

Azerbaijan Medical University
Department of Biological Chemistry
Training program on the subject
"Biological Chemistry"
(syllabus)

"I CONFIRM"
Head of the Biological
Chemistry Department
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SYLLABUS

**LECTURES AND LABORATORY CLASSES ON STATIC BIOCHEMISTRY.
CALENDAR-TOPIC PLANS. QUESTIONS FOR CLASSES, COLLOQUIUMS
AND EXAMS PREPARING. PRESENTATION TOPICS ON STATIC BIOCHEMISTRY**

Subjectcode: 2406.02
Typeofsubject: Obligatory
Subjectteachingterm: III (General-medicine faculty)
Subjectcredits: 4
Form of teaching the subject: full-time
Language of teaching: Azerbaijani, Russian, English
**Teachers teaching the subject: The teaching staff of the Department of
Biological Chemistry**

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Programme is prepared by Employees of the Biological Chemistry Department –senior teacher Dashdamirova G.S., ass. Bayramova N.Sh (with general editing by the head of the department, prof. G.I.Azizova).

Evaluation method		Score (points)	
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Exam (final)		50	
Ongoing assessment (1st colloquium)		5	
Ongoing assessment (2nd colloquium)		20	
Ongoing assessment (3rd colloquium)		5	
Assessment for class attendance		10	
Free topics (students' project presented in a group)		10	
<i>Student knowledge assessment based on the sum of the cumulative grade, midterm grade and a grade received on the exam</i>			
less than 51 points	unsatisfactory grade (failed)	F	
51-60 points	marginal grade	E	
61-70 points	satisfactory score	D	
71-80	good score	C	
81-90	very good score	B	
91-100	excellent score	A	
Study-load in semester			
Activity	Amount	Duration (hours)	Total working hours
Ongoing assessment (colloquium)			
Semester exam			
Lectures			
Laboratory (practical exercises)			
Self-training			

Calendar-thematic plan on static biochemistry laboratory classes for students of II course in General Medicine Faculty autumn term of 2022/2023 academic year

№	Topics of the lessons	Biochemistry laboratory manual theory and methods, 2019
1.	<i>Acquaintance with the group, internal discipline and technical safety rules. Chemical composition of the organism. Structure, classification, physico-chemical properties of amino acids. Peptide bond. Distribution of free topics - 4h.</i>	4-24
2.	<i>Serum proteins in normal and pathological conditions. Proteinograms. Properties, structural features of proteins. Simple proteins. Natural peptides - 4 h..</i> Lab. work: Color reactions on amino acids and proteins. Protein sedimentation reactions. Distinguishing of the isoelectric point of proteins.	25
3.	<i>Complex proteins. Phospho-, glyco-, lipo-, chromo-, metalloproteins. Hemoglobinopathies. Lipoproteins, clinical significance, their fractions - 4 h.</i> Lab. work: Reactions on phospho- and glycoproteins. Reactions on hemoglobin.	27-34
4.	<i>Nucleoproteins. Structural properties of nucleic acids. Matrix biosynthesis - 4 h.</i> Lab. work: Hydrolysis of nucleoproteins.	34-38
5.	<i>Structural and functional features of enzymes. Active, allosteric centers, isoenzymes, polyenzymatic systems. Molecular bases of regulation and action mechanism. Clinical enzymology - 4h.</i> Lab. work: Termolability, specificity of enzymes and the effect of optimum pH on the activity of enzymes. The effect of activators and inhibitors on amylase activity. Inactivation of the enzyme cholinesterase with proserin.	60-68
6.	<i>Intermediate assessment – 4h.</i>	
7.	<i>Biochemical features of vitamins Water-soluble vitamins. Coenzymes. Vitamin disbalances. Antivitamins - 4h.</i> Lab. work: Reactions on vitamins B ₁ , B ₂ , PP, B ₆ and C.	68 75-83
8.	<i>Fat soluble vitamins. Microelements, their role in oxidative stress. Vitaminotherapy - 4h.</i>	70-75
9.	<i>Structural features and biochemical properties of hormones, classification. Mechanism of hormones action, types of receptors. The use of hormones in medicine - 4h.</i>	87-90
10.	<i>Biochemical features of adrenal hormones, pancreas and thyroid glands. Cytokines, prostaglandins - 4h.</i> Lab. work: Reactions on adrenaline, insulin and thyroxine	91-106
11.	<i>Biochemical characteristics of carbohydrates and lipids. Lipids of nervous tissue. Connective tissue proteoglycans. - 4h.</i> Lab. work: Reactions on carbohydrates. Emulsification of fats. Distinguishing of fatty acids. Qualitative reactions on cholesterol.	38-48 48-57

Totally: 44 hours.

