP, etc. in blood.
- 3.32 The role of liver in the regulation of ABB, hormonal homeostasis and level of biologically active substances. Main steps and ways of xenobiotics metabolism (characteristics and role of cytochrome P450, the role of UDPGA, PAPS, etc.).
- 3.33 Structural-functional and metabolic characteristics of muscle fibers (white, red). Features of muscle tissue metabolism that characterize its relative autonomy: ATP synthesis pathways in muscle tissue (substrate and oxidative phosphorylation, reactions catalyzed by creatine kinase, adenylate kinase, the role of AMP deaminase, purine nucleotide cycle).
- 3.34 Specific muscle proteins and their characteristics. The role of muscle tissue in interorgan substrate metabolism (Cori and Felig cycles, creatine biosynthesis).
- 3.35 Features of Ca^{2+} metabolism in muscle tissue. The mechanism of electromechanical coupling (the theory of muscle contraction). Features of smooth muscle contraction.
- 3.36 Features of myocardial metabolism. Biochemical mechanisms of heart failure development. Biochemical principles for treatment of heart failure. The mechanism of cardiac glycosides and other cardiotropic drugs action.
- 3.37 The lack of physical activity (hypokinesia). The main elements of hypokinetic syndrome pathogenesis.
- 3.38 General characteristics of nervous system metabolism: carbohydrate, lipid, protein metabolism. Features of brain metabolism in normal and hypoxic conditions.
- 3.39 Neurotransmitters (catecholamines, acetylcholine, GABA, DOPamine, histamine, serotonin): characteristic, synthesis and inactivation (enzymes, reactions), receptors, effects.
- 3.40 Biochemical mechanisms of electrogenesis in nervous tissue. The mechanism of synaptic transmission: the role of membranes, receptors, enzymes and mediators.
- 3.41 Biochemical mechanisms of alcohol, drugs (opioids, cocaine, amphetamines) action onto brain. Pathological conditions of nervous system (depression, parkinsonism, schizophrenia).
- 3.42 Characteristics of connective tissue (CT) fibrous structures. Features of collagen and elastin structure and metabolism. Collagen processing and metabolism. Non-collagenous structural glycoproteins – fibronectin, its structure, properties and functional role. CT changing in aging, collagenoses, wound healing, and vitamin C deficiency.
- 3.43 Bone and cartilage: chemical composition a features of metabolism. Bone metabolism

and the factors influencing it (vitamin D, calcitonin, parathyroid hormone, growth hormone, etc.) The mechanism of bone mineralization.

3.44 SSART: no.

4. PRACTICAL PART OF THE CLASS (no).

5. STUDY PROCESS.

5.1 Introduction.

5.2. Writing a written control on the covered topics.

5.3. The final part of the class. Summarizing.

6. LITERATURE.

1. Биохимия : учебник / под ред. Е.С. Северина. – 5-е изд., испр. и доп. – М.: ГЭОТАР-Медиа, 2020. – 768 с.: ил.

2. Схемы и реакции основных метаболических путей : учеб.-метод. пособие для студентов учреждений высш. образования, обучающихся по специальностям 1-79 01 01 "Лечеб. дело", 1-79 01 04 "Мед.-диагност. дело" / М-во здравоохранения РБ, УО "ГомГМУ", Каф. общей, биоорганической и биологической химии ; А.И. Грицук [и др.]. – Гомель: ГомГМУ, 2018. – 127 с. – Рек. УМО по высш. мед., фармацевт. образованию.

3. Baynes, J. W. Medical biochemistry / J.W. Baynes, M. H. Dominiczak ; ELSEVIER . – 2019. – 682 p.

4. Ferrier, D. R. Lippincott's Illustrated Reviews: Biochemistry / D. R. Ferrier ; Wolters Kluwer . – 2014. – 552 p.

5. Chatterjea, M. N. Textbook of Medical Biochemistry / M. N. Chatterjea, R. Shinde ; Jitendar P Vij. – 2012. – 876 p.

6. Vasudevan, D. M. Textbook of Biochemistry for Medical Students / D. M. Vasudevan, S. Sreekumari, K. Vaidyanathan ; Jitendar P Vij. – 2011. – 657 p.

7. Marks, D. B. Board Review Series: Biochemistry / D. B. Marks ; Harwal Publishing . – 1994. – 337 p.