Calendar-thematic plan on static biochemistry lectures in General Medicine Faculty for II course students. Autumn term of 2022/2023 academic year

№	Subject of lecture	Hours
1.	Biochemistry subject, its goals, objectives and role in medicine. Physico-chemical properties and structural features of proteins. Aminoacids.	2

2.	Simple and complex proteins. Hemoglobin, its heterogeneity and cooperativeness. Immunoglobulins.	2
3.	Biochemical properties of nucleic acids. Matrix biosynthesis process.	2
4.	Enzymes, their classification, and mechanism of action: coenzymes. Enzymology.	2
5.	Vitamins, their classification and mechanism of action. Structure and biochemical properties of water-soluble vitamins.	2
6.	Fat-soluble vitamins. Vitaminotherapy.	2
7.	Hormones: their classification and biochemical properties. Mechanism of some hormones synthesis. Hormones secretion and transmission of hormonal signal.	2
8.	Metabolism of some hormones. Metabolic changes during hypo- and hypersecretion of hormones. Importance of hormones in the diagnosis.	2
9.	Chemistry of carbohydrates. Clinical importance of hete-ropolysaccharides.	2
10.	Chemistry of lipids.	2

Totally: 20 hours.

COLLOQUIUM QUESTIONS

Biochemical properties of amino acids, proteins and nucleic acids. Matrix biosynthesis

1. Classification of amino acids based on different principles (depending on side chain structure, charge of radical, radical polarity, the number of amino- and carboxylic groups, nutritional requirements).
2. Proteinogenic and non-proteinogenic amino acids structure (with examples), their general characteristics and role in metabolism.
3. Physico-chemical characteristics of amino acids: stereoisomerism, optical activity, electric charge of amino acids depending on the pH of the medium, solubility and dissociation ability of amino acids, their value for organism, titration curves, isoelectric point and their importance for human body.
4. Chemical composition of proteins, their distribution in organism, representatives, differed by their functions. Obtaining from biological materials (homogenization, extraction, fractionation), salting out and impact of this process on ionization stage of the solution. Hofmeister series. Chromatography, electrophoresis, their types and principles of techniques.
5. Physico-chemical properties of proteins: shapes, solubility, optical activity, amphotericity, izoelectric point. Denaturation, features of denaturing factors' action, renaturation. Protein sedimentation factors, use these reactions in methods of protein's features investigation.
6. Different types of protein classification. Fibrous proteins' structural features and functions. Collagen: amino acid composition; structure of collagen's protomer – tropocollagen and molecule-stabilizing bonds. Keratin: occurrence in the human body, α - and β -keratins, their aminoacids composition.
7. Proteins' structural organization levels, their features. Primary structure and peptide bond. Methods of amino acids distinguishing in the protein molecule: hydrolysis (types and their limitations). Distinguishing of N- and C-terminal amino acids and disulfide bonds in the polypeptide chain. Common and specific color reactions for proteins and amino acids, their principles and value.
8. Spatial configuration of proteins: bonds stabilizing secondary, tertiary and quaternary structure of protein. Protein domain concept. Folding of proteins molecules. The concept of chaperones.
9. Natural peptides: their classification, representatives according to the origin, and specific ways of action. Angiotensin and kinins, their precursors, scheme of formation and enzymes involving in this process. Glutathion, carnosine, anserine – their structure, value, occurrence.
10. Simple proteins, prinsiple of their classification. Albumines and globulines; prolamines and glutelins, protamines and histones. Human blood protein fractions (proteinogram) and its changes in the pathology.
11. Metalloproteins, their representatives, occurrence, value; linkage types, formed between metals and the peptide chain. Metalloid proteins.
12. Phosphoproteins: representatives, occurrence, types of linkage between prostetic group and protein part. Significance of proteins phosphorylation and dephosphorylation.

13. Glycoproteins and proteoglycans: representatives, biological role, occurrence, composition and the percentage of carbohydrate component (examples). Bonds for linkage between carbohydrate component and the protein moiety. Diagnostic value of sialic acid distinguishing by Hess method.
14. Lipoproteins and proteolipids: physico-chemical properties, occurrence, localization in organism, bonds involved in protein-lipid interactions, types of apo-proteins. Blood plasma lipoprotein fractions, their structural features and functions.
15. Chromoproteins: classification, representatives. Flavoproteins, hemoproteins: occurrence, role in metabolism. Structure of heme.
16. Structural features of hemoglobin: heterogeneity, chemical properties, effect of cooperativeness, Bohr effect, allosteric regulators. The methods of scarce blood detection in biological materials.
17. Different forms of hemoglobin: oxyhemoglobin, carbhemoglobin, met-hemoglobin, and carboxyhemoglobin – their structure and functional features, the significance of blood saturation with oxygen. Hemoglobinoses and hemoglobinopathies.
18. Myoglobin and other representatives of hemoproteins (catalase, peroxydase, cytochromes), their structural and functional features.
19. General characteristics of nucleic acids. Purine and pyrimidine bases: lactam and lactim forms, nucleic acid minor forms and nitrogen bases that are not included in the nucleic acids composition. Nucleoside and nucleotide structures, their syn- and anti-configurations.
20. Primary, secondary and tertiary structure of DNA. Chargaff rules. Formation of nucleosome and chromatin.
21. The main structural features of different types of RNA. Formation of secondary and tertiary structure of RNA.
22. The role of transcription in the biosynthesis of proteins. The concept of amino acid codons.
23. Recognition of amino acids. Translation, its stages.
24. Regulation of protein biosynthesis, the effect of inducers and inhibitors on protein biosynthesis.
25. Post-translational modification of proteins.

Biochemical characteristics of enzymes and vitamins

1. Chemical nature of enzymes, their difference from inorganic catalysts. Ribozyme. Simple and complex enzymes.
2. The main properties of enzymes: their specificity types, thermolability, the impact of pH of medium on the enzymes activity.
3. Mechanism of enzymatic action. Organization of active center. Activation energy, Michaelis-Menten kinetics. Koshland theory as an induced-fit model; the concept of orientation and deformation in enzymatic action. Catalysis types: acid-base, electrophilic, nucleophilic, covalent.
4. The impact of substrate and enzyme concentration on the reaction rate. Michaelis coefficient: the relation between the substrate concentration and reaction rate.
5. Classification of coenzymes. Vitamin- and non-vitamin coenzymes: nucleotide coenzymes, metalloporphyrins, prosthetic groups of metallo-enzymes; phosphorous esters of monosaccharides and glutathione as coenzymes, their biological role.
6. Polyenzyme systems: 3 types of their organization (give an example). Localization of enzymes in cells, organelles, organs and tissues. Isoenzymes: clinical significance, enzyme-diagnostics.
7. Activators of enzymes. Activators affecting the active center: cofactors, substrates, metal ions. Activators, that affect off-center sites. Activation of proenzymes by partial proteolysis. Enzyme activation by enzyme sulfhydryl groups reduction and dissociation of inactive enzyme complexes.
8. The two main ways of enzyme inhibition (reversible and irreversible). Inhibitor types: competitive, non-competitive and uncompetitive (give example), difference in their impact on the enzyme activity. Reactivators (give example).
9. The ways of enzymes intracellular regulation: quantitative change via induction or repression, compartmentalisation, shuttle mechanisms; the principle of feedback (retro-inhibition), conversion of proenzymes into active enzymes, chemical modification of enzymes, allosteric regulation.
10. Enzymes nomenclature and classification; six main classes of enzymes, their subclasses; enzyme code.

11. Enzymes usage in medicine: "immobilized enzymes", enzyme-pathology, enzyme-therapy and enzyme-diagnostics.
12. Vitamin A, its chemical and biological names, structure, vitamers, provitamins, biochemical functions, hypo- and hypervitaminosis, natural sources.
13. Vitamin D, its chemical and biological names, structure. Metabolism of vitamin D, its conversion into hydroxylated active derivatives and their biochemical functions; avitaminosis, hypervitaminosis, natural sources.
14. Vitamin E, its chemical and biological names, vitamers, metabolism, antioxidant activity, avitaminosis, natural sources.
15. Vitamin K, its chemical and biological names, vitamers, metabolism, biochemical functions, imbalance, natural sources.
16. Vitamin B₁, its chemical and biological names, structural features, metabolism; Coenzymes structural features (co-carboxylase). Role of vitamin B₁ in metabolism, avitaminosis, natural sources.
17. Vitamin B₂, its chemical and biological names, structural features, metabolism, coenzyme forms (FMN and FAD), their synthesis, structure. Biochemical function of vitamin B₂, avitaminosis, natural sources.
18. Pantothenic acid, its chemical and biological names, structural features, metabolism, coenzyme forms, biochemical functions, deficiency, natural sources.
19. Vitamin PP (nicotinic acid), its chemical and biological names, structure, metabolism. Coenzymes NAD⁺ and NADP⁺, their biosynthesis, structure, biochemical functions, deficiency, natural sources.
20. Vitamin B₆, its chemical and biological names, vitamers, their structure, metabolism. Coenzymes PALP and PAMP, their structure, biochemical functions, avitaminosis, natural sources.
21. Folic acid, its chemical and biological names, structural features, metabolism, coenzyme forms and biochemical functions, cause of deficiency and its manifestations, natural sources.
22. Vitamin B₁₂, its chemical and biological names, chemical nature, metabolism, coenzymes, biochemical functions, causes and manifestations of deficiency, natural sources.
23. Vitamin H (biotin), its chemical and biological names, structure, metabolism, biochemical functions, deficiency, natural sources. Avidin.
24. Vitamin C, its chemical and biological names, structure, metabolism, biochemical functions, avitaminosis, natural sources.
25. Vitamin-like substances: vitamins P, B₁₅, U and F, carnitine: chemical names and chemical nature, metabolism, biochemical functions, avitaminosis, natural sources.
26. Inositol, lipoic, orotic and paraaminobenzoic (PABA) acids, choline, ubiquinone: their structures, metabolism, biochemical functions, natural sources.
27. Vitamin therapy in treatment of various diseases; use of vitamins-, coenzymes- and antivitamin – based drugs in medicine.

Biochemical characteristics of hormones

1. Characteristics of hormones: general concept, nomenclature, types according to classification.
2. Regulation mechanism of hormone synthesis and secretion: feedback principle, synergism, antagonism, permissiveness.
3. Transmission of hormonal signals through protein-receptors. Differences in hormonal effect based on receptor localization. G-proteins and secondary messengers. Hormones action mechanism: adenylate cyclase, guanylate cyclase, calcium polyphospho-inositol systems.
4. Hormones with intracellular mechanism of action. Intracellular and intranuclear receptors. The role of hormones in the regulation of the transcription.
5. Hormones synthesis, secretion, circulation, metabolism and excretion.
6. Hormones of the hypothalamus: somatoliberin, corticoliberin, thyroliberin, prolactoliberin, gonadoliberins (luliberin and folliberin), melanoliberin, melanostatin, somatostatin and prolactostatin; their chemical nature, effects and violation of secretion.
7. Hormones of the adenohypophysis: somatotropin (growth hormone), prolactin, their chemical nature and effects. Diseases associated with the pituitary gland endocrine function disorders: pan-hypopituitarism, hyper- and hyposecretion of somatotropin.

8. Hormones of the pituitary gland: thyrotropin and gonadotropins. POMC derivatives: adrenocorticotropin, lipotropic and melanocyte-stimulating hormones: their chemical nature, biochemical effects, hyper- and hyposecretions.
9. Hormones of neurohypophysis: oxytocin and vasopressin, their chemical nature, biological effects. Violation of vasopressin and oxytocin secretion.
10. Hormones of the pineal gland: melatonin, serotonin and adreno-glomerulotropin, their structure, biological effects. Diseases associated with disorders of these hormones. Biologically active substances synthesized in thymus.
11. Thyroid hormones: their structure, biological effects, metabolism. Iodine intake. Disorders of thyroid hormone secretion.
12. Hormones affecting calcium metabolism: parathormone, calcitonin, calcitriol, their chemical nature, biological effects, violation of secretion resulting in fibrous osteochondro-dystrophy, tetany and spasmophilia.
13. Pancreatic hormones. Insulin: chemical nature, regulation of secretion, influence on carbohydrate, protein, lipid metabolism. Violation of insulin secretion, causes of diabetes mellitus, metabolic changes in this disease.
14. Glucagon, somatostatin and pancreatic peptide, their chemical nature and biological effects.
15. Hormones of the adrenal medulla, catecholamines: dopamine, adrenaline, noradrenaline and isopropyl adrenaline, their structure. Synthesis of adrenaline, its biological effects depending on receptor types. The main ways of catecholamine catabolism.
16. Hormones of the adrenal cortex: their different groups. Glucocorticoids: representatives, structure, regulation of secretion and biological role. Diseases associated with hyper- and hyposecretion of glucocorticoids (Itsenko-Cushing's disease, Cushing's syndrome, steroid diabetes, Addison's disease and Addison's syndrome).
17. Mineralocorticoids: representatives, their structure, regulation of secretion, biological effects, catabolism. Diseases associated with changes in mineralocorticoid concentration: aldosteronism (Conn's syndrome), adrenogenital syndrome.
18. Male sex hormones: their structure and biological effects and disorders of endocrine function.
19. Female sex hormones: their structure, biological role, dysfunction. Endocrine function of the placenta (chorio-gonadotropin, choriomammotropin).
20. Hormones of the digestive system; their chemical nature. Eicosanoids, their chemical nature and biological effects. Cytokines. Blood kinin system.

QUESTIONS FOR PREPARING FOR LABORATORY CLASSES

LESSON II

Serum proteins in normal and pathological conditions. Proteinograms.

Properties, structural features of proteins.

Simple proteins. Natural peptides

1. General concept about the organism chemical composition. Functions of proteins.
2. Proteinogenic and non-proteinogenic amino acids. Reactions on aminoacids.
3. Titration curves of amino acids and their significance for the organism.
4. Bonds involved in the formation of proteins primary structure.
5. Spatial configuration of proteins: proteins secondary, tertiary and quaternary structure.
6. Folding of proteins, "chaperone" and the concept of domain. Reactions on aromatic and sulphur containing aminoacids (lab. works).
7. The role of the physicochemical properties of proteins for the organism: solubility, optic activity and amphotericity of proteins. Isoelectric point of proteins and its distinguishing (lab. work).
8. Salting out of proteins. Sedimentation reactions of proteins (lab. work).
9. Mechanism of protein denaturing factors and related laboratory work.
10. Simple proteins, their classification. Characteristics of albumins and globulins. Distinguishing of total protein in blood serum by biuret method. Distinguishing of serum albumin levels. (lab. work).

11. Presentation of a free topic: "Biochemical characteristics of blood plasma proteins. Protein blood fractions in norm and its changes in pathology (proteinogram)".
12. Natural peptides, their classification, main representatives.

LESSON III

Complex proteins. Phospho-, glyco-, metallo-, chromoproteins. Hemoglobinopathies. Lipoproteins, clinical significance, their fractions

1. Classification of complex proteins. Metalloproteins, their role in medicine.
2. Phosphoproteins, their representatives and the significance of the phosphorylation reaction in the organism. Extraction of caseinogen from milk (lab. work).
3. Types of glycoproteins. Influence of the carbohydrate component on proteins.
4. Biological role of glycoproteins. Extraction of mucin from saliva, Podopedov-Molish reaction (lab. work).
5. Structural features of lipoproteins, blood lipoproteins, biological role.
6. Presentation of a free topic: "Structural and biochemical features of blood lipoproteins, the role of apoproteins, their changes."
7. Structural features of hemoglobin, heterogeneity, cooperative effect.
8. Heme structure. Test on hemin crystals (lab. work).
9. Influence of various chemical factors on the function of hemoglobin: Bohr effect, influence of 2,3-BPG.
10. Physiological and pathological types of hemoglobin. Generally about saturation. Reactions on hemoglobin: benzidine and guayanic (lab. work.).
11. Myoglobin, structural features, differences and similarities with hemoglobin. Distinguishing of iron in heme molecule (lab. work).
12. Presentation of a free topic: "Structural and biochemical features of hemoglobin. Hemoglobinopathies".

LESSON IV

Nucleoproteins. Structural features nucleic acids. Matrix biosynthesis

1. Nucleoproteins: types, composition and functions.
2. Isolation and hydrolysis of nucleoproteins from yeast. Specific reactions to the distinguishing of protein, carbohydrate component and phosphoric acid (lab. work).
3. The chemical composition of nucleic acids: purine and pyrimidine bases, the status of nucleoside, nucleotide species in the body (forms).
4. Primary, secondary structures of DNA. Chargaff's rules.
5. Tertiary structure of DNA and the role of other spatial structures in the formation of chromosomes.
6. Species - RNA, structural features.
7. Transcription - the stage of protein biosynthesis.
8. Translation, post-translational processing.
9. Regulation of protein biosynthesis and the effect of activators and inhibitors on biosynthesis.
10. Presentation of a free topic: "Structural and biochemical features of DNA and prospects for research (CPR-diagnostics, GMOs)".

LESSON V

***Structural and functional features of enzymes.
Active, allosteric centers, isozymes, polyenzyme systems.
Molecular basis of regulation and mechanism of action.
Clinical enzymology***

1. Features of enzymatic catalysis, coenzyme, apoenzyme, holoenzyme.
2. Properties of enzymes: thermolability. Distinguishing of the optimum temperature of saliva amylase (lab. work).
3. Dependence of enzyme activity on pH medium. Distinguishing of pH optimum for salivary amylase (lab. work).
4. Specificity of enzymes and its types. Distinguishing of the specificity of salivary amylase and sucrase (lab. work).
5. Classification of enzymes and coenzymes, representatives.
6. Explanation and graph of the mechanism of enzymes action by activation energy.
7. Explanation of the mechanism of enzymes action on the active center: the effects of orientation, deformation. Active center, structural and functional features.
8. Molecular basis of the mechanism of enzymes action: acid-base and covalent catalysis.
9. Dependence of the rate of an enzymatic reaction on the concentration of the substrate: the concept of the Michaelis constant.
10. Regulation of enzyme activity: feedback principle, covalent modification. Change in the number of enzymes, allosteric regulation.
11. Regulation of enzyme activity: isoenzymes, polyenzyme systems.
12. Influence of activators on enzyme activity. Influence of activators and inhibitors on the activity of amylase (lab. work).
13. The use and importance of enzymes and enzyme inhibitors in medicine (case study).
14. Clinical enzymology. Enzyme immobilization.

LESSON VI

***Biochemical features of vitamins. Water soluble vitamins.
Coenzymes. Violation of the balance of vitamins.
Antivitamins.***

1. General characteristics of vitamins: types, classifications, names.
2. Disorders of vitamin balance.
3. Vitamins B₁ and pantothenic acid, structural and biochemical features, functions (lab. work).
4. Vitamins B₂ and PP, structural and biochemical features, functions (lab. work).
5. Vitamins B₆ and H, structural and biochemical features, functions (lab. work).
6. Vitamins B₉ and B₁₂, structural and biochemical features, functions (lab. work).
7. Vitamin C, structural and biochemical features, functions.
8. Qualitative reactions and quantitative distinguishing of vitamin C in rosehip extract (lab. work).
9. Presentation of a free topic: "Biochemical properties of vitamins involved in redox processes and their use in medicine. Hypoenergetic states.

LESSON VII

***Fat soluble vitamins. Microelements, their role in oxidative stress.
Vitamin therapy***

1. Vitamin A, its structural and biochemical properties, its functions, hypo- and hypervitaminosis.
2. Vitamin D, its structural and biochemical properties, its functions, hypo- and hypervitaminosis.

3. Vitamin E, its structural and biochemical properties, its functions, hypo- and hypervitaminosis.
4. Vitamin K, its structural and biochemical properties, its functions, hypo- and hypervitaminosis.
5. The role of microelements in the human body.
6. The use of vitamins in medicine.
7. Presentation of a free topic: "The value of antioxidants, vitamins and trace elements in oxidative stress, their biochemical properties."

LESSON IX

Biochemical features of hormones: classification. The mechanism of action of hormones: types of receptors. The use of hormones in medicine

1. General information about hormones. Types of action of hormones.
2. Nomenclature and classification of hormones based on different principles.
3. Role in the regulation of the synthesis and secretion of hormones, the hypothalamic-pituitary system.
4. Biological active substances of the hypothalamus: types, structural and biochemical features.
5. Hormones of the adenohypophysis, structural and biochemical features.
6. Hormones of the neurohypophysis. Diabetes insipidus.
7. Types of relationships between the functions of the endocrine glands.
8. Information about receptors of biochemical mechanisms of action of hormones (optional).
9. Presentation of a free topic: "Mechanisms of action of mountains-monov: modern ideas about it."

X LESSON

Biochemical features of hormones of the adrenal, pancreas and thyroid glands. Cytokines, prostaglandins

1. Thyroid hormones: the process of thyroïdogenesis, structural and biochemical features, types of catabolism.
2. Violations of the secretion of thyroid hormones. Detection of iodine in thyroidin (lab. work).
3. Hormones involved in calcium metabolism: structural and biochemical features, biochemical mechanisms of disorders.
4. Metabolism of insulin: biosynthesis, structural features, catabolism. Qualitative responses to insulin (lab. work).
5. Insulin metabolism: a universal regulatory role in metabolism. Biochemical mechanisms of diabetes mellitus.
6. Presentation of a free topic: "Causes and biochemical mechanisms of diabetes."
7. Metabolism of glucagon. Insulin/glucagon index and its changes.
8. Hormones of the adrenal medulla - adrenaline, norepinephrine - metabolism, synthesis, catabolism pathways. Qualitative reactions to adrenaline (lab. work).
9. Metabolism of adrenaline: types of receptors and their biological role.
10. Presentation of a free topic: "ACTH - the hormone-cortical layer of the adrenal glands, physiological and biochemical properties. Prostaglandins, cytokines, structural and biochemical features and their role in inflammatory processes."

LESSON XI

Biochemical features of carbohydrates and lipids. Lipids of nervous tissue. Proteoglycans connective tissue

1. Information about carbohydrates: biological significance, classification, types.

2. Monosaccharides, widely distributed in the body, structural and biochemical features.
3. Derivatives of monosaccharides: products of reduction and oxidation, value. Reactions on monosaccharides (lab. work.).
4. Representatives of oligosaccharides, value, reducing properties. Reactions on disaccharides (lab. work).
5. Representatives of polysaccharides, chemical nature, meaning. Hydrolysis of starch (lab. work).
6. Presentation of a free topic: "Starch, glycogen, structural features, similarities and differences, their metabolic properties in the body."
7. Representatives of heteropolysaccharides, their significance in the connective tissue.
8. Information about lipids, biological significance, classification according to different principles.
9. Simple lipids - properties, biochemical features of fatty acids. Vitamin F. Emulsification of fats (lab. work).
10. Complex lipids, types of classification. Structural and biochemical features of glycerophospholipids, sphingolipids.
11. Presentation of a free topic: "Nervous tissue lipids".
12. Sterols and sterides, meaning. Reactions on cholesterol (lab. work.).
13. Presentation of a free topic: "Proteolicans of the connective tissue."

PRESENTATION TOPICS FOR INDEPENDENT STUDY ON STATIC BIOCHEMISTRY

1. Biochemical characteristics of blood plasma proteins. Changes in protein fractions in the human body under normal and pathological conditions (proteinogram).
2. Structural and biochemical features of blood lipoproteins, the role of apoproteins, changes.
3. Structural and biochemical features of hemoglobin. Hemoglobinopathies.
4. Structural and biochemical features of DNA and prospects for research (CPR-diagnostics, GMOs).
5. Biochemical properties of vitamins involved in redox processes and their use in medicine. hypoenergetic states.
6. The value of antioxidants, vitamins and microelements in oxidative stress, their biochemical properties.
7. The mechanism of action of hormones: modern ideas about it.
8. Causes and biochemical mechanism of diabetes mellitus.
9. ACTH - hormones of the adrenal cortex, physiological and biochemical properties. Prostaglandins, cytokines, structural and biochemical features and their role in inflammatory reactions.
10. Starch, glycogen, structural features, similarities and differences, their metabolic properties in the body.
11. Lipids of nervous tissue.

